

58th Annual Meeting of the International Whaling Commission

SHIP STRIKES WORKING GROUP

FIRST PROGRESS REPORT TO THE CONSERVATION COMMITTEE



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Acknowledgements

This progress report on ship strikes has been drafted with the input from various members of the International Whaling Commission, from its Secretariat, as well as from a number of International Governmental and Non-Governmental Organisations and maritime sector stakeholders. We extend our sincere appreciation for their valuable collaboration¹.

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INTRODUCTION

During the 57th annual meeting of the Commission in Ulsan, Korea (June 2005), a working group on ship strikes was set up and chaired by Belgium. Ship strikes had been identified as a priority item within the Conservation agenda² proposed by Belgium and adopted by the Conservation Committee and the Commission.

The work should be conducted over a few years in order to get a comprehensive picture of the issue and propose viable solutions. The larger the number of members attending the Conservation Committee, the better the issue will be covered. Further parallel work by the IWC Scientific Committee is of paramount importance.

This report constitutes therefore a first contribution towards assessing the level of threats to cetaceans caused by maritime traffic worldwide and identifying measures to reduce these threats. Vessel strikes are known to be a significant source of anthropogenic mortality for some large whale populations. However, for most species the population level impacts are unknown. Collisions between whales and vessels may result in a range of outcomes from instant fatality to minor injury. Many types of vessel may also suffer damage due to collisions with whales including the risk of injury and death to passengers and crew.

While this report intends to concentrate on policies that could be conducted to mitigate the impact of ship strikes, the issue of assessing the population level impacts of ship strikes is under consideration by the Scientific Committee.

1. SCOPE AND ISSUE DRIVERS

1.1 Scope

The concept of ship strike can be defined as a collision between a vessel and a cetacean causing either injuries to or the death of the marine mammal or damage to the vessel and sometimes to its passengers.

In this report, the emphasis will be put on large whales although ship strikes are considered to affect some small cetaceans as well. This aspect will be reviewed comprehensively by Van Waerebeek *et al.* (2006, in preparation).

According to Jensen and Silber (2003) and Laist *et al.* (2001), no less than 21 species of cetacean have been affected. The highest number of collision incidents with large whales has been reported for fin whales, southern and northern right whales, sperm and humpback whales. The extent of the problem is currently unknown but there are indications that the number of deaths following a collision is greater than estimated. If whale strandings constitute a strong indicator of collisions, the full picture is presently difficult to assess given the number of unnoticed, under-reported cases and, in many instances, the absence of a full necropsy.

Ship strikes may occur anywhere where vessel and whale distribution overlap. Although the majority of reports are for coastal areas, collisions also occur offshore on the high seas (Pers. Com. with Pierre Gallego).

Ship strikes injuries to whales tend to fall into two categories: lacerations from sharp objects, particularly propellers and blunt trauma injuries from impact with the hull resulting in fractured skulls, jaws or vertebrae in conjunction with large haematomas (Laist *et al.*, 2001). Blunt trauma injuries in particular may not be apparent without a full necropsy.

As mentioned in the chair's report (§ 6.1.1.3) of the 57th IWC annual meeting, "the Revised Management Procedure (RMP) estimates a catch limit for the number of non-natural removals". As a consequence, estimates of the mortality due to vessel strikes are needed for any stock for which a catch limit may be set under the RMP.

1.2 Issue drivers

We distinguish four main drivers influencing the number and gravity of ship strikes: vessel type, underwater noise, weather conditions and time of navigation, whale behaviour.

² See excerpts of doc IWC/57/CC7 in appendix. It is worth noting that the subcommittee on Bycatch and other human-induced mortalities deals with some aspects of ship strikes. See in the reference list at the end of the report.

Vessel type

The threat and impact differ depending on vessel type (ferry, tanker, fast ferry, yacht, sailing boat, fishing vessel, military vessel, e.g.) and their navigation speed. Over 2000 fast ferries, capable of navigating at speeds higher than 30 knots, are in operation worldwide (Fast Ferry International magazine³) and their number is increasing. Ultra high-speed boats can go up to 50 knots. Whale-watching activities can also have an impact, as asserted by K. Amaral *et al.* (IWC, 2005): “Whale-watching is recognized as having social, economic and educational benefits and is growing worldwide. However, impacts on whales may result from acoustic disturbance, increased energy budgets, habitat exclusion and vessel strikes, and overall life history processes of cetaceans”.

Underwater noise

The level of underwater noise is a potential factor influencing the collision rate. High levels of ambient noise may make it difficult for cetaceans to detect approaching vessels and to judge their relative location and movement. Cetacean responses to approaching vessels may also be affected by habituation to vessel noise. In addition, exposure to very loud sounds may cause damage to the auditory system and reduce the ability to detect oncoming vessels.

Sources of anthropogenic underwater noise include the noise generated by ships, seismic surveys and sonar systems. Shipping noise has contributed to an overall increase in low frequency ambient noise levels throughout the oceans in recent decades. Seismic surveys and sonar (especially high-intensity military sonar) have the ability to cause auditory damage to cetaceans at close ranges⁴.

In this context, Evans (2003) divided cetaceans in three groups on basis of their sensitivity to frequencies:

- all baleen whales, with likely low frequency hearing, therefore most vulnerable to noise disturbance and physical damage from large ships;
- all large odontocetes (sperm whale, beaked whales, pilot whales and killer whale) with mid-frequency hearing, equally vulnerable;
- all small odontocetes with high-frequency hearing vulnerable to physical damage from smaller ships.

Weather conditions and time of navigation

Weather conditions, sea state and night navigation also influence the risk of ship strikes. These conditions will affect the ability of the crew of vessels to detect whales visually. In addition, weather and oceanographic conditions may affect acoustic propagation conditions and thus the ability of cetaceans to detect oncoming vessels acoustically.

Whale behaviour

In addition to the role of anthropogenic noise, several studies conclude that the behaviour of whales towards maritime traffic is species specific. That is, sensory capabilities, manoeuvrability, swim speed, behaviour, and other species-specific factors may influence the likelihood of becoming victim to a strike. Also, juvenile or sick individuals will be more vulnerable than healthy adults.

Apart from whale behaviour, impaired hearing and tolerance to traffic noise, Koschinski (2003) suggests three other possible reasons why cetaceans may be struck by ships: reduced perception, distraction by other activities, lack of recognition of the threat.

