Annex J

Report of the Working Group on Estimation of Bycatch and Other Human-Induced Mortality

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1. CONVENERS OPENING REMARKS AND TERMS OF REFERENCE

Berggren welcomed the participants and noted that the Commission has instructed the Scientific Committee (SC) that catch limits calculated under the Revised Management Procedure (RMP) shall be adjusted downwards to account for human-induced mortalities caused by aboriginal subsistence whaling, scientific whaling, whaling outside the IWC, bycatches and ship strikes. Further, that each such adjustment shall be based on an estimate provided by the SC of the size of adjustment required to ensure that total removals over time from each population and area do not exceed the limits set by the RMP. In order to address this task the Terms of Reference given in Appendix 1 has been developed by the SC Convener group. Further, the task primarily applies to areas where the RMP is likely to be implemented, the Northeast Atlantic and the western North Pacific.

2. ELECTION OF CHAIR AND APPOINTMENT OF RAPPORTEURS

Berggren was elected Chair and Leaper agreed to act as rapporteur assisted by Northridge.

3. ADOPTION OF AGENDA

The adopted Agenda is given as Appendix 2.

4. REVIEW OF DOCUMENTS

The following documents were relevant to the Working Group (WG): SC/57/BC1, 3-5, SC/57/NPM5-7, 11, SC/57/WW8, SC/57/Rep4.

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

5.1 Collaboration with the Food and Agriculture Organisation (FAO) on fishing fleet data

Northridge reported on intersessional work with the FAO on the Inventory of Fisheries. The WG had previously agreed to gather information on the nature and scale of fisheries that might be involved in large whale bycatch, as a step towards quantifying such bycatch and that it had agreed that this task would best be achieved by collaborating with the FAO. The FAO is in the process of building a global Inventory of Fisheries, and this had been identified as the most useful route of collaboration.

The Inventory of Fisheries is being compiled on a regional basis by consultants familiar with fisheries in their geographical area or country. The inventory is still being compiled, and the level of detail available varies by region. The Inventory contains around 60 data fields per fishery record. These address, among other things, fishing gear type, area of operation, number of fishing vessels, seasonal patterns, target species, discards and incidental catches. It represents a massive undertaking by the FAO.

An initial examination of nearly 1,000 existing fishery records revealed that there were only two fisheries in the database in which the incidental catch of any cetacean had been recorded. In several cases where incidental catch of cetaceans in a fishery was known to occur, the specific fishery was not individually identified in the database, because the fishery had been described from a resource perspective, whereby several gear types are subsumed into a overall fishery for a species or species group. In some other cases there were no details of fleet size. However, some idea of the scale of the fishery can usually be found from other fields indicating total landings or value of the fishery concerned, while the database is also structured in such a way that it is easy to define 'sub-fisheries' that would allow a gear technology perspective to be added to an existing fishery description in a 'parent-child' relation.

The inventory would be most useful to the WG at the present time to examine fisheries likely to have a large whale bycatch in the Northeast Atlantic and the western North Pacific. In the latter case, little information was yet available in the Inventory, but this was being addressed by the FAO. In the Northeast Atlantic, a preliminary search of the database for these regions showed few records of pot fisheries, and at present, information on gillnet fisheries was often subsumed in fishery descriptions from a resource perspective (multi-gear types). Further work will be required to produce the level of detail that would be most useful to the SC. A quick examination of other regions in the

Atlantic, however, revealed several major pot fisheries (often implicated in large whale bycatch). Further work along these lines was suggested to link existing bycatch records with fisheries detailed in the Inventory.

The WG welcomed this work and recommended that it should be continued. Specifically, Northridge was asked by the WG to continue the work that he had planned in collaboration with the FAO, with the aim of integrating bycatch records into the Inventory of Fisheries to the extent possible and with the help of the IWC Secretariat.

In discussion it was noted that the information flow was a two way process, with bycatch records held by the IWC being provided to the FAO, and the FAO able to assist the SC by providing detailed information on nature and scale of fisheries in areas where large whale bycatch might be an issue of concern.

In order to facilitate this transparency, the Working Group agreed that it would be helpful if the IWC could join the Fishery Resource Monitoring System (FIRMS) agreement, and recommended that the Secretary should be asked by the SC to pursue this with the FAO.

Other fishery agencies were suggested as potential sources of useful fishery data, but it was pointed out that the object of the FIRMS agreement was to try to facilitate the sharing of fishery data between agencies through the FAO. By joining FIRMS the IWC would then be able to access such data.

