

Annex J

Report of the Sub-Committee on Estimation of Bycatch and Other Human-Induced Mortality

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1. CONVENOR'S OPENING REMARKS AND TERMS OF REFERENCE

Leaper welcomed the participants noting that Perrin who was the Convenor of the sub-committee had unfortunately not been able to attend this year's meeting. The terms of reference for the sub-committee relate to issues of estimating human induced mortality of great whales so that such mortality can be subtracted from any catch limits that might be calculated using the RMP.

2. ELECTION OF CHAIR AND APPOINTMENT OF RAPORTEURS

Leaper was elected Chair. Weinrich and Cipriano agreed to act as rapporteurs.

3. ADOPTION OF AGENDA

The adopted Agenda is given as Appendix 1.

4. REVIEW OF DOCUMENTS

The following documents were relevant to the sub-committee SC/60/BC1-9, SC/60/E5, SC/60/O9 and Yang *et al.* (2008).

5. ESTIMATION OF CETACEAN MORTALITY FROM SHIP STRIKES

5.1 Results from studies of collisions between whales and vessels

SC/60/BC6 presented results from a study of vessel collisions in the Canary Islands. Of 556 cetacean carcasses found ashore in the Canary Islands between 1991 and 2007, 59 strandings (11%) were classified as fatalities from vessel – whale collisions. The great majority of strandings (58%) occurred on the island of Tenerife. The four species primarily involved were sperm whales ($n=24$, 41%), pygmy sperm whales ($n=10$, 17%), Cuvier's beaked whales ($n=7$, 12%), and short-finned pilot whales ($n=6$, 10%). Twenty-six 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. Ship strikes appear to be a major threat to at least some cetacean populations in the Canary Islands, and especially to sperm whales. Measures to mitigate the risk of ship strikes could include the placement of dedicated look-outs on fast moving vessels, the shift of ferry transects where feasible, and a speed limitation for a number of high-risk areas where cetacean abundance is notably high. Dedicated look-outs and the introduction of an obligatory reporting system of vessel-whale collisions would assist in assessing collision rates.

It was questioned whether there had been necropsies and/or other tests to determine whether the animals reported in the paper had been struck before or after death. While such data have not been collected for many of the animals to date, investigations through both rigorous necropsies and forensic methods using tissue samples (especially heart and lung) have been conducted where possible. It was also suggested that knowing local population estimates and trends might help to interpret the stranding data; in Hawaii, for example, the apparently increasing number of strikes may be at least partly attributable to increasing populations. There is a need for abundance and trend data from the Canary Islands, particularly to understand the significance of ship strike mortality to sperm whales and interpret any changes in reported collision rates. In addition it might be helpful to plot strandings/carcass locations against the 'core use areas' suggested in the paper to see if these did correspond to the areas identified as having the highest collision risk.

It was also noted that there appeared to be collision incidents in this paper that were not included in the IWC database described in SC/60/BC5. Such papers are a useful source of validated data for the global IWC database.

SC/60/BC9 reported on ship collisions with Bryde's whales off of New Zealand. Several major shipping lanes run towards the northeastern coast of New Zealand, with the main port located in Auckland, in the Hauraki Gulf. Significant numbers of recreational boats, commercial vessels and ferry services are also present in this region. Vessel movements coincide with whale habitats, especially that of Bryde's whales, and collisions between vessels and animals have resulted in fatalities. A review of New Zealand's stranding data (held at the Museum of New Zealand - *Te Papa Tongarewa* and the Department of Conservation) shows that between 1989 and 2007, 38 Bryde's whale carcasses were reported in northern New Zealand. Of these, 13 whales were confirmed or suspected to have died due to vessel strike injuries. More information is needed to determine the effect of vessel collisions on large whales in this region. The Bryde's whale is of special concern, abundance in this area is estimated to be between 46 and 159 individuals, some of which are found year-round in the Hauraki Gulf area.

The sub-committee welcomed the paper and noted that there were useful data that could be incorporated into the IWC database. The paper itself also noted the need for a database of collision events.

5.2 Modelling collision risk

SC/60/BC4 presented information on the potentially increasing risk of ship collisions to right whales off the coast of Argentina. From 1974 to 2004, the Southern right whale population observed at Peninsula Valdés has grown at an annual rate of approximately 7%. Coincidentally, in the same time period, the human population of the city of Puerto Madryn and vessel activity in the bay in front of the city (Bahía Nueva) had the same average annual growth rate of 7%. Geographic Information System (GIS) data were used to integrate bathymetry, urban shoreline and coastal attributes, and vessel and whale use of the bay. Patterns of use of coastal waters were analysed through whale and vessel sightings, tracks and paths at micro and meso-scale level. A number of scenarios for the bay were generated, based on vessel activity and abundance of whales in the Bay, suggesting an increasing risk of collision events.