2. GLOBAL OVERVIEW OF EXISTING SHIP STRIKE MITIGATION LEGISLATION, PROGRAMMES, MEASURES, RESOLUTIONS AND RECOMMENDATIONS⁵

2.1 Nations with binding legislation in territorial or EEZ waters

Below, an account is provided on legislation directly related to ship strikes mitigation. In addition, should be noted that the Scientific Committee has developed guidelines for good whale-watching practice and as part of an on-going process, its Whale-watching Working Group reviews whale-watching guidelines and assesses the impacts of whale-watching on cetaceans, including the risk to cetaceans from whale-watching vessel collisions⁶.

³ Website: <http://www.fastferryinfo.com>

⁴ See section 4.2 iii below.

⁵ Countries and organisations are ranked in alphabetical order. Non-IWC member countries are covered when information is available.

⁶ The IWC guidelines and a review of worldwide whale-watching guidelines and regulations (2004) is available on IWC's website (<http://www.iwcoffice.org/conservation/whalewatching.htm>).

Australia

Australia's *Environment Protection and Biodiversity Conservation Act 1999* imposes obligations relating to ship strikes in waters declared as the Australian Whale Sanctuary. The Sanctuary encompasses Australia's Exclusive Economic Zone (EEZ), and includes the waters around Australia's external territories. Within the Sanctuary, the Act makes it an offence to recklessly kill, injure, take, trade, keep, move or interfere with a cetacean. The Act also applies to Australians and Australian corporations, vessels and aircraft outside the Sanctuary. In the areas of application, if a cetacean is killed or injured a report must be made to the Secretary of the Department of the Environment and Heritage about the incident within seven days. The Australian Government Department of the Environment and Heritage also has a protected species reporting telephone hotline.

Part 8 of Australia's *Environment Protection and Biodiversity Conservation Regulations 2000* sets out how people must interact with cetaceans in and beyond the Sanctuary. The Regulations impose restrictions on vessels while around cetaceans, including minimum approach distances, operation of vessels, and vessels prohibited to approach cetaceans.

Australian States and Territories have in place legislation protecting cetaceans in waters under their jurisdiction. Some individual states and territories also have telephone reporting hotlines for information about cetaceans.

Belgium

The Royal Decree of 21 December 2001 on the protection of species in marine areas under Belgian jurisdiction foresees in its article 3 §2 that ships encountering cetaceans should avoid the collision and in general not change direction suddenly⁷ so as to reduce any perturbation. The Royal Decree is applicable not only in waters under Belgian jurisdiction but also (article 2) wherever the ships under Belgian flag navigate, which therefore also covers their activities outside Belgian waters.

Canada

In December 2002 the International Maritime Organisation approved the Government of Canada's proposed changes to the shipping lanes in the Bay of Fundy to protect the endangered North Atlantic right whale. This action was part of Canada's Right Whale Recovery Plan. Amendments have been made to navigational charts and vessel traffic control procedures. Notification procedures have been set up. The new shipping lanes are based on considerable scientific whale research and were reviewed by several marine industry stakeholders and experts to ensure safety would be maintained.

A new Right Whale Recovery Plan is in the final stages of development and will be available by the end of 2006 with implementation in 2007. The new plan reflects the 2002 Species At Risk Area legislation.

USA

As the USA is the only other nation having implemented legislation directly related to ship strikes, more detailed information is provided below. As is the case with Canada, the focus is on one particular species: the North Atlantic right whale, whose mortality due to collisions was estimated to 40 % in 2002 (Laist).

Proposed U.S. Regulations

The National Oceanic and Atmospheric Administration (NOAA) has prepared proposed regulations, currently in clearance, to regulate ships along the U.S. east coast. The proposed regulations focus primarily on limiting ship speed where relatively high right whale and ship densities overlap near a number of U.S. east coast ports, at calving/nursery areas in waters off Georgia and Florida, and in New England waters. The proposed regulations are expected to be published for public comment by summer 2006, with final regulations expected by mid 2007.

Mandatory Ship Reporting systems (MSR)⁸

The United States sought and received endorsement from the International Maritime Organization (IMO) to establish two Mandatory Ship Reporting systems – one in waters off New England and another in calving/nursery areas in waters off Georgia and Florida. The systems, operational since July 1999, require that all ships of 300 gross tons and greater report to a shore-based station via satellite communication systems. Upon receipt of the report, an automated message is sent to the reporting ship providing (a) information about the vulnerability of right whales to ship strikes, (b) information about where the mariner can obtain guidance on reducing ship strikes, and (c) recent right whale sighting locations. The incoming reports are gathered and used to quantify ship traffic patterns.

⁷ Except to avoid collision.

⁸ See Appendix 2: landmark resolutions.

Realigning the Traffic Separation Scheme (TSS) servicing Boston

On 28 March 2006 the United States have submitted to the IMO a proposal to reconfigure the Boston Traffic Separation Scheme (TSS). The proposed realignment involves only a 12 degree shift in the northern leg of the TSS and is expected to provide a significant reduction in ship strike risk to right whales and all baleen whales occurring in the area, with minimal concurrent impact to mariners using the TSS. If adopted by the IMO, the TSS shift accomplished through domestic regulations issued by the U.S. Coast Guard is expected to occur some time in 2007.

Recommended Routes

The United States is considering establishing recommended shipping routes in key right whale aggregation areas: within Cape Cod Bay and the calving/nursery areas in waters off Georgia and Florida. If approved, these routes will likely be introduced by late 2007 or early 2008.

Endangered Species Act and the Marine Mammal Protection Act.

NOAA's National Marine Fisheries Service (NMFS) has responsibility to protect endangered marine mammals, and does so under the Endangered Species Act (ESA) and the Marine Mammal Protection Act. Under the ESA, the NMFS issued regulations prohibiting vessel approach within 500 yards of a right whale, and is planning to issue regulations to reduce ship collisions with right whales.

Collision Reporting

In addition to ship strikes reduction regulations that effect maritime industries, most U.S. federal agencies (e.g., U.S. Navy, U.S. Coast Guard) require their vessel operators to report ship strikes involving their ships.