5.2 Review progress on standardised reporting in Progress Reports

The WG reviewed a summary of the National Progress Reports (Annex Q) to assess how well the revised reporting requirements had been adopted. The WG **agreed** that the revised table provided data in a much more useful format than had previously been the case. There had been a fairly good response, though a few member states had continued to supply information in the previous format, or in some hybrid format. The WG encouraged these countries to address this issue for SC/58 by providing large whale bycatch records in the format suggested.

It was also suggested that a fuller explanation of the codes that are used to describe the fate of entangled whales and how they were observed would be helpful, and that gear codes should be updated periodically, as the FAO was reported to have made some recent additions to these. It was suggested that a web link to the FAO website dealing with fishing gear codes could be included in the National Progress Report guidelines for next year.

It was noted that some distinction should be made between those countries that had monitoring schemes, where no records implied a low or zero bycatch rate, and others where no such schemes existed and the absence of records could not be taken to imply a low or zero bycatch rate.

The WG also reviewed information from the National Progress Reports relating to the bycatch of large whales. Different species dominated different country's records, with humpback whales (*Megaptera novaeangliae*) dominating the records from Australia, North Atlantic right whales (*Eubalaena glacialis*) and humpback whales dominating the US records and minke whales (*Balaenoptera* spp.) dominating those of Korea and Japan.

A record of 26 whale entanglements in shark nets was noted in the South African Progress Report, as this was an unusual return. It was noted that these represented large whales that encountered a shark net but swam through it, though of course their later fate would remain unknown.

The WG noted that a humpback whale had been reported released alive in Japan, and also noted the records in the Korean Progress Report of five minke whales found floating dead at sea – the cause of whose deaths was unknown.

5.3 Observer coverage required to reliably estimate bycatch

There had been no new papers presented on this topic this year, but it was noted that this issue was on the agenda of member states of the European Union (EU), as recent legislation required them to make estimates of cetacean bycatch in selected gillnet and pelagic trawl fisheries. This would require some consideration of this topic by those countries, and it was suggested that members of the WG involved in such schemes might report back to the WG next year.

The WG was reminded that in some areas fisheries were very hard to monitor using observers, due to the nature of the fleets. Further consideration as to how these fisheries could be addressed would be helpful.

5.4 Other

SC/57/BC3 presented a preliminary overview of records of cetacean interactions with longlines. Longline fisheries for large pelagic fish are very widespread throughout the world, and have expanded in recent years. Although it has been recognised for many years that cetaceans sometimes depredate longlines, there has until recently been less understanding of the threat that longlines pose to small and large cetaceans worldwide. The authors of SC/57/BC3 had collated records from around the world, including some of their own records. Documented mortalities of whales in longlines have included sperm (*Physeter macrocephalus*) and humpback whales, notably in the South Atlantic and Gulf of Alaska.

Not all entanglement in longlines is necessarily fatal, though entanglement in demersal longlines may be more likely to be so. Cetacean fatalities may also occur where depredation is severe and fishermen take violent counter-measures. Hidden mortalities may occur if animals escape whilst still entangled in line, which can cut into them and cause progressive damage.

The WG welcomed this preliminary review and looked forward to seeing a revision at next year's meeting. During discussion it was pointed out that a whale swimming away from an encounter with a single line attached to it could later die. It was suggested that where possible, records of encounters between longlines and whales should try to record whether the whales left with any lines attached.

SC/57/O13 also recorded interactions between cetaceans and longlines, but in the Southern Ocean. The two species primarily involved in interactions between fisheries and cetaceans in the Southern Ocean were killer whales (*Orcinus orca*) and male sperm whales. Both species took fish from the line primarily during daylight hours. Catch rates of longliners declined to less than 50% when killer whales occurred close to longline vessels, while the loss to sperm whales was much less obvious. Sperm whales frequently became entangled in the line. Other cetaceans were rarely seen in the vicinity of longline vessels and were only occasionally entangled in the line. Two dolphins and a humpback whale were released alive while one rorqual, tentatively identified as a minke whale, died in the Ross Sea.