It was noted that this was a very well studied population where there were estimates of abundance and mortality. These parameters may provide useful baseline data for interpreting any changes in collision risk related to increasing vessel traffic.

In order to provide data on shipping density for modelling of risk, SC/60/BC3 estimated shipping density and vessel speed distributions using information received from VHF radio Automatic Identification Systems (AIS) during a combined visual and acoustic survey for cetaceans in the eastern Mediterranean. A total of 9,405 individual vessel transits were recorded in 780 hours of data collection. Analyses were complicated by the variability in reception range and fine scale concentration of shipping density along specific routes. The preferred method of analysis was to generate a relative index of density for the whole survey area using all data and to estimate a correction factor based on truncation at radial distances of 25km to allow absolute density to be estimated. Along the major route from the Sicilian Channel to Suez Canal, the estimated shipping density was 280km travelled per km² per year. Mean vessel speed along this route was 17.3 knots compared to an overall mean of 13.9 knots for all data.

It was noted in discussion that using AIS data may miss some vessels that can have fatal collisions with whales, including vessels under 300 gross tons and military vessels (especially when undertaking military exercises), neither of which are required to use the system. Data might also be analysed from archives from fixed aerials on shore but these will be limited to a certain area within range of the receiving point. However, the ease of data collection and storage (an AIS receiver and a computer) makes it easy to gather this information while at sea, and it may be of great use in establishing risk of collision. In particular, gathering such data during cetacean surveys has the advantage of using designed tracklines and allows cetacean and shipping density to be compared directly.

An index of risk may also be generated by comparing patterns of shipping and whale density and this was investigated in SC/60/BC8 using spatial model results to predict high ship strike-risk areas for humpback, fin and killer whales in British Columbia (BC), Canada. The analyses used data from a systematic line transect survey in 2004 and 2005, with the inclusion of additional data from summer 2006. Shipping information used data provided by Marine Communications and Traffic Services (MCTS) of the Canadian Coast Guard, which monitors ship traffic using radio contact, radar detection and satellite tracking. A simple 'risk map' was produced for each species to show the expected distribution of interactions between whales and ships, defined as the product of average whale density (animals per km²) and shipping intensity (total number of ships transiting the grid cell during the year). For fin whales, two regions of ship strike risk were predicted: in Dixon Entrance (near the BC-Alaska border), and along a primary shipping and ferry channel on the BC central coast. The region of broadest risk for humpback whales was found off northeastern Vancouver Island, but one high-risk area was found along the inner passages of the central coast. For 'northern resident' killer whales, the region of highest risk was found in Johnstone Strait, which is the core whalewatching area and has been proposed as critical habitat for the population. While these maps do not quantify ship strike risk in absolute terms, the relative risk maps do identify areas that may warrant closer attention. Ship strike risk is expected to increase for humpback and fin whales in coming years, due to new, oil-related developments and port expansions. The analysis framework is also expected to be useful for allocating resources efficiently for monitoring ship strike mortality in sparsely populated parts of the BC coastline.

In discussion it was suggested that the variability in species distribution between years will also be different between species. The data were based on three seasons of survey effort which may not have captured the extent of known variability in distribution of fin and humpback whales, but for killer whales, the surveys results were consistent with previous studies based on almost 30 years of observations.

This paper raised several general issues regarding modelling relative risk. The model used in SC/60/BC8 generated species-specific indices of risk for a specific area. Other species or area-specific variables could include such factors as surface behaviours which might make the whales unusually vulnerable to ship collision (for example in the North Atlantic, surface feeding and surface active groups of North Atlantic right whales are believed to be more vulnerable to collisions), and variability in seasonal changes in habitat use. In the BC area, a behavioural component appears to exist for killer whales with females nursing young being more likely to be struck by small boats. There is less information from this area on relationships between behaviour and collision risk for baleen whales.

