Collisions of Vessels with Cetaceans: How to mitigate an issue with many unknowns

Fabian Ritter[1,2]
[1] *IWC ship strike data coordinator*
[2] *M.E.E.R. e.V., Bundesallee 123, 12161 Berlin, Germany*

_____

The worldwide number of collisions has significantly increased since the 1950. During the past years, with a steep global increase of shipping traffic and increasing average travel speeds of vessels, the situation became - at least in some areas of the world – a real conservation problem, sometimes even a matter of survival for cetaceans on a population level. Whales may be hit either by the bow or the keel of a vessel, protruding parts of vessels like skegs or stabilizers, or by its propeller, leaving such nasty wounds on a live animal. Sometimes whales will be stuck on the bow of large ships and brought into the harbour. Such cases might only be recognized upon arrival at port.

Which vessel types are involved?
As cetaceans are animals that have to come to the surface to breathe, quite naturally every type of vessel can hit a whale or dolphin. All of the following have been reported to hit cetaceans: freighters, large ferries, high speed ferries or cruise ship, small boats, hydrofoils, navy vessels, whale watching boats and even sailors, especially those ones traveling at considerable speeds, for example during regattas & ocean races.

Which species are affected?
In principle every cetacean, be it a dolphin or a whale, can be hit. However, we know that certain species are especially vulnerable: namely those ones that are slow swimmers and/or stay for longer periods on the surface: such as right whales. As an example, 35% of North Atlantic right whales fatalities on the East coast US have been attributed to collisions and 20% of Sothern right whales in South Africa die due to ship strikes. In the Mediterranean Sea, collisions predominantly occur with fin and sperm whales, while around Hawaii, numbers of collisions with humpbacks are rising - apparently as a result of their increasing abundance in that area. In the Canary Islands sperm whales - another species spending prolonged periods of time on the surface - are threatened, with animals sometimes cut into halves by large high speed ferries.
And there is another species affected, that is us humans – as we know of several incidents where humans got injured, including some cases of fatality. A number of sailors have lost their boat as a consequence of running into a whale, and ferry passenger were injured, so we are talking about a safety issue here, too.

Why do collisions occur?
Cetaceans may be in a state of decreased alertness when resting. They might be distracted by hunting or feeding behaviours. Also, there will be interspecies differences or differences between age or sex classes, and even between individuals within a species. This in turn is related to experience & learning by individual animals.
Additionally, high levels of background noise or the fact that animals suffer from hearing damage will make them less likely to detect approaching ships. Phenomena like refraction,

bending and absorption of sound, as well as bubbles, sound shadows created in front of a vessel, Lloyd mirror effect or near field effects may all play a role. This will lead to difficulties or even confusion about how to interpret vessel noise, i.e. knowing how far away and how fast a vessel is, which direction it comes from, etc. And of course we thereby already imply that whales know to interpret certain types of noise as a danger, which simply might not be case either.
So there are still many unknowns. We *do* know, however, that fatality and severity of injuries (on the side of the whales) are related to size and speed of vessels. The great majority of accounts when whales were severely hurt or killed occurred at speeds of 14 knots or more. This graph shows that from around 10 knots the probability of a lethal outcome for a whale increases sharply. Moreover, large ships cause most lethal and serious injuries.
As an admittedly extreme example think of a fast ferry travelling at 35-40 knots where the crew detects a whale 600 m in front of the bow: The remaining reaction time will be just about 30 seconds before the ship is where that whale was seen. So what do you do? This will be referred to again in a minute… (*Slide 11*)
And we have to keep in mind that larger vessel might not be able to freely navigate due to their size, the presence of other vessels or the fact that they are navigating in shallow or otherwise restricted waters.

How many ship strikes are there?
The honest answer is: We don‘t know! Our knowledge gaps are a result of the fact that collisions may not be recognised at all (as whales hit mostly will not stay on the bow), injured animals may not be identified as such, dead animals often will drift way and sink to the bottom, and in stranded animals the cause of death not always is unambiguously identifiable as you need decent knowledge to tell pre-mortem from post-morten strikes, etc. Hence we can be quite sure that there is a probably quite large *dark number*.