During discussion Sadler reported to the WG that a humpback whale had been disentangled from a lobster pot line this year (2005) off northern Wales in the UK. The pot line was later traced to its owner, a fisherman in Donegal,

Ireland. The animal had clearly swum at least 200km with this line attached. Its subsequent fate was unknown. Sadler also reported an account of five sperm whales that had been disentangled from a driftnet in the Mediterranean Sea, and suggested that more could be learned from incidents such as these, both on the nature of entanglement events and how animals might be released. Sohn pointed out that in Korea the whales were dead when they were found in pound nets and that they were then taken to the market after investigation as to whether the take was deliberate or not.

6. ESTIMATION OF BYCATCH BASED ON GENETIC DATA

6.1 Report of Workshop on the use of market sampling to estimate bycatch

At last years meeting the SC had strongly recommended that the methodological Workshop (on the use of market sampling to estimate bycatch) should take place as described in the proposal (IWC, 2005, p.13). A Steering Group (Berggren, Donovan, Hammond, Zeh) was appointed by the SC, who contacted potential invitees through the Secretary of the Commission to participate in a planning meeting that was to take place during Autumn 2004. At that meeting, the intention was that information needs for the Workshop would be reviewed, papers needed to provide background for the Workshop would be identified, a list of participants would be finalised, and meeting logistics would be arranged. However, it was not possible to find dates when most of the Invited Participants to the planning meeting were available. The Steering Group therefore decided that the planning meeting and Workshop would be replaced by a two-stage Workshop of which an initial Workshop would be held during two days before the 2005 SC meeting, followed by a second Workshop at a later date as decided by the outcome of the initial Workshop. The initial Workshop would identify information about the markets that would be required for a market sampling approach and review the possible approaches to bycatch estimation and their relative precision. The initial Workshop was held 27-28 May 2005 in Ulsan, Republic of Korea (SC/57/Rep4). None of the market survey methods considered at the Workshop were able to distinguish between whales entering the market through unreported fisheries bycatch and other unreported takes. Hence the term bycatch used in the Workshop report includes unreported takes that may have originated from sources other than bycatch in fisheries.

The objectives of the two-stage Workshop were:

(1) to review available methods that have been used to provide estimates of large cetacean bycatches via market samples, including a consideration of their associated confidence intervals in the context of the RMP;
(2) to identify information about the markets that would be required for a market sampling approach; and therefore
(3) to provide advice as to whether market-sampling-based methods can be used to reliably estimate bycatch for use in addressing the Commission's objectives regarding total removals over time and if so, the requirements for such methods.

Berggren summarised the report of the initial Workshop in the use of market sampling to estimate bycatch of large whales that was held between 27-28 May 2005 in Ulsan, Republic of Korea (SC/57/Rep4). The Workshop considered information on simplified pathways from source to consumer for bycaught whales on the Japanese and Korean market based on recent data from a range of sources including personal interviews. The Workshop agreed that while interviews may be productive, questionnaires *per se* were unlikely to generate useful quantitative data on market structure. The Workshop also agreed that using genetic methods to examine the concordance between labelling of market samples and genetic analysis would be useful to determine whether labelling could inform the design of market surveys in Japan. The Workshop identified a list of information that was key to reducing the potential sources of bias when developing a sampling design for specific markets. The information available to the Workshop was limited to the markets of Japan and Korea and it was clear from considering these two very different cases that each market needed to be considered on a case by case basis. The Workshop agreed that information from other countries with domestic markets for whale products should be encouraged. These countries include Norway and Iceland in the Northeast Atlantic.

The Workshop considered a capture-recapture analysis to estimate bycatch levels of minke whales from market surveys in Korea. The Workshop agreed that the inclusion of data taken at source would improve the power of this type of analysis. Thus the availability of samples from DNA registers would greatly enhance the precision and reduce the bias in bycatch estimates from market surveys based around capture-recapture methods. In particular, it was noted that if the first 'mark' was from a register, then only heterogeneities in 'capture' probability that were correlated with whether a whale was on the register or not, would matter. The Workshop agreed that if samples taken at source in Korea were not available then there would be value in obtaining samples from whales as they passed through the wholesalers. One possible way for optimising sampling design is to investigate the performance of different sampling designs, and their sensitivity to the assumptions that have been made regarding market characteristics, through simulation. Simulation exercises may also help in identifying the data requirements on markets that are most critical for obtaining unbiased estimates.

Further information on the markets in both Japan and Korea are needed and the Workshop agreed that the planned follow-up Workshop would be very valuable. However, such a Workshop would be more successful if progress had been made on addressing the data requirements and on developing suitable simulation frameworks for sensitivity analyses and to test sampling design. This work should begin as soon as possible and will have budget requirements.

The Workshop concluded that market sampling is a potentially useful method and also agreed that bycatch estimates from market surveys could be improved considerably if data from DNA registers on whales entering the market were available. Whilst the Workshop recognises the political sensitivity of market-related issues in an IWC context it respectfully requested relevant governments to consider a collaborative effort to investigate these methods as a potentially valuable source of information for management and use in the RMP.

Mae reiterated the position of the Government of Japan that market related issues are a domestic matter and in view of this the contribution from Japan to these discussions will be limited. Kim noted that, at the 56th IWC Commission meeting, Korea reserved its position on the decision of holding a Workshop on market sampling. Accordingly, the Government of Korea was not represented at the initial

Workshop. Therefore, some texts in the workshop report (SC/57/Rep4) do not necessarily reflect the views of scientists from the Korean delegation.

Mae noted the complexity of the Japanese market and that the distribution system in Japan is dynamic and constantly changing. In view of these issues of market complexity, and the likely costs involved in obtaining appropriate sample sizes, some members doubted the conclusion of the Workshop that market sampling was a promising approach.

Others noted that the discussions at the Workshop drew attention to the ways in which estimates from market surveys could be improved through a collaborative approach using a combination of official statistics and market surveys. If data from DNA registers were available then the statistical precision of estimates would be improved considerably and only a relatively low level of sampling would be required. In addition, market surveys would not need to be conducted continuously, particularly if the estimates were in agreement with the reported figures.

The initial Workshop had only considered the first two of objectives (1)-(3). Although the view of some members was that market surveys would not provide reliable estimates of bycatch, the WG **agreed** that the planned follow-up Workshop would be very valuable in order to evaluate this fully. The WG also **agreed** that such a Workshop would be more successful if progress had been made on addressing the data requirement needs, and on developing simulation frameworks for sensitivity analyses and to test sampling designs prior to the Workshop. The WG **agreed** that the follow-up Workshop should go forward as described in Appendix 3.

6.2 Data from market surveys

Funahashi described a preliminary analysis of concordance between labelling and genetic identification of whale products on the Japanese market. This had been conducted following a recommendation by the initial Workshop. The efficiency of surveys to estimate the bycatch of a particular species from market samples will be improved if the proportion of the target species in the samples can be maximised. One possible way to do this is to incorporate information from product labelling into sampling design. However, this will only improve results if sampling based on product labelling both increases the proportion of samples from the target species, and does not introduce further sources of heterogeneity in the sampling probability of whales from different sources.

Of 598 samples purchased in Japan between February 1999 and February 2004 a total of 147 had written labels. New regulations on food labelling came into force in July 2000 that required that products be labelled with species of origin. Of the 257 products purchased prior to this date, 57 (22%) were labelled. Of these, three (1% of total) were correctly labelled to species level, including making the distinction between Antarctic minke whales from the Southern Ocean and common minke whales from the North Pacific, when compared to the genetic analysis. Of 341 products purchased after July 2000, 90 (26%) were labelled. Of these, 21 (6% of total) were correctly labelled to species level including making the distinction between species of minke whale.

In discussion, Funahashi confirmed that although only products that were labelled as baleen whale were considered, some of these products had actually originated from odontocetes based on genetic analysis. Cipriano commented that in an analysis of market surveys conducted in Japan in 1996, around 35% of products labelled or advertised as baleen whales were odontocetes.

Mae stated that enforcement of food labelling regulations was the responsibility of the Government of Japan. However, the food labelling regulations were primarily designed for consumer protection and thus had not been introduced for the purpose of estimating bycatch.

The WG welcomed these results and Funahashi offered to present further data to next year's meeting. Cipriano also stated that his group had similar data and that they would collaborate with Funahashi. It was noted that the presented breakdown by species of concordance between labels and genetic analysis would allow these data to be incorporated in simulation trials to test the extent to which product selection based on labelling might assist with market survey design.