2.2 Nations with recommended mitigation measures, dedicated national programmes or conservation measures⁹

France

It should be noted that France is one of the three co-founders of the Pelagos Sanctuary for Mediterranean Marine Mammals, whose limits in the Ligurian Sea cover both national - France, Monaco, Italy - and international waters. The international marine mammal sanctuary is a Specially Protected Area of Mediterranean Importance (SPAMI) extending over 87,500 km² of sea surface in a portion of the northwestern Mediterranean Sea comprised between southeastern France, Monaco, northwestern Italy and northern Sardinia, and encompassing Corsica and the Tuscan Archipelago. It was set up, amongst others, specifically to address increasing mortality of large whales from entanglements and collisions with vessels.

Italy

No legislation is in place, but a Mediterranean Marine Mammal Tissue Bank has been put in place. Italy is a co-founder of the Pelagos Sanctuary for Mediterranean marine mammals.

Mexico

There is no Mexican legislation on ship strikes.

Monaco

Monaco is a co-founder of the Pelagos Sanctuary for Mediterranean marine mammals.

New Zealand

The country has developed a Marine Mammal Action Plan for 2005-2010, in which the threat of collisions is considered. Its focus is on effective reporting and recording of incidents and ensuring sensible navigation of recreational boats and commercial shipping operators in areas where boat strike is likely.

Spain

A programme to mitigate the impact of collisions in the Gibraltar Strait is starting in 2006. It will comprise a network to inform in real-time about the presence of fin and sperm whales and an educational programme for the crew of ferries and fast ferries (Spanish report to the IWC Ship strikes working group, November 2005).

⁹ Including marine mammal sanctuaries. For a comprehensive overview of these sanctuaries, see E. Hoyt's handbook on Marine Protected Areas for Whales, Dolphins and Porpoises. Earthscan, 2005.

USA

Together with other federal and state agencies, the National Oceanic and Atmospheric Administration (NOAA) supports or conducts extensive aircraft surveys for right whales. Right whale sighting locations are passed to mariners via e-mail, notices to mariners, posted on websites, and through other maritime broadcast media. The NOAA and the U.S. Coast Guard issue warnings and ship speed advisories to mariners regarding right whale aggregations.

2.3 Intergovernmental organisations and Programmes¹⁰

ACCOBAMS

In 2003 the Scientific Committee of the Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic “recognized the potential threat of ship collisions to the conservation of some cetacean populations in the ACCOBAMS area, especially of large whales” (*Recommendation 2:8 on ship collisions*). As a follow-up, the organization convened a large whale ship strikes workshop on 14-15 November 2005 together with a separate fin whale workshop (*Recommendation 2:5 on a fin whale workshop*). Among the recommendations of the ship strikes workshop, four types of measures can be highlighted: education and training courses for vessel crew; independent observers on ferries; education of enforcement officials; information of ship owners and shipping companies on “high-use” areas by species and season. The creation of an international database of ship strikes was also advocated.

ASCOBANS

The Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas has been addressing the issue of ship strikes on a regular basis since the year 1999. Its Advisory Committee requested Parties to report annually on the development of high-speed ferries, i.e. ferries capable of travelling at speeds in excess of 30 knots.

In 2003, during ASCOBANS’s 4th Meeting of Parties, Resolution 5 on Effects of noise and of vessels was adopted: *The Meeting of the Parties to ASCOBANS Invites* Parties and Range States to [...]: (3) conduct further research into the effects on small cetaceans of: (a) vessels, particularly high-speed ferries [...].

CMS

During its 8th Conference of Parties in 2005, the UNEP Convention on the Conservation Of Migratory Species of Wild Animals adopted Resolution 8.22 on Adverse human-induced impacts on cetaceans, which includes a request to the CMS secretariat and Scientific Council to cooperate with the IWC on ship strikes and to review the extent to which CMS and CMS-related agreements are addressing them.

EUROPEAN UNION

The EU 1992 Habitats Directive constitutes a general framework for nature monitoring and conservation. Its Annex IV strictly protects all cetacean species. Article 12 § 4 of the directive stipulates: “Member States shall establish a system to monitor the incidental capture and killing of the animal species listed in Annex IV(a). In the light of the information gathered, Member States shall take further research or conservation measures as required to ensure that incidental capture and killing does not have a significant negative impact on the species concerned”.

IAATO

The International Association of Antarctica Tour Operators has issued a whale collision reporting form to be used in Antarctica waters by expedition leaders.

IMO

The International Maritime Organisation via its Maritime Safety Committee holds a precursor role on the matter. In 1998 it adopted Resolution MSC.85 on mandatory ship reporting systems, which aimed at diminishing the impact of maritime traffic on (North Atlantic right) whales off the northeastern and southeastern coasts of the United States. The resolution is appended to this report.

¹⁰ See the list of acronyms in Appendix 3.

IWC

Resolution 2000:8 of the International Whaling Commission on the western North Atlantic right whales noted that this highly endangered population numbers less than 300 and is declining, and identifies entanglement in fishing gear and collisions with shipping as the two main causes of deaths of these right whales. It called for continued work to help ships avoid right whales and for co-operation with the International Maritime Organisation (IMO).

Resolution 1999:7 on small populations of highly endangered whales identified ship strikes as a threat for some populations.

Resolution 1998:2 on total catches over time specified, for the first time, that incidental catches, along with collisions with ships and other sources of human-induced mortality, should be considered on a par with deliberate catches, and should be counted towards total allowable removals.

SPREP

The Secretariat of the Pacific Regional Environmental Programme will be the administrative agency for a Memorandum of Understanding (MOU) for the Conservation of Cetaceans and their habitats in the Pacific Islands region, which will open for signature in 2006. The MOU will contain an Action Plan that will address threat reduction and habitat protection, including migratory corridors. This will include maintaining a database on vessel strikes and investigation of potential approaches to mitigation.

UNEP

The United Nations Environment Programme (UNEP) in 1984 adopted a Global Plan of Action for the Conservation, Management and Utilization of Marine Mammals. This programme is currently being revised and reevaluated. Its regional action plans were conducted under the umbrella of UNEP's Regional Seas Programme. The most relevant action plans cover the Mediterranean, the Southeast Pacific and the Wider Caribbean. In the Mediterranean, an Action Plan for the Conservation of Cetaceans in the Mediterranean Sea was adopted in 1991. The Southeast Pacific marine mammals action plan in its last version adopted in 1991 by the 5th Intergovernmental meeting in Santiago de Chile does not address ship strikes. A new action plan for the Conservation of marine mammals in the Wider Caribbean is currently being drafted and should be considered at an intergovernmental meeting in September 2006 in Martinique. Its draft version includes various measures regarding ship strikes (research, high-risk area identification, monitoring of strikes, impact minimization, education, area-based management and technical improvements to vessels and propeller design).