The analysis of risk could also include data on vessel type and speed. The data on shipping was taken from year-round records, whereas the whale data was seasonal. Therefore it might have been preferable to use only shipping data for the seasons when whales were believed to be present. However, the primary seasonal change in shipping traffic was in the amount of shipping with little variability in spatial use patterns. Speed of ships was not taken into account in SC/60/BC8, although this has been shown to be a primary predictor of fatal mortalities in other species and areas. One way to gain more precision in this would be to use a GLM with a number of co-variables, including variables on ship parameters, as well as whale parameters (e.g. behavioural variation as predicted by such factors as tide or time of day).

It was noted that the areas where risk was shown to be greatest for humpbacks and fin whales were also separated from human population centres, so the probability of carcass detection may be low for those species. The highest risk for killer whales was identified to be those areas which are heavily utilised for whale watching and so collision events are more likely to be detected. One of the objectives of the surveys in SC/60/BC8 was to fill a knowledge gap in the range of humpback and fin whales between the BC/Washington border and the BC/Alaska border. A more complete picture of relative risk could be obtained by combining these data with both whale and shipping data in adjacent areas.

5.3 Collaboration with ACCOBAMS

The ACCOBAMS Scientific Committee has established a Steering Committee and larger Working Group to carry out the recommendations of two inter-related workshops, working in close contact with the ACCOBAMS Secretariat, the IWC, the Pelagos Sanctuary and other relevant experts (SC/60/BC7). The workshops on the status and threats to fin whales and on ship strikes of all species in the ACCOBAMS area were held in Monaco in November 2005 (Panigada and Weinrich, 2006). An early focus for the ACCOBAMS Working Group will be to liaise with riparian nations and others to obtain information concerning both cetaceans and vessel traffic that will enable the identification of where cetaceans (especially fin and sperm whales) are (or potentially are) susceptible to ship strikes. Steps to this goal include: (1) reporting of vessel movements and density at appropriate geographical scales from

maritime companies, involving both bottom-up (i.e., awareness, involvement) and top-down (i.e. regulatory) approaches; (2) mapping the temporal and geographic distribution and abundance of cetaceans in relationship to similar information on vessel traffic to identify potential higher risk areas; and (3) estimation of numbers of ship strikes including data from strandings networks (including detailed necropsies), photo-identification studies (photographs may contain evidence of non-lethal encounters with vessels) and modelling exercises to assess potential threats at the population level.

The work will ultimately lead to the creation of a Mediterranean network, including ACCOBAMS Range States, ACCOBAMS Partners, different research institutes, and concerned shipping companies, to build a central database of ship strike data to facilitate information exchange and data sharing. A link with the IWC vessel strike data standardisation group was established to use the same database developed by the IWC. Work is also underway to develop a paper form to be distributed to shipping companies, relevant bodies and researchers to gather information on ship strikes throughout the Mediterranean Basin.

The sub-committee welcomed the collaboration between the IWC and ACCOBAMS, especially on compiling and storing data compatible with the IWC database.

5.4 Progress on developing an international database

The need for a global database of incidents involving collisions between vessels and whales has been recognised by both the IWC Scientific Committee and Conservation Committee, as well as other bodies such as the International Maritime Organization (IMO) and ACCOBAMS. *Inter alia*, the objectives/benefits of a single global database are that it will: (1) allow use of all available data to generate larger sample sizes in order to investigate how factors such as speed and vessel type relate to collision risk – this should lead to better ways to model risk and identify high risk areas; (2) improve ability to identify areas where the impacts of ship strikes may be of particular conservation concern at the population level, based on the numbers of reported incidents and/or modelling of risk; and (3) improve potential to develop the most effective mitigation measures

The database design developed by the Vessel Strike Data Standardisation Group was agreed by the Committee in 2007 and it has also been approved by ACCOBAMS for their work. Subsequently, a small group of scientists under the direction of Van Waerebeek began the task of populating the database. To date, 763 records, mainly from published sources, have been entered. The second report of the Vessel Strike Data Standardisation Group (SC/60/BC5) identified some problems encountered during data entry, particularly validation of data sources and assessing the uncertainty surrounding source data. This process is greatly facilitated by papers to the SC which review data on a regional basis. Two useful examples of these were discussed this year (SC/60/BC6, BC9). Suggested improvements to the database included converting some descriptive fields to categorical fields for easier quantitative analysis. There are still historical sources of data that require further investigation and data entry, including entering new reports, is an ongoing task.