6.3 Analytical tests for assignment to stocks and/or Areas

SC/57/NPM6 provides an estimate of the proportion of J- and O-type minke whale products purchased on Japanese markets from December 1997 to February 2004, using mixed-stock analyses. This approach was presented as an alternative to the capture-recapture analysis described in SC/57/BC5, for the purposes of estimating bycatch from market surveys. An initial sample of 232 North Pacific minke whale products, identified first to species by analysis of variation in mtDNA, was reduced to 188 unique market individuals by additional analysis of microsatellite genotypes and sex, as described in SC/57/NPM5. Market individuals were classified into one of four mtDNA haplogroups, one of which is characteristic of the O stock (O-type) targeted by the Japanese scientific hunt (JARPN and JARPN II), and three of which are characteristic of the depleted J stock (J-type) found in the East Sea/Sea of Japan. The overall proportion of J-type individuals was high, representing 44% of all market individuals purchased in 15 prefectures over seven years of surveys. There was no significant change in this proportion after the 2001 change in regulations controlling the sale of bycatch, despite the 4- to 5-fold increase in reported bycatch and the 50% increase in the scientific catch since that time. There were moderate differences in the proportion of J-type in prefectures bordering three coastal regions, West, Southeast and Northeast, perhaps reflecting local sale of bycatch in coastal prefectures. Given the absence of temporal differences and the relatively small geographical differences, all market individuals were pooled for an updated mixed-stock analysis of market individuals using haplogroup frequencies reported for the JARPN program (n=368 for 1994-98) to represent the O stock, and haplogroup frequencies for Korean market individuals (n=187 for 1999-2004) to represent the J stock. The resulting maximum likelihood estimate of 45.5% (SE=4.3%) for the J-stock proportion and the known scientific take of 740 from the O stock were used to calculate a minimum total take of 616 J-stock minke whales over the seven-year survey period. If market proportions are also influenced by incidental takes of O-stock minke whales, as assumed in past RMP simulations, the estimated total bycatch would have to be several times larger than the scientific hunt to explain the observed market proportions.

In discussion, Goto noted that previous analyses had demonstrated that some haplotypes (around 8%) are shared by whales in the East Sea/Sea of Japan and Pacific. He suggested that the results of statistical tests would have been affected depending on whether these haplotypes were

assumed to be J or O stock. Baker responded that the mixed-stock analysis used in SC/57/NPM6 is not biased by the existence of shared haplotypes but the precision of estimates is affected. Waples queried the conclusion that 'differences in microsatellite allele frequencies between O type and J type were not as great as expected if the breeding cycle of the two stocks is six months out of phase', since some misidentification of individuals would be expected to blur these differences. Baker responded that there might be some influence of this effect for some whales, but in the case of Korea, all whales were assumed to be from the J stock. Kim reiterated concerns about interpretations of population structure based on market samples where the locality and timing of origin was not known.

Gong expressed doubts about the suggestions of alternative North Pacific stock structure with separate stocks along the coasts of Korea and Japan in the East Sea/Sea of Japan. He believed that most minke whales around Korea are from one population and that subdivision within the East Sea was unlikely based on the distribution of prey species. Baker responded that while the distribution of different stocks suggested in SC/57/NPM5 was merely a hypothesis, the existence of multiple stocks could not be ruled out.

Park described some preliminary results of an analysis of samples from bycaught minke whales in Korean waters based on microsatellite DNA. Genetic diversities were compared regionally, annually and monthly with six microsatellite loci. Some concerns were raised in connection to the F_{ST} values presented and whether appropriate corrections to significance levels had been made to account for multiple tests. Sohn replied that this was a preliminary analysis and that they would undertake further analyses including grouping the results in different ways. It was noted that other corrections for multiple comparisons, as well as Bonferroni should be considered, because this method is known to overcompensate for these types of analyses. The WG welcomed this work and looked forward to seeing new analyses at next years' meeting.

6.4 Use of capture-recapture methods for estimating bycatches from market data

SC/57/BC5 used a series of market surveys in Korea to make inferences on the numbers of minke whales entering the market, based on a genetic capture-recapture analysis. This was an update of an analysis which the Committee had discussed in 2004. The revised analysis treated the collection of products purchased on a single day from a single outlet as a single sample. This avoided problems from the previous analysis of multiple samples of meat from the same shop that introduced a positive bias to the number of recaptures. The results yielded estimates of total supply for the five-year period 1999-2003 of 679 (SE=241) minke whales using between-survey recaptures only, and 827 (SE=164) using both within- and between-survey recaptures. The standard errors of these estimates are relatively high, but nevertheless the estimate of the number of individuals entering the market was significantly higher than the reported bycatch figure for this period.

Kim expressed concerns over the uncertainty surrounding these estimates and that they might cause speculation about illegal activities as possible explanations of the differences between the estimates in SC/57/BC5 and reported figures. Soh stated that it would have been preferable if the authors had contacted the relevant authorities in Korea before presenting the paper, in order to achieve better co-operation. The authors responded that there was no intention to challenge the accuracy of reporting by the Government of Korea and that they believed the Committee was the appropriate forum for the exchange of this information.

The Government of Japan has conducted its own market research that started in 1995 when approximately 50 samples were collected. Subsequently, market surveys of around 600 samples a year have been conducted since 1999, including species identification and some individual identification. Mae drew attention to the position of Japan on these issues and that Japan would not be prepared to submit information from DNA registers for comparison with market samples. Kim reported that the Government of Korea had also conducted market surveys since 2003, but no decision had yet been made as to what data would be made available.

Hester noted that market sampling showed some possibilities but he believed that further progress was unlikely without the co-operation of national governments and questioned what could be achieved if data from DNA registers were not available. Cooke responded that the results in SC/57/BC5 had been obtained without access to such data and that the precision of these methods would improve with increased sample sizes. Nevertheless, the power of the approach and the efficiency of market surveys would be improved considerably if data from DNA registers were available. It was also noted that access to diagnostic DNA registers would reduce the need to understand market structure, although it is still necessary to understand the different pathways that products from reported and unreported sources might follow.

The WG **agreed** that all the approaches to market sampling under discussion would be most effective if conducted with collaboration from national governments using data from DNA registers. Berggren noted that the planned second stage Workshop is intended to allow further discussion of data sharing and collaboration on methodology. He encouraged members to participate.

7. EMPIRICAL ANALYSIS OF THE FUNCTIONAL RELATIONSHIP BETWEEN BYCATCH LEVELS TO FISHING EFFORT AND TO POPULATION ABUNDANCE

SC/57/NPM7 suggested methodology for the assessment of the J stock of North Pacific minke whales. An integral component of the approach was the estimation of bycatch for years for which this information is not available. This was based on the assumption that the expectation for bycatch each year was proportional to the product of population size and an annual index of effort of fixed-gear fisheries in which bycatches occur (effectively that bycatch-per-unit-effort is proportional to population size). The Bayesian structure of the model allowed for variation of bycatch about the expected level predicted by this model to be taken into account.

Kim presented data on fishing effort of stationary gear which consists of set nets, fyke nets and pound nets along the eastern coast of Korea. These data did not include gillnets and account for around 34% of the minke whale bycatch along the east coast of Korea reported to the IWC. Gong explained that it appears that many bycatches occur during the northward migration and that most bycatches of minke whales occur in spring and summer.

There is a need for a better understanding of the nature of bycatch in order to assess the reliability of the assumptions related to bycatch rates such as those used in SC/57/NPM7. This needs to include temporal and spatial information on

the distribution of different types of gear, as well as data on the seasonal and geographical distribution of bycatch. These types of analyses require similar data to those used in CPUE GLM standardisation analyses of fisheries, and in particular, some breakdown of bycatches by individual nets, locations, or gear types. Soh indicated that the Korean authorities could consider collaboration on this work in a balanced way.

8. ESTIMATION OF CETACEAN MORTALITY FROM SHIP STRIKES

SC/57/BC1 presents two case studies of lethal collisions with large container ships involving a Bryde's whale (*B. edeni*) in Ecuador and a sei whale (*B. borealis*) off West Africa. In both cases the whales became draped across the bow of the vessel. Other information on ship strikes in the South East Pacific and the eastern tropical Atlantic were reviewed. Unless stricken whales become wrapped around the bow and are inadvertently taken into port, whale collisions with large ships often go unnoticed by crew members. Under-reporting of ship strikes in the above-mentioned regions, suggested to be severe, is compounded by the absence of obligatory reporting, deficient awareness of ship strikes and the lack of systematic necropsies of beached whale carcasses.

The WG **agreed** on the need to improve awareness of vessel strikes and reporting systems in order to gather more data. Concerns were expressed that in some countries, such as the US, there may be penalties that result in a negative incentive to report ship strikes. Matilla noted that the Hawaiian National Marine Sanctuary authorities were investigating systems for anonymous reporting of ship strikes. A recent workshop on vessel collisions had been held and the report is available[1].

The WG welcomed this information. The Committee had previously discussed whether the number of whales that become impaled could be used to estimate total ship strikes. It was noted that the detailed examination of carcasses reported in SC/57/BC1 could assist in estimating the probability that a whale struck by a vessel would became draped on the bow.

There was some discussion regarding further modelling studies comparing shipping routes and whale distribution as a way of identifying key areas. This had been proposed at previous meetings and some regional studies, such as those of North Atlantic right whales along the east coast of the USA and Canada, were known to be underway.

SC/57/WW8 presented data on collisions between whalewatching boats and whales worldwide. Thirty-two records of strikes were presented in the review; while 31 were from North America, one occurred in Norway. Collisions that either killed animals or caused serious injuries were more frequent with larger vessels, especially those travelling at speeds higher than 18 knots. Further, since whalewatching industries take place in the Northeast Atlantic and Northwest Pacific, there is the possibility that strikes could affect animals in those areas. Other whalewatching industries target highly sensitive species (e.g. North Atlantic right whales), where even a single collision could have serious conservation implications. In order to assess the associated risk to whales, information on the extent of the industries in those areas, and the size and speed of the vessels involved, would be helpful. This information could be collected in co-operation with the whalewatching sub-committee. Many of the reported collisions occurred while whalewatching vessels were in transit. Thus, these data could be used to estimate likely collision rates for other vessels of similar size that regularly transit through whale habitats.

As in previous years, the WG reviewed the information on ship strikes presented in National Progress reports. Weinrich noted that he had been involved in the examination of the carcass of one of the reported collisions from the USA. The carcass involved showed no external marks and it was only when it was flensed to the bone that the shattered skull revealed evidence of a collision with a ship. This further emphasises that flensing to the bone is often necessary in order to reveal that a stranded whale has been killed by ship strike. In Korea, a genetic sample from the propeller of a vessel involved in a collision had been analysed and found to be from a minke whale. It was noted that such analysis was a useful method for obtaining data on collisions with vessels.

It was noted that ACCOBAMS is planning a Workshop on ship strikes to be held in Monaco in November 2005. One reason for the Workshop had been the recognition of the threat to fin whales in the Mediterranean from vessel strikes. Panigada confirmed that he would be attending the Workshop and that the Workshop would also be addressing the question of how to estimate the number of whales involved in collisions with vessels. He also agreed to present the report of the Workshop to the Committee at next year's meeting. ASCOBANS is also collecting data on high-speed ferries within the region covered by the agreement. Kock agreed to contact ASCOBANS to find out the status of these investigations and report back any relevant information to the WG.

9. ESTIMATION OF CETACEAN MORTALITY FROM OTHER HUMAN ACTIVITIES

At the 2004 meeting, the WG had agreed that consideration of possible mortalities due to acoustic sources should be closely co-ordinated with the Standing Working Group on environmental concerns. Although some data on seismic surveys had been presented at this year's meeting, there were no reports of mortalities.

10. WORK PLAN

The WG discussed the priority items for consideration at the next year's meeting and beyond. The following work plan for next year's meeting was agreed.

(1) Further review of information and methods to estimate bycatch based on fisheries data and observer programmes:
   (a) continue collaboration with FAO on collation of relevant fisheries data;
   (b) progress on joining the FIRMS partnership;
   (c) report back on EU bycatch monitoring schemes;
   (d) review modelling to determine observer coverage needed in a fishery to estimate bycatch.

(2) Further consider methods to estimate bycatch based on genetic data:
   (a) review progress on intersessional work related to market sampling;
   (b) report from Steering Group for follow-up Workshop on the use of market sampling to estimate bycatch.

[1] *http://hawaiihumpbackwhale.noaa.gov/special_offerings/sp_off/Vessel_ collision_wkshp.html.*

(3) Further review of information and methods to estimate mortality from ship strikes:
   (a) review results of data collected on vessels relevant to ship strikes;
   (b) review report from planned ACCOBAMS Workshop on ship strikes.

(4) Consider methods for estimating additional human induced mortalities e.g. from acoustic sources and marine debris.

11. ADOPTION OF REPORT

The WG adopted the report at 16:53 on 6 June 2005.

REFERENCE

International Whaling Commission. 2005. Report of the Scientific Committee. *J. Cetacean Res. Manage. (Suppl.)* 7:1-62.

Appendix 1

TERMS OF REFERENCE OF THE WORKING GROUP ON ESTIMATION OF BYCATCH AND OTHER HUMAN-INDUCED MORTALITY

At its 52nd meeting, under agenda item 12.1.2, the Commission instructed the SC that catch limits calculated under the RMP shall be adjusted downwards to account for human-induced mortalities caused by aboriginal subsistence whaling, scientific whaling, whaling outside IWC, bycatches and ship strikes. The Commission stated that each such adjustment shall be based on an estimate provided by the SC of the size of adjustment required to ensure that total removals over time from each population and area do not exceed the limits set by the RMP. Total removals include commercial catches and the human-induced mortalities listed above to the extent that these are known or can be reasonably estimated.

Terms of reference of the Working Group appointed to this task are:

(1) examine methods that have been used to estimate bycatch, and describe acceptable estimators and measures of their precision;
(2) consider requirements for sampling to obtain unbiased estimates of specified precision;
(3) consider confidence or probability intervals for such estimates that provide reasonable assurance that the Commission's objective regarding total removals over time is met;
(4) examine methods for estimating mortalities caused by ship strikes similarly;
(5) consider methods for summarising known and estimating unknown mortalities from the types of mortalities listed;
(6) consider establishing and maintaining a database containing the requested information;
(7) consider how best to communicate this information to the Commission.

Appendix 2

AGENDA

1. Conveners opening remarks and terms of reference.
2. Election of Chair and appointment of rapporteurs.
3. Adoption of agenda.
4. Review of documents.
5. Estimation of bycatch based on fisheries data and observer programmes.
   5.1 Collaboration with the Food and Agriculture Organisation (FAO) on fishing fleet data.
   5.2 Review progress on standardised reporting in Progress Reports.
   5.3 Observer coverage required to reliably estimate bycatch.
   5.4 Other
6. Estimation of bycatch based on genetic data.
   6.1 Report of Workshop on the use of market sampling to estimate bycatch.
   6.2 Data from market surveys.
   6.3 Analytical tests for assignment to stocks and/or Areas.
   6.4 Use of capture-recapture methods for estimating bycatches from market data.
7. Empirical analysis of the functional relationship between bycatch levels to fishing effort and to population abundance.
8. Estimation of cetacean mortality from ship strikes.
9. Estimation of cetacean mortality from other human activities.
10. Work plan.
11. Adoption of report.

Appendix 3

PROPOSAL TO HOLD A SECOND-STAGE WORKSHOP ON THE USE OF MARKET SAMPLING TO ESTIMATE BYCATCH

P. Berggren, G. Donovan, P. Hammond and J. Zeh

Background

The Commission has decided that catch limits calculated under the RMP shall be adjusted downwards to account for human-induced mortalities including bycatches and ship strikes. It has also stated that such adjustments shall be based on an estimate provided by the Scientific Committee (SC) of the size of adjustment required to ensure that total removals over time from each population and area do not exceed the limits set by the RMP. At last year's meeting, the SC strongly recommended that a methodological Workshop (on the use of market sampling to estimate bycatch) should take place as described in the proposal (IWC, 2005, p.13). A Steering Group (Berggren, Donovan, Hammond and Zeh) was appointed by the SC, who contacted potential invitees through the Secretary of the Commission to participate in a planning meeting that was to take place during Autumn 2004. However, it was not possible to find dates when most of the invited participants to the planning meeting were available. The Steering Group therefore decided that the planning meeting and Workshop would be replaced by a two-stage Workshop of which an initial Workshop would be held during two days before the 2005 SC meeting, followed by a second Workshop at a later date as decided by the outcome of the initial Workshop. The initial Workshop was held 27-28 May 2005 in Ulsan, Republic of Korea (SC/57/Rep4).

Workshop objectives

The objectives of the two-stage Workshop are:

(1) to review available methods that have been used to provide estimates of large cetacean bycatches via market samples, including a consideration of their associated confidence intervals in the context of the RMP;
(2) to identify information about the markets that would be required for a market sampling approach; and therefore
(3) to provide advice as to whether market-sampling-based methods can be used to reliably estimate bycatch for use in addressing the Commission's objectives regarding total removals over time and, if so, the requirements for such methods.

The initial Workshop had only considered the first two of objectives (1)-(3). Although the view of some members was that market surveys would not provide reliable estimates of bycatch, the WG agreed that the planned follow-up Workshop would be very valuable in order to evaluate this fully. The WG also agreed that such a Workshop would be more successful if progress had been made on addressing the data requirement needs