2.4 Other organisations

IUCN

The Conservation Action Plan for the World's Cetaceans 2002-2010 (Reeves *et al.*, 2003) adopted by the World Conservation Union notes that the significance of ship strikes as a risk factor for cetaceans has been increasing, with the increase in the volume and speed of shipping. Ship strikes have been definitively identified as a factor endangering the small remaining population of North Atlantic right whales. Substantial numbers of fin and sperm whales have been observed killed by ship strikes in the Mediterranean and around the Canary Islands. Vessel collisions also cause deaths of the endangered Hector's dolphin in New Zealand waters. IUCN states that no global assessment of the problem has yet been conducted.

3. IDENTIFICATION OF KNOWN OR POTENTIAL HIGH-RISK AREAS DUE TO INTENSE SHIPPING

3.1 Criteria

For the present preliminary listing of high-risk areas, no quantitative criteria were used, but rather common knowledge of some areas with dense shipping traffic. The number of vessels transiting per day would be a logical parameter, but the question remains what dataset to choose and under what authority would the data be used.

3.2 Information sources

Various commercial, international, and national data sources are available on shipping traffic volumes and vessel characteristics. The main categories of vessel traffic are:

- Merchant (port-to-port)
- Ferries
- Fishing
- Naval, surveillance, rescue
- Recreational
- Research and cruise ships
- Supply vessels to offshore installations.

Information on merchant shipping movements and vessel characteristics are available in collated form from commercial databases such as Lloyds Marine Intelligence Unit (www.lloydsniu.com). The LMIU data cover ships greater than 99 gross tonnage and enable most cargo (port-to-port) shipping traffic to be determined from arrival/departure times and origin/destination information, in conjunction with information on shipping routes. The database contains data going back around 30 years and so can also be used for retrospective analysis.

A recent development is the real-time collection of data on ship locations collected from the AIS (Automatic Identification System) radio signals that certain classes of ships are required to emit (e.g. all passenger vessels, and cargo vessels above 500 gross tonnage (domestic voyages) or 300 gross tonnage (international voyages)). The signals are received at over 500 coastal stations, mainly in Europe and North America, and made commercially available in collated form (e.g. www.seasearcher.com, www.aislive.com). Because of the limited range of the signals, geographical coverage is not high worldwide, but may be adequate in some busy coastal areas. Because the AIS signals are emitted primarily to enhance navigational safety and traffic management, their use for other purposes has not been entirely uncontroversial.

Data on ferry movements may need to be compiled from ferry operators and published timetables for individual routes: no comprehensive worldwide database seems to exist at the current time. Data on supply vessel traffic will rely on operators and port authority data. Ships contributing data to the World Meteorological Organisation (WMO, www.wmo.ch) can be tracked via their submitted weather records. This scheme currently includes about 4000 vessels worldwide.

Fishing vessel movements are probably best estimated from fishery statistics. One should distinguish between actual fishing activity on the one hand and transit to/from fishing grounds on the other, because in general different speeds will pertain. Sources of data include the Inventory of Fisheries currently being compiled by FAO.

Rough data on recreational traffic may need to be obtained from boating and yachting associations, marinas and harbors.

In certain areas such as parts of the Southern Ocean, vessel traffic is dominated by research and cruise vessels. Information on the movements of these vessels would need to be obtained from the vessel operators.

Some countries or provinces have national public databases¹¹ on shipping movements in their coastal waters with varying level of detail, such as the COAST database on the UK.

3.3 Potential high-risk areas due to intense shipping

In this section, we propose two presentation approaches. One approach would be to list areas in function of pure geographical criteria. The other approach would be to use a classification like, for instance, the IUCN framework of 18 marine regions of the world ocean. However, it appears premature to list all areas where shipping is affecting cetaceans. There are indeed potentially hundreds of high-risk areas.

Further research could provide a more quantified assessment of risk through analyses that overlay data on whale distribution with shipping density.

¹¹ Ward-Geiger *et al.* (2005) have made a detailed analysis of ship traffic off the east coast of the United States and provide estimates of the distribution of vessel speeds which may also be relevant to other areas.

A few areas are listed below according to the geographical approach evoked above.

HIGH-RISK AREAS (INDICATIVE)	COASTAL STATES
Europe	
English Channel	UK/Ireland/France
Baltic Sea	Sweden/Denmark/Latvia/Estonia/Finland
Kattegat and Belt Sea	Denmark/Sweden
Skagerrak	Sweden/Denmark/Norway
Strait of Dover/Pas-de-Calais	UK/Belgium/France
Strait of Gibraltar	Spain/UK/Morocco
Americas	
Strait of Florida	USA/Cuba
Gulf of St. Lawrence	Canada
Bay of Panama and approach to Colón (SW Caribbean Sea)	Panama
Gulf of Guayaquil	Ecuador
Middle East/Africa	
Gulf of Biafra, Bight of Benin	Cameroon, Nigeria, Benin, Togo, Ghana
Strait of Hormuz	Iran/UAE
Gulf of Aden	Yemen/Djibouti
Asia	
Strait of Malacca and Singapore	Singapore/Indonesia
Sea of Japan/East Sea	Japan
Korea Strait	Korea/Japan
Southern Ocean	
Cook Strait	New Zealand
Gulf of Hauraki	New Zealand

4. RESPONSES TO THE PROBLEM

4.1 Technical mitigation measures

i- Detection and avoidance manoeuvres

Detection systems are varied: sonars, whale anti-collision systems (see below, section 4.2), night vision systems, aerial surveillance, listening devices, tagging. Their effectiveness varies strongly and is also subject to weather and day/night conditions. According to Cdt Frédéric Capoulade (Pers. Com.) who was with the SNCM, a company operating ferries in the Mediterranean Sea, night vision systems are not effective. The volume of night traffic could therefore constitute a determinant factor of whale mortality and this traffic should be estimated.

With respect to sonars, these can play an important role in spotting whales when they are fitted to look forward of the vessel. However, it should be noted that commercial lines vessels are usually not equipped with them. It is mainly fishing vessels and military ships that are equipped with sonars and not all of them are in the category 'forward-looking', although some oceanographic research vessels also use sonars. Further consideration of sonars is made under section 4.2 ii and iii.

The U.S. National Oceanic and Atmospheric Administration, in collaboration with academic scientists, has initiated several studies involving passive listening devices to assess right whale distribution with the goals of (a) better characterizing right whale distribution and occurrence, and (b) providing whale sighting locations to mariners. Temporary acoustic detection devices have been deployed at a number of locations along the U.S. eastern seaboard. For example, collaborative efforts are underway to provide acoustic coverage of nearly all of the Stellwagen Bank National Marine Sanctuary off the coast of Massachusetts. Whale distribution data from these sources, when coupled with vessel traffic patterns from the Mandatory Ship Reporting systems (see page 6 above), will aid in the design of management measures. Not all of the listening devices have "real-time"

capabilities. They have provided a retrospective look at distribution as whale vocalization data has been stored and retrieved from the devices. However, in recent months, real-time capabilities have been achieved providing immediate – and posted – whale occurrence information.

ii- Repulsion

Repulsion systems range from sound emissions to acoustic alarms. These may potentially either alert a whale to the presence of an incoming ship or cause whales to move out of the area. However, these systems are adding to the existing underwater noise level.

During the test of alerting signals with North Atlantic right whales, some sounds caused whales to come to the surface, which would actually put them at greater risk of collision (Nowacek *et al.*, 2003).

iii- Protection

Protection measures include protected or closed areas, dynamic or seasonal management areas, or speed restrictions. The basic objective is to either route shipping away from areas of high whale density or to reduce the risk of death or serious injury by reducing vessel speed. Re-routing may occur over a range of temporal and spatial scales depending on the surveillance data on which measures are based. For example, routes may be permanent to avoid areas of high whale density identified from long-term studies or vessels may be routed on the basis of near real-time surveillance data. However, navigational safety concerns may in some cases prevent re-routing (Pers. Com. with G. Silber).

As it is the case for IMO shipping lanes, navigational charts should include the location of protected areas in areas beyond national jurisdiction. US NOAA is issuing ship speed advisories (i.e., speed guidance of 12 knots or less) in areas where right whales are known to occur, particularly when they are known to be present. Speed advisories are provided to mariners through a number of media, including NOAA Weather Radio, the Mandatory Ship Reporting outgoing message, National Weather Buoy websites, and are being published in U.S. Coast Pilots, international Notice to Mariners/Sailing Directions, and Admiralty Publications.

iv- Training

Training of crew in avoidance procedures is critical in order to reduce the number of collisions. However, regarding large vessels, Clyne and Leaper (2004) assess that “there is limited ability for them to take effective avoidance action”. In the cruise sector, the cruise company Holland America Line/Windstar Cruises, in collaboration with the US National Oceanic & Atmospheric Administration and the National Park Service, have designed an interactive CD to be used for training purposes (“Avoiding Whale Strikes”, Holland America Line, 2005) that is now required for certification for all its captains and crew. Efforts are underway to distribute the CD to the entire cruise industry.

From what is described above, it is obvious that a combination of the four categories of technical mitigation measures is needed in order to get results. However, depending on the cetacean species involved as well as on the specific cases, one category might prove to be more effective.

4.2 Research

Research into ship-related whale behaviour and underwater acoustics has started but should be further developed. Underwater acoustics considerations are developed below¹².

i- In October 2005, along the coasts of the Mediterranean Sea (Barcelona), the LAB¹³ scientific staff tested a prototype of the Whale Anti-Collision System (Dr. M. André, Pers. Com.) designed to prevent collisions with sperm whales. The system integrates two inter-related techniques: a 3D passive system that allows the 3D detection of submerged acoustic sources (distance, azimuth and elevation); and an azimuthal location of silent objects or animals by the spatio-temporal contrast produced by the ambient noise in the area. The system is adaptable for other large whale species.

ii- In May 2001, during the 15th annual conference of the European Cetacean Society (ECS), the Tethys Research Institute organized a workshop on collisions. It reviewed the situation both in the Mediterranean Sea and the North Atlantic Ocean. Interestingly, it also presented the benefits and limitations of active and passive sonar technologies to prevent collisions. As asserted in the workshop proceedings, the main benefit of the active sonar would be its ability to give exact position information about animals in the water column whether or not they are

¹² See also US NOAA’s white paper on Technological alternatives to the problem of North Atlantic right whale ship strikes.

¹³ Laboratory of Applied Bioacoustics, Technical University of Catalonia: <http://www.lab.upc.es>.

visible or vocalizing. The coverage of the system could be 360 degrees or restricted to forward looking. Multiple returns over time could be used to track animals and provide their course information to allow manoeuvre planning. This information is not subject to light or weather conditions so the system can run continuously. It could be fully automated and provide an alert to the ship's crew on detection of significant sonar returns. The system should work for all marine mammal species and be able to give size information, e.g. large, medium, small animal, based on the strength of the return.

However, several issues need to be taken into consideration when dealing with a system like this:

- the target strength (TS) of marine mammals is fairly low, due to the fact that, to an impinging sound wave, the density and elasticity of their bodies are not much different than that of the water that they inhabit. This low level translates directly into more sound level needed to "capture" poor targets. Another problem is the aspect dependence of marine mammal TS, which can vary substantially between the head and tail aspect or the beam aspect. It may be therefore possible only to detect "crossing" targets, those presenting broadside aspect to the forward-looking sonar;
- the transmission loss due to oceanographic conditions should be carefully considered, since in the open ocean sound velocity is a function of water pressure, temperature and salinity, and may vary considerably with depth;
- non-ambient sources of noise may also be present in the environment, and should be considered in the active sonar equation. There are several other sources of noise which fall into two categories: active reverberation and nearby acoustic sources;
- source level and animal safety is another aspect that needs further investigation and careful planning.

iii- The question whether whales are becoming deaf due to some types of underwater noise like active sonars or seismic surveys is posed. According to Michel André's experiments with sperm whales (Pers. Com.), it could be concluded that acoustically-induced lesions in their inner ear is preventing them from reacting to approaching ships. This would then be a major factor to take into account in any mitigation strategy. There may also be questions of habituation or de-sensitization to ships and ship noise. Research on marine acoustics is therefore of utmost importance to help advance understanding of the impact of underwater ambient noise¹⁴. Near-collisions, when reported, could help understand the behaviour of the whales confronted with ship noise of different amplitude.

4.3 Outreach

The "public" which should be made aware of the issue and the potential outreach targets are broad: e.g. ship owners, crew, port authorities, coast guards, yachting associations, whale watching companies, marine insurance companies, pilots and other components of the maritime community. For example, in 1996, the International Fund for Animal Welfare (IFAW), in partnership with the shipping industry, the U.S. Coast Guard and Port Authorities, hosted a series of workshops to discuss the problem of ship strikes.

4.4 Economic feasibility of mitigation measures

Within the range of possible measures, a cost-benefit analysis of mitigation measures has to be made. It is not clear at this stage who would bear the costs of such measures, although the study made by Spain (de Stephanis *et al.*, 2005) gives some useful indications.

The French shipping company SNCM (Corse-Méditerranée) was involved into different research and development actions related to sonar, ladar (laser detection and ranging) and night vision systems. See above, section 4.1.

In any case, the shipping industry, boat owners and coastal municipalities should be aware of the costs involved by doing nothing to mitigate collision risks. Costs linked to the evacuation and treatment by accredited bodies of only one stranded whale carcass can reach large amounts of money, in the range of US\$ 15,000.

¹⁴ It is worth noting the Scientific Committee workshop on anthropogenic noise being held in 2006 before IWC's 58th annual meeting.

5. PRIORITY ACTIONS AFTER IWC58

5.1 Follow-up actions by the Ship strikes Working group

- i- identify large-area and small-area hot spots of dense shipping globally;
- ii- offer guidance for improved reporting and data management and processing from IWC member nations as well as others;
- iii- review geographical distribution of stranding networks to identify gaps in coverage;
- iv- initiate a cost-benefit analysis of selected mitigation measures;
- v- further work to develop mitigation measures¹⁵;
- vi- evaluate the potential for whale-related data into Automatic Identification System (AIS) data that appear on vessel radar screens.

5.2 Actions which might be considered by the Scientific Committee

- i- identify whale stocks potentially most threatened by ship strikes;
- ii- check identified high-density shipping lanes for potential overlap with high whale density or known migration routes;
- iii- analyse the links between underwater noise and collisions;
- iv- further investigate the relationship between vessel type, speed and risk of collision;
- v- continue work to develop methods for quantifying mortality due to vessel strikes, including involving stranding networks more closely¹⁶.

6. CONCLUSIONS

The quest for information revealed that much has already been written on the subject, but that geographical coverage of studies is poor and depth of information varies.

Legislation to reduce the threat of ship strikes to cetaceans has been implemented by only two countries, USA and Canada.

While it is mostly cetaceans that suffer from ship strikes, in several cases damage has also been caused to vessels and human beings. There have been cases where a whale-watching boat struck a whale and caused human death and even smaller sailing boats can sink after a collision. All types of vessels can be involved in strikes with cetaceans but with varying consequences.

A few consulted international maritime organisations are taking action or are considering doing so, such as information circulation, organisation of workshops and training.

This first progress report should be the basis for further reflection and action within all international and regional organisations concerned. A better protection for whales from ship strikes can only arise after a wide mobilisation around the issue, by all bodies concerned and in the framework of regional cooperation between various international agreements.

¹⁵ Including: a) development of surveillance systems for different whale species in high risk areas,

b) development of predictive models based on environmental conditions (depth, bathymetry, sea surface temperature).

¹⁶ Namely through the Sub-Committee on estimation of bycatch and other human-induced mortality. See the report of the Scientific Committee, Annex M: Report of the Working Group on Estimation of Bycatch and Other Human-Induced Mortality. J. Cetacean Res. Manage. 4 (Suppl.): 361-371 (2002) where the importance of systematically conducting full necropsies ('flensing to the bone') is stated.

7. RECOMMENDATIONS

Below is a first set of recommendations with their potential addressees. The recommendations will in time be updated by the Ship strikes Working Group members and other contributors.

REC 1

All national progress reports on cetacean research submitted by IWC members should include ship strikes data in a format allowing their full utilisation.

Potential addressees of the recommendation: IWC Members and Secretariat.

REC 2

Set up a centralized international database on ship strikes

- using a template with standardized parameters
- developing a data repository .

Potential addressee: to be determined.

REC 3

As appropriate, adopt national and regional legislation, rules and action plans to reduce the impact of ship strikes, with priority for high-risk areas.

Potential addressees: Members of the Commission and regional organisations.

REC 4

Identify and circulate information on training material for crew and maritime and marine officials.

Potential addressees: Members of the Commission and of the Ship strikes Working Group.

REC 5

Continue the work within the Ship strikes Working Group, widen its membership and circulate the progress report widely.

Potential addressees: Chair of the Ship strikes working group, Chair of the Conservation Committee, Members of the Commission and Secretariat.

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Appendix

Appendix 1. IWC Conservation agenda (excerpts from Conservation Committee doc IWC/57/CC7)

PROPOSED INITIAL CONSERVATION AGENDA

1. Human impacts
 - 1.1. Ship strikes
 - frequency of occurrence by area/species
 - monitoring and reporting
 - mitigation measures. [...]

BACKGROUND INFORMATION AND PROVISIONAL PROGRAMS OF WORK

In this section we provide some ideas for initial programs of work. These are not part of the proposal for the Conservation Agenda. We envisage that after a Conservation Agenda has been adopted, Programs of Work could be elaborated and these ideas could be used as input into that discussion.

1. Human impacts

1.1. **Ship strikes**

Collisions with ships can and do kill whales, especially the larger species and those inhabiting waters with high shipping volumes. For at least one species (North Atlantic right whale), ship strikes have been identified along with entanglements as the top two factors that threaten the species with extinction. Apart from certain species and areas (e.g. Right Whales off USA and Canada), the issue is mainly still at the stage where more information on the extent of the problem and the options for counter-measures needs to be gathered.

Outline Program of Work

(1) Conduct a study of shipping traffic volumes around the world in relation to cetacean occurrence to identify:

- areas of potentially high interaction;
- areas of uncertain status due to lack of information on cetacean occurrence;
- areas of uncertain status due to lack of information on shipping volumes;
- areas where interaction can be assumed to be relatively low.

(2) Promote, review and collate research into assessing and improving the efficacy of counter-measures, including:

- systems for warning vessels of whale presence in the area;
- arrangements for sighting whales and taking avoiding action;
- mechanisms for alerting whales to oncoming vessels;
- relocation of shipping lanes;
- speed limits.

(3) Develop and implement in conjunction with the appropriate maritime organisations of a global scheme for reporting observed or suspected ship strikes. This should be web-based and supervised in close to real time so that the database supervisor can solicit further information from those reporting ship strikes soon after the event.

(4) Based on the information gathered, identify areas, routes, seasons and species for which priority for preventive action is highest. Develop mitigation plans for these priority cases in collaboration with coastal states and relevant organisations.

Appendix 2. Landmark resolutions related to ship strikes

- International Maritime Organisation: Resolution MSC.85(70) on mandatory ship reporting systems (adopted on 7 December 1998)

THE MARITIME SAFETY COMMITTEE,

RECALLING Article 28(b) of the Convention on the International Maritime Organization concerning the functions of the Committee,

RECALLING ALSO regulation V/8-1 of the International Convention for the Safety of Life at Sea (SOLAS), 1974 concerning the adoption by the Organization of ship reporting systems,

RECALLING FURTHER resolution A.858(20) which authorizes the Committee to perform the function of adopting ship reporting systems on behalf of the Organization,

TAKING INTO ACCOUNT the Guidelines and criteria for ship reporting systems adopted by resolution MSC.43(64),

HAVING CONSIDERED the recommendations of the Sub-Committee on Safety of Navigation at its forty-fourth session,

1. ADOPTS, in accordance with SOLAS regulation V/8-1, the mandatory ship reporting systems:

- Off the northeastern and the southeastern coasts of the United States area described in Annex 1 to the present resolution; and
- In the Strait of Dover/Pas-de-Calais area described in Annex 2.

2. DECIDES that the aforementioned mandatory ship reporting systems will enter into force at 00.00 hours UTC on 1 July 1999.

3. REQUESTS the Secretary-General to bring this resolution and its Annexes to the attention of Member Governments and Contracting Governments to the 1974 SOLAS Convention.

ANNEX 1 to Resolution MSC.85(70)

DESCRIPTION OF THE MANDATORY SHIP REPORTING SYSTEMS FOR PROTECTION OF ENDANGERED NORTH ATLANTIC RIGHT WHALES IN SEA AREAS OFF THE NORTHEASTERN AND SOUTHEASTERN COASTS OF THE UNITED STATES

1 Categories of ships required to participate in the system

All ships of 300 gross tonnage or greater are required to participate in the reporting systems, except sovereign immune vessels which are exempt from reporting by regulation V/8-1(c).

2 Geographical coverage of the proposed systems and the number and edition of the reference chart used for the delineation of the system

2.1 Northeastern United States: Geographical boundaries of the proposed northeast area include the water of Cape Cod Bay, Massachusetts Bay, and the Great South Channel east and southeast of Massachusetts (Appendix 1). Co-ordinates of the proposed area are as follows: from a point on Cape Ann, Massachusetts at 42°39'.00 N, 70°37'.00 W; then northeast to 42°45'.00 N, 70°13'.00 W; then southeast to 42°10'.00 N, 68°31'.00 W; then south to 41°00'.00 N, 68°31'.00 W; then west to 41°00'.00 N, 69°17'.00 W; then northeast to 42°05'.00 N, 70°02'.00 W, then west to 42°04'.00 N, 70°10'.00 W; and then along the Massachusetts shoreline of Cape Cod Bay and Massachusetts Bay back to the point on Cape Anne at 42°39'.00 N, 70°37'.00 W. NOAA Chart No.13009.

2.2 Southeastern United States: Geographical boundaries of the proposed southeast area include coastal waters within about 25 nautical miles along a 90 nautical miles stretch of the Atlantic seaboard in Florida and Georgia (Appendix 2). The area extends from the shoreline east to longitude 80°51'.60 W with the southern and northern boundary at latitudes 30°00'.00 N and 31°27'.00 N, respectively. NOAA Chart No.11009.

3 Format, content of report, times and geographical positions for submitting reports, authority to whom the reports should be sent, available services

3.1 Format

The format for reporting is as set forth in paragraph 2 of the appendix to resolution A.851(20). An example of a transmission between ship and shore is at Appendix 3.

3.2 Content

Ships are required to provide the following information: the name of the ship; call sign or IMO identification number if applicable; position when entering the system; course; speed; route; and destination. Commercially sensitive information received in conjunction with the reporting system shall be kept confidential.

3.3 Geographical position for submitting reports

Participating ships are required to report to a shore-based authority only when entering the reporting area during a single voyage (that is, a voyage in which a ship is in the area to visit one or multiple ports or traverse the area before leaving for a port outside the reporting area); ships will not be required to report in again after leaving a port in the area or when exiting the system.

3.4 Authority

The authority for both areas of the system is the United States Coast Guard.

4 Information to be provided to participating ships and procedures to be followed

Ships will be provided with the following information:

4.1 Mariners shall be informed that they are entering an area of critical importance for the protection of the highly endangered right whale; that such whales are present; and that ship strikes pose a serious threat to whales and may cause damage to ships. Communication systems between ship and shore are described in paragraphs 7 and 8, below.

4.2 To obtain seasonal right whale advisories which are broadcast periodically, mariners would also be advised to monitor Coast Guard Broadcast Notice to Mariners, NAVTEX, NOAA Weather Radio, and, in the northeastern ship reporting system area only, the Cape Cod Canal Vessel Traffic Control and the Bay of Fundy Vessel Traffic Control. These advisories are based on surveys that are flown seasonally and in daylight and good weather conditions only. The sighting information may be useful only for brief periods as the whales move and surveys detect a small percentage of the whales present.

4.3 Mariners would be advised to consult with NAVTEX, Inmarsat-C SafetyNET (satellite text broadcasts), the United States Coast Pilot, Notice to Mariners, the nautical charts for information on the boundaries of the right whale critical habitat and the national marine sanctuary, applicable regulations, and precautionary measures that mariners may take to reduce the risk of hitting right whales. Mariners will further be advised that information placards, videos, and other educational materials are available from shipping agents, port authorities, pilots, relevant state agencies, the Coast Guard, and the National Marine Fisheries Service.

4.4 In the message back to the ship, mariners would also be requested to report any whale sightings and dead, injured, or entangled marine mammals to the nearest local Coast Guard station.

4.5 Where available, specific and timely information on whale locations will be provided to ships.

5 Radio-communications required for the system, frequencies on which reports should be transmitted and the information to be reported

5.1 The reporting system in the northeastern United States will operate independently of the system in the southeastern United States. The system in the northeastern United States will operate year round, and the system in the southeastern United States will operate from 15 November through 15 April.

5.2 The systems will require ships to report in standard format preferably through Inmarsat-C. For ships using Inmarsat-C, the message will be sent to the shore-based authority described in paragraph 7.1 and a message will be automatically transmitted back to the ship also via Inmarsat-C.

5.3 Ships not equipped with Inmarsat-C will be required to report in standard format to the shore-based authority described in paragraph 7.2, either through direct-printing telegraphy (Inmarsat A/B, HF, MF or VHF) or by telephony (Inmarsat A/B, MF, HF or VHF). Ships reporting through such direct-printing telegraphy systems will receive a message from the shore-based authority described in paragraph 7.2.

5.4 The language used for reports in the system will be English, using the *IMO Standard Marine Communication Phrases* where necessary. Standard phrases in a prescribed format will be used in all direct-printing telegraphy and radiotelephony communications.

5.5 Commercially sensitive information will be kept confidential.

5.6 The United States will review the ship reporting systems no later than five years after their implementation date, to examine advances made in ship communication technologies and to ensure effective operation of the systems.

6 Rules and regulations in force in the areas of the system

The United States has taken appropriate action to implement international conventions to which it is a party including, where appropriate, adopting domestic legislation and promulgating regulations through domestic law. Relevant laws in force include domestic legislation and regulations to implement the International Convention on Collision Regulations, the Safety of Life at Sea Convention, the International Convention on the Prevention of Pollution from Ships, the International Convention on Oil Pollution, Preparedness, Response and Co-operation, the Convention on the International Trade in Endangered Species of Wild Fauna and Flora, the International Convention for the Regulation of Whaling, and other treaties. Relevant domestic legislation includes the Ports and Waterways Safety Act, the Endangered Species Act, the Whaling Convention Act, the Marine Mammal Protection Act, the Marine Protection Resources and Sanctuaries Act, and a variety of other acts. In some cases, rules have been promulgated including those relating specifically to right whales or governing ship operations. For example, a regulation has been promulgated which prohibits most approaches within 500 yards (460 meters) of a northern right whale. This regulation, as well as other domestic law, is implemented and enforced consistent with international law.

7 Shore-based facilities to support operation of the system

7.1 The shore-based authority for those ships reporting via Inmarsat-C is the United States Coast Guard. The e-mail address to be used for this reporting will be provided well in advance of implementation of the systems through Notices to Mariners.

7.2 The small percentage of ships that do not have Inmarsat-C capabilities will be required to contact the nearest Coast Guard communication station through appropriate communication channels. The United States Coast Guard maintains communication stations along the United States east coast. Information about these stations can be found in the GMDSS Master Plan (GMDSS/Circ.7) or National Imagery and Mapping Agency (NIMA) Publication 117. Information received from the ships will be sent electronically to a central location for data storage, handling, and retrieval.

8 Alternative communications if the communication facilities of the shore-based authority fails

Short-term failure of the reporting systems due to communications problems will not result in a loss of life, and will have minimal impact on the safety of vessels. NAVTEX Broadcast Notice to Mariners can be used to notify mariners of the temporary failure of the system and can provide mariners with basic information necessary to avoid right whales. Downtime is likely to be minimal and is not expected to result in increased ship strikes and whale mortality. For those ships reporting through INMARSAT C or direct printing radiotelegraphy, the standard protocol now used for such systems will be used to re-route incoming and outgoing communications through an alternate address and it is expected that this will minimize the system's downtime, though some delay may occur. The Coast Guard operated MF, HF, VHF voice communications systems, by design, have built in redundancies and overlapping coverage areas and an individual equipment or site failure are unlikely to affect the ability of a mariner to contact a Coast Guard facility to make a required report.

- International Whaling Commission: Resolution 2000:8 on Western North Atlantic Right Whales

[...] THE COMMISSION CALLS UPON the United States and Canada to continue to pursue actively, practicable actions to reduce as far as possible ship strikes on right whales, in particular by using the information from the Mandatory Ship Reporting System to assess further mitigation steps, including adjustment of traffic;

URGES range states to consider appropriate fishery measures to reduce right whale mortality and injury, including fixed gear modifications and restrictions on usage;

ENCOURAGES the United States and Canada, as well as other countries whose ships transit through northern right whale habitat, to continue and expand educational programs to help mariners actively avoid collisions with right whales;

ENDORSES the research and management recommendations of the Scientific Committee at IWC 52 and the recommendations endorsed by the Scientific Committee from the Workshop on Status and Trends and from the Workshop on Causes of Reproductive Failure;

REQUESTS that the Secretariat transmit the text of this Resolution to the IMO for distribution at its Maritime Safety Committee and Marine Environment Protection Committee;

FURTHER REQUESTS range states for this species to report back to IWC 53, and annually thereafter, on progress made on the management recommendations.

Appendix 3. List of acronyms

ACCOBAMS	Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic
ASCOBANS	Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas
CMS	Convention on the Conservation Of Migratory Species of Wild Animals
EU	European Union
IAATO	International Association of Antarctic Tour Operators
IMO	International Maritime Organization
IFAW	International Fund for Animal Welfare
IUCN	World Conservation Union
IWC	International Whaling Commission
NMFS	National Marine Fisheries Service (USA)
NOAA	National Oceanic & Atmospheric Administration (USA)
SPREP	Secretariat of the Pacific Regional Environmental Programme
UNEP	United Nations Environment Programme

4. List of members of the Ship strikes working group

Argentina Miguel Iniguez	France Vincent Ridoux	New Zealand Mike Donoghue
Australia Gillian Slocum	Italy Caterina Fortuna	South Africa Herman Oosthuizen
Belgium Alexandre de Lichtervelde Koen Van Waerebeek	Korea Zang Geun Kim	UK Jenny Lonsdale
Denmark/Greenland Maj F. Munk Michael C.S. Kingsley	Luxemburg Pierre Gallego	USA Greg Silber

Appendix 5. List of national contact points

COUNTRY	CONTACT	E-MAIL
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