The sub-committee noted that consideration is now needed on the best way to continue the data collection process, including ongoing maintenance of the database. The required tasks were divided into 'one-off' items and ongoing work. The one-off tasks are: (1) to generate a web-based data entry system and (2) further refine the database design. Ongoing tasks are (1) continue to investigate sources of historical records to populate database; (2) receive and process additional records that have not been presented to the Committee; (3) follow up with data holders on summary reports in National Progress reports in order to ensure as much detail as possible about each incident is entered into the database; and (4) follow up with authors of papers presented to the Committee that include data on incidents that are not already in the database.

The sub-committee **recommended** that the best way forward for the coming year would be for the Secretariat to undertake the following activities with advice from members of the Committee.

- (a) collate information from 2008 Progress Reports and SC60 papers;
- (b) work with an appropriate contractor to refine the database and develop the web-based system;
- (c) encourage holders of historic data to submit data either via the web-based system, in a replicate database, or through newly developed paper forms (the database can be queried if there is uncertainty whether data have already been entered);
- (d) investigate ways to ensure that governments, industry and other relevant bodies are made fully aware of the database (including a dedicated section of the IWC website) and the importance of supplying information either via the web or paper forms;
- (e) assess the amount of information gathered to estimate the likely resources needed to maintain and populate the database for both historical and ongoing data;
- (f) based on the experience gained, develop a detailed medium-term funding proposal for consideration at next year's meeting

A Ship Strike Review Group of Leaper (Convenor), Ferguson, Mattila, Panigada, Rowles, Van Waerebeek, and Weinrich was convened with the terms of reference to advise on (a)-(f) above.

6. ESTIMATION OF BYCATCH BASED ON FISHERIES DATA AND OBSERVER PROGRAMMES

6.1 Collaboration with FAO on collation of relevant fisheries data and Progress on joining the Fishery Resource Monitoring System (FIRMS)

The Committee has been working on collaboration with FAO on collation of relevant fisheries and bycatch data. One aim of this work is to identify fisheries where further monitoring would be valuable. Northridge and the Secretariat have been working intersessionally to move forward with entering data from all bycatches reported to IWC since 1980. Once the data entry is complete, Northridge has proposed to go back to FAO to determine how the bycatch data can be related to their fisheries database. The sub-committee noted that unfortunately Northridge was not present, but encouraged this work to continue.

There is a need for an agreed data format before an Annex to the FIRMS memorandum can be completed. Hence IWC has not yet signed the memorandum but this work will be continued intersessionally.

6.2 Modelling approaches to determine appropriate levels of observer coverage

No new information on required levels of observer coverage was presented to the sub-committee. However, attention was drawn to an ICES workshop on bycatch of protected species which had been held in January 2008. This workshop considered co-ordination of monitoring programmes and the report is available at www.ices.dk/reports/ACOM/2008/SGBYC/SGBYC_2008.pdf.

The sub-committee also noted that the Secretariat of ACCOBAMS in collaboration with the General Fisheries Commission for the Mediterranean (GFCM) and with the support of the Italian Ministry of Agriculture and Forestry, will organise a workshop on cetacean bycatch within the Agreement Area in September 2008 in Rome. This workshop is a part of the project for the 'Assessment and mitigation of the adverse impacts of interactions between cetaceans and fishing activities in the ACCOBAMS area,' known as the ByCBAMS project. The Terms of Reference include: (1) National overviews from all ACCOBAMS relevant countries on the current status of cetacean by-catch and critical review of historical data; (2) adoption of standard protocols for by-catch data collection; and (3) discussion on the further implementation of the ByCBAMS project and synergies with other IGOs and the existing regional framework.

6.3 Review progress on standardised reporting in Progress Reports

The sub-committee reviewed a compilation of bycatch reports from all received national Progress Reports. It was noted that in this year's reports the time period covered by reports varied from as far back as 2005 to the current year. One national delegate reported that it was often hard to have the immediate prior year's data collated in time for reporting, but noted that previous year's reports can always be amended. There was a question about whether animals that were entangled and released alive, or struck by vessels and not injured, should be included in the reports; the sub-committee felt that their inclusion was called for under current guidelines. In addition, there was no clarity about the inclusion of unconfirmed reports; this seems to vary considerably between countries. In some of the reports, there are also multiple tables of entanglements or ship collisions within a single report (e.g. for different regions within a country); these may lead to some of the incidents being missed.

Members of the sub-committee **requested** that if possible the Secretariat make the Progress Report template available by 1st January of each year to facilitate the most complete and accurate reports possible.

6.4 Estimating risk and rates of entanglement

SC/60/BC1 described a study of entanglement on Gulf of Maine humpback whales. The Gulf of Maine is a site of long-term population monitoring efforts and a well-established entanglement reporting and response network. These data and mark-recapture techniques were used to determine the composition and fate of animals involved in entanglements witnessed from 1998-2006. Of 95 live entanglement cases examined, 61% ($n=58$) were sufficiently documented to allow the individual to be re-identified with or without gear. Previously catalogued whales ($n=46$) were 50% female and 55% adult and consistent with the demographic composition of the overall population during the same period. One previously catalogued adult (4%) was not re-sighted after entanglement, while 52% ($n=15$) of well-documented animals known or presumed to be juvenile were not seen again. Mark-recapture statistical analyses accounting for differential detection probabilities further indicated that juvenile survival, in particular, might have been lower after entanglement, although more data are necessary to confirm this result. Despite a specific concern about oral entanglements in baleen whales (IWC 2007), mouth entanglements known to have persisted up to 46 days did not appear to reduce survival, but other entanglement configurations were not studied. The authors noted entanglement survival was likely over-estimated in this study. For example, research focused on the fate of live reports, and some animals may have died before they could be detected. Animals with more serious entanglements were more difficult to photo-identify and so were less likely to be included in a mark-recapture study. Finally, there was an extensive disentanglement effort in the region that likely improved animal fate in some, but not all, cases. Parallel, longitudinal studies of large whale populations are critical for determining the fate of previously entangled whales and for placing those results in context. Such studies would be assisted by obtaining individual identification data when large whale entanglements are witnessed, and using alternate approaches (such as underwater photography and molecular genetic matching) to maximise sample sizes and reduce bias.

The sub-committee thanked the authors for bringing this work forward which followed on from suggestions at last year's meeting. There was discussion among the sub-committee about entangled animals that later died. SC/60/BC1 referred to one animal that had been disentangled and had been found dead four days later; while it would have been ideal to conduct a full necropsy on this carcass, the inaccessible location where it washed ashore prevented completion of this task. Externally, however, this animal did not exhibit external injuries more severe than animals that had survived after disentanglement. In general, health assessment work on entangled large whales is on-going, but it is rarely possible to draw some desirable physical samples (e.g. blood or serum samples) to aid in diagnostics. A concerted effort is made to biopsy sample entangled animals; these samples are being held until the technique that derives the maximum amount of information from the sample is identified. It also now appears to be feasible to collect respiratory exhalation contents from both entangled and apparently healthy animals, if this proves to be valuable.

6.5 Bycatch in longline fisheries

SC/60/09 presented information on depredation by killer whales and sperm whales in longline fisheries for Patagonian toothfish in the Southern Ocean. Modifications to longline gear have been trialled by Chile, Uruguay and Russia participating in the longline fishery in waters adjacent to the Southern Ocean. These modifications involve the use of net sleeves, weights at the end of vertical lines, and clusters of 10 hooks fixed 30cm above the weight. It is likely that this method will be introduced in longline fishing in the Southern Ocean from the season 2007/08 onwards. It was noted that very few instances of fatal cetacean entanglements have been reported for these fisheries. Successful mitigation measures to reduce depredation should result in further reduction in entanglement risk by removing the incentive for whales to approach long-line gear.

7. ESTIMATION OF BYCATCH BASED ON GENETIC DATA

The Committee held an initial workshop on the use of market sampling to estimate bycatch of large whales in 2005. Subsequently the Committee agreed that the planned follow-up workshop would be very valuable, but several tasks were required first. These tasks are listed in IWC (2007, pp.218-20).

One of these tasks had been to collate temporal and spatial information on bycaught whales destined for market. Funahashi had presented information up to 2006 entered into a GIS software package at last year's meeting (IWC, 2008, pp.237-38). She had updated this with data from 2007 but these new data did not substantially affect the overall distribution patterns. Results from simulation trials had also been presented in 2006 and 2007, leading the Committee to conclude that a mark-recapture method gave consistent but negatively biased estimates of the number of whales entering the market and that current understanding of markets was adequate for application of such methods (IWC, 2008, p.237). This discussion had led the authors to conclude that further simulations would be unlikely to provide information that would change the view of the Committee unless more data were available.

It was noted that a large quantity (estimated at 40-50 tons in one report) of minke whale meat had been reported in the media as confiscated by the authorities in the Republic of Korea in January 2008 (see for example <http://joongangdaily.joins.com/article/view.asp?aid=2887540>). This is still under investigation but may substantiate results of previous market surveys (Baker *et al.*, 2007) indicating higher numbers of minke whales than reported entering the market. An noted that in Republic of Korea, fishermen and whale meat sellers submitted DNA samples of bycaught animals voluntarily so far and the DNA sequences were registered. However the DNA data were used for forensic purposes during the investigation, and now fishermen and whale meat sellers will not submit samples any more. So the authorities of the Republic of Korea are preparing regulations and protocols for collecting tissue samples of by-caught animals to register DNA sequences and monitor pollutants. One member questioned whether health inspections for meat consumption might be a point at which market samples could be tracked, but this seemed unlikely as a tracking system, as exists for other meat products, does not seem to exist for whale meat in either Republic of Korea or Japan.

It was also noted that issues considered by the Committee related to using market sampling to estimate the number of whales entering the market are relevant to a much wider body of scientists involved in monitoring wildlife and fishery trades, including the trade in bush meat and non-cetacean bycatch in several countries. Synergies in interest exist between the Committee and these other situations with potentially similar issues and solutions. The sub-committee **agreed** that the proposed follow-up Workshop would be valuable and that consideration should be given to a possible joint Workshop with other disciplines facing similar issues.

7.1 Information from market surveys

SC/60/BC2 reports on species identification of whale-meat products purchased directly and via the Internet from commercial markets of Japan from mid September 2007 to late March 2008. A total of 99 products included six species of baleen whale; humpback ($n=5$), fin ($n=39$), Bryde's ($n=13$), sei ($n=21$), North Pacific minke ($n=15$) and Antarctic minke whales ($n=5$). The individual identity of market fin whales was considered by comparison to the expected number of 13 fin whales killed since scientific hunting in the Antarctic was initiated in the austral season of 2005/06 as part of the JARPA II programme. Based on mtDNA sequences alone, the 39 fin whale products from the 2007 survey represented 12 individuals and the 15 products purchased in the 2006 survey represented 8 individuals, five of which were also found in 2007. None of the 15 haplotypes from the 2006-07 surveys matched to haplotypes found on the market prior to 2006. It is difficult to explain this minimum census of 15 individual fin whales from the market surveys given the reported take of 13 from JARPA II and the number and timing of fin whale entanglements in official reports of bycatch in recent years.

In discussion, Baker noted that previous market surveys had found products derived from fin whales in Japan. It had been assumed that the primary source was long-term storage of Icelandic products, since sequences from most products identified in early market surveys (1993-2003) grouped with reference sequences from the North Atlantic. After 2003 there had been an increase in the number of fin whale products identified from Japanese markets that did not group with the available North Atlantic reference sequences.

Information on sequences from the complete set of common minke whales (189) from the Icelandic scientific permit takes 2003-2007 and from the commercial catch of minke whales in 2006-7 (7) and fin whales in 2006 (7) are included in the Icelandic DNA registry. Additional genetic data on fin and common minke whales were made available to Committee members for use in the RMP implementation and implementation review, respectively, of these two species. Earlier data pre-2003 are not as complete as the more recent data included in the Icelandic DNA registry. Requests for genetic information from the DNA registry should be directed to the Icelandic Ministry of Fisheries.

It was noted that it would be very helpful if sequences from the 15 individuals described in SC/60/BC2 could be compared against the registry sequences from whales taken in the JARPA II hunt and documented bycatch, since it is otherwise difficult to estimate the extent of any under-reporting of whales entering the market. The sub-committee noted previous agreements by the Committee that availability of data from DNA registers would improve estimates of total take from market surveys. The sub-committee **recommended** that these data be made available through the Data Availability Agreement.

8. ESTIMATION OF CETACEAN MORTALITY FROM OTHER HUMAN ACTIVITIES

8.1 Mortality from acoustic sources

Yang *et al.* (2008) reported on an increase in cetacean strandings along the coast of Taiwan from July 19 to August 13, 2005, including 23 animals in total: 13 dwarf sperm whales, two Longman's beaked whales, two Blainville's beaked whales, two pygmy sperm whales, two striped dolphins, a pantropical spotted dolphin, and a short-finned pilot whale. Fifteen of the 23 animals were initially reported as live strandings, of which three were released. Fifteen animals were examined post-mortem of which three were sufficiently fresh for detailed pathological examination. Two of these were beaked whales that had severe, diffuse vascular congestion and marked disseminated microvascular haemorrhages associated with widespread, round to oval cavitory lesions within vital organs, consistent with gas emboli. Samples of lung tissues and lymph nodes from nine animals, including the three fresh animals, were considered negative for the presence of fat emboli. Microscopically detectable fat emboli were absent from all the Kogiidae and Ziphiidae cases examined. During the period of this mortality event, at least two naval exercises with anti-submarine warfare components held by China and the USA took place in the western Pacific. The exercise by the USA was not considered as a potential factor in this event due to the distances (410 to 1,600 miles) from the stranding site. In summary, the cause of this unusual mortality event could not be conclusively determined. Although it had some features in common with sonar-related cetacean strandings, it also had a number of differences, including the fact that the strandings occurred over a much longer period and over a larger geographical range. The authors noted that there is a clear need for internationally coordinated research to address important gaps in knowledge and to improve the detection of affected species in view of ongoing naval activities using high-intensity sonar in potentially sensitive regions.

In response to a question about what could be learnt from this case for other situations of unusual mortalities, Fernandez stressed that each animal must be necropsied as quickly as possible. Each necropsy that he has conducted, especially on beaked whales, has had some unique features and must be addressed with an 'open mind'. In addition, there is a need to gather as much information as possible on the animal's environment at the time of the death/stranding, including coordinating with military and other government agencies as well as all examining other factors related to the stranding (e.g. presence of disease, weather patterns, etc.).

8.2 Marine debris

SC/60/BC8 presented spatial model results to fit a density surface to effort and sightings data for floating marine debris in coastal waters of BC, Canada. This analysis showed that debris was concentrated off southern Vancouver Island and off northern Queen Charlotte Islands. Density of marine debris was quite low near the most urbanised area off the city of Vancouver. This surface has not yet been multiplied by the density of marine mammal species, but distribution of marine debris appears to show stronger overlap with that of fin and humpback whales than killer whales.

It was noted that the lack of obvious correlation between proximity to large urban areas and density of marine debris suggests that this analysis identifies areas of debris accumulation rather than sources of debris. It was noted that such analyses may also be useful for identifying priority areas to search for whale carcasses that have become entangled in marine debris.

Although there were no new reports of entanglements in marine debris, one member reported that in Hawaii, the majority of entangling gear removed from humpback whales tends to be fishing gear largely from Alaska. There are current investigations underway to determine if this gear was active or 'ghost' gear (which might be regarded as marine debris) at the time of entanglement. The sub-committee also discussed the incidence of plastic ingestion as a cause of mortality. Plastic bags have been frequently found in cetacean stomachs. Most instances have involved small cetaceans but An reported a 50cm x 50cm styrofoam piece which appeared to be the cause of death for a sperm whale in Korea.

The sub-committee **agreed** that further consideration of estimation of mortality rates in large whales due to ingestion of marine debris would be valuable and encouraged the submission of papers for next year.

8.3 Other

SC/60/E5 reports on what appears to be an unusual mortality event in the NE Atlantic occurring over at least the first three months of 2008 featuring the strandings of 14 Cuvier's beaked whales, 5 Sowerby's beaked whales, 4 unidentified beaked whales and 22 long-finned pilot whales in Scotland, Ireland and Wales. Most were dead when they stranded and many were in advanced stages of decay, making determination of the causal factors especially difficult. Simmonds commented that investigations had included consulting with the UK Navy, who reported that there had been no deployment of sonar on their part in the region. A modelling exercise of drift patterns prior to stranding is being conducted to try to determine the region(s) of origin of the bodies and thereby try to narrow down the factors involved. In addition to loud noises, factors potentially involved could include disease, acute prey changes and fisheries.

There was a question as to whether any seriological investigations had taken place, as even in older carcasses blood can contain antibodies or infectious disease agents. Regarding the strandings on the British coast, it was noted that a morbillivirus was known to be present in the pilot whales in the area, but Simmonds noted that in his experience mass mortalities driven by infectious diseases tend to affect only a single species, and these deaths crossed a variety of taxa. Pathology from a few animals which either stranded alive, or washed ashore as fresh carcasses, were sampled, and it is hoped that these results may help identify causes of mortality in at least some of these cases. The sub-committee looked forward to results of further investigations of these strandings that might have implications for estimating human induced mortality (e.g. use of oceanographic modelling to relate location of death to possible human causes).

Fernandez reported on a study of cumulative levels of human-induced mortality in the Canary Islands between 1999-2005 as part of the Ph.D. thesis of Manuel Arbelo, University of Las Palmas de Gran Canaria, Canary Islands, who recovered 233 stranded whales and dolphins of 19 different species. From etio-pathological studies, 62% of the 138 studied cetaceans were diagnosed as natural (i.e. non-anthropogenic) from pathological entities that included infectious diseases, neonatal pathology, intra- and inter-specific interactions and typical mass strandings. Another 33% of cases were diagnosed as anthropogenic entities including fishing interaction (bycatch), atypical mass-stranding linked to naval exercises, ship collisions, and other anthropogenic-related pathology. A cause of death could not be ascribed in only 4% of the 138 animals examined.

9. WORK PLAN AND BUDGET REQUESTS

The sub-committee **agreed** to carry over a number of items from this year's Agenda and to give attention to the topics intersessionally.

- (1) Collaboration with FAO on collation of relevant fisheries data;
- (2) progress on joining the Fishery Resource Monitoring System (FIRMS);
- (3) estimation of bycatch
- (4) estimating risk and rates of entanglement;
- (5) progress in including information in national Progress Reports;
- (6) review methods to estimate mortality from ship strikes, including modelling risk;
- (7) continue to develop global database of ship strike incidents; and
- (8) continue to consider methods for assessing mortality from acoustic sources and marine debris.

No new items were proposed for the agenda but other topics may emerge intersessionally. Work on the ship strike database will involve a budget request (initially of £2000 for a web based data entry system).

10. ADOPTION OF REPORT

The report was adopted at 16:55 on 7 June 2008. The Chair thanked the rapporteurs for their hard work and the group thanked the Chair for his leadership, especially at such short notice.

Table 1
Total number of recorded incidents of ship strikes and entanglements from 2008 National Progress reports
Compiled by Mason Weinrich

	Korea	Australia	Brazil	Denmark	Italy	Mexico	Spain	U.K.	U.S.	Japan	France	Total
Minke - Ship strike	1											1
Minke - Entanglement	79	1(1)						1	1	156 (1)		238
Humpback - Ship strike		4	1	1					5			11
Humpback - Entanglement		5 (3)	1	3 (1)		2 (1)			1	1		13
Sperm - Ship strike		1										1
Sperm - Entanglement		2									1	2
Fin - Ship strike					2		2		5		1	10
Fin - Entanglement								1		1		2
Bryde's - Ship strike												0
Bryde's - Entanglement	1								1			2
Right - Ship strike									3			3
Right - Entanglement		1(1)										1
Bowhead - Ship strike												0
Bowhead - Entanglement				2 (1)								2
Gray - Ship strike												0
Gray - Entanglement										1		1
Unk - Ship strike												0
Unk - Entanglement		3										3

Numbers in brackets indicate the subset of whales reported to have become free or released alive. These types of incidents are not reported in all Progress Reports.

Ship strikes include incidents that may not have been fatal. Progress Reports of Chile, Croatia, Germany, Iceland, Netherlands, Sweden, Argentina, Norway and New Zealand reported no large whale mortalities.

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Appendix 1

AGENDA

- 1 Conveners opening remarks and terms of reference
- 2 Election of chairperson and appointment of rapporteurs
- 3 Adoption of agenda
- 4 Review of documents
- 5 Estimation of cetacean mortality from ship strikes
 - 5.1 Results from studies of collisions between whales and vessels
 - 5.2 Modelling collision risk
 - 5.3 Collaboration with ACCOBAMS
 - 5.4 Progress on developing an international database
- 6 Estimation of bycatch based on fisheries data and observer programmes
 - 6.1 Collaboration with FAO on collation of relevant fisheries data
 - 6.2 Progress on joining the Fishery Resource Monitoring System (FIRMS)
 - 6.3 Modelling approaches to determine appropriate levels of observer coverage
 - 6.4 Review progress on standardized reporting in Progress Reports
 - 6.5 Observer coverage required to reliably estimate bycatch
 - 6.6 Estimating risk and rates of entanglement
 - 6.7 Bycatch in longline fisheries
- 7 Estimation of bycatch based on genetic data
 - 7.1 Review of intersessional work related to market sampling
 - 7.2 Plans for second workshop on the use of Market Sampling to estimate bycatch of large whales
 - 7.3 Other
- 8 Estimation of cetacean mortality from other human activities
 - 8.1 Mortality from acoustic sources
 - 8.2 Marine Debris
 - 8.3 Other
- 9 Work plan and budget requests
- 10 Adoption of report