There are three categories of mitigation measures: TECHNOLOGICAL, OPERATIONAL and EDUCATIONAL. Here is an overview.
TECHNOLOGICAL: *Sonar* will only be applicable within a very short range, and of course it introduces an additional source of noise into the marine environment. Actually, historically whalers used to use Sonar (Asdic) to bring whales to the surface so such a measure could also cause more hits. The same applies to *Acoustic warning devices* (AWDs), where again nobody knows what type of warning sound would be an alerting signal for cetaceans, and even if that was the case there easily might be effects like habituation. Other systems have been developed include *night vision, infrared or thermal imaging* technologies but again efficacy will largely depend on the general conditions.
As for measures that can be summarized as *alerting tools*, a famous example is the passive acoustic monitoring system off Boston (USA), involving a number of hydrophones where acoustical whale detections are broadcasted in real time to mariners in the area. No need toll tell that this system involves large amounts of money which not always will be available elsewhere, e.g. in developing countries. Another system is REPCET developed in the Mediterranean Sea where ship crews can inform each other about whale sightings via an online interface. Recently the first mobile APP was developed which has a similar mode of operation. Placing on-board observers is another option, especially as studies have revealed that observers are an effective means to detect whales in the path of a ship.
It has to be noted that the value of alerting tools may be limited given the unpredictable nature of whale movements, their dependence on favourable (light, weather and sea state)

conditions and the fact that they will strongly rely on crews and captains reacting in the right way. Hence, all these systems need proper testing before being considered as „true“ and effective mitigation tools. As a conclusion: there is currently no technology known to effectively avoid collisions.

Possible OPERATIONAL mitigation measures include the relocation of shipping lanes, such as the realignment of the Traffic Separation Schemes (TSS) servicing Boston, and the ones implemented off San Francisco and in Southern Spain off Almeria, where the TSS was moved offshore away from an existing marine mammal protected area. These re-routing measures were implemented through the International Maritime Organisation (IMO). Here we need to consider a multi-species approach, as moving shipping routes offshore may lift the pressure from the more coastal species, but at the same time create problems for others with a more pelagic distribution. So there is always a necessity that such measures are based on sufficient scientific data. And the process to implement such measures through the IMO can sometimes be quite lengthy. Other operational measures include Areas To Be Avoided (ATBAs) off Nova Scotia in Canada, as well as voluntary & mandatory speed reductions introduced in the Strait of Gibraltar or in the Glacier National Park in Alaska. Off the east coast of the US, there are seasonal speed restrictions in place for North Atlantic right whales in accordance to their occurrence when migrating north or south. Here, all ships 65 feet or longer have to slow down to 10 knots in certain areas and during certain seasons.
Generally, mandatory reporting should be implemented wherever possible, ideally through strong legislation. Common sense tells us that there should always to be the possibility to initiate avoidance manoeuvres, but one may become a sceptic as we know of countless cases of near misses even under good conditions, where the whale was seen well in advance and still there was no obvious option to avoid it.
As a skipper or captain, when you detect or are alerted to a whale, you will have to decide

a) where to go so as to steer away from the animal
b) about reducing speed which has consequences for manoeuvrability, or
c) opt for doing nothing relying on the whale to avoid the vessel.

These are no trivial questions and decisions, especially when you only have seconds to react.

The third level of mitigation is EDUCATION. Training vessel personnel & crew is paramount, but knowledge about the issue must also be increased in managers and policy makers. Introduction of the issue into the curricula at navigational schools is equally important, and speed reductions can be noted on nautical maps.
Other tools to make people including the general public aware are given here, they include websites, brochures and a leaflet produced by Belgium as a member state of the IWC in collaboration with IFAW.

The role of the International Whaling Commission
IWC has been central in placing the issue high on the international agenda. Already in the 1990s, a dedicated Ship Strike Working Group has been set up and recently two SSDCs have been appointed. Under the leadership of Belgium the IWC has set up regular documentations of the global situation, as well as international expert workshops. The according reports all can be found on the organisation‘s website.
At the moment, IWC is reaching out to the shipping industry to develop guidance documents, and only recently IWC had a very fruitful collaboration with WWF and the Volvo Ocean Race (VOR), a global regatta that took place 2014/15.

One of the take-home-messages is: *Reporting is essential.* That is why the IWC has developed its global database on ship strikes, which went online in 2009, and which was modernized and re-launched in 2015. The database currently holds a total of about 1,200 incidents, both historical and recent, with numbers of reports increasing steadily. Please visit the IWC Website if you are searching for more information: www.iwc.int/ship-strikes . The database guides you through questions in an interview style with an intuitive and interactive interface. Most importantly: If you have witnessed a strike, if you found a dead animal with suspicious lesions, or if you were unlucky enough to have had a collision, go there and enter all the information you have.

IWC recommendations:

- Wherever possible, separate vessels from whales: A precondition will be the availability of sufficient data about abundance of cetaceans
- The *only* mitigation measure known to date to be effective in reducing numbers of ship strikes is SPEED REDUCTION
- On-board observers: but note the limitations that have been mentioned
- Report collisions to the IWC data base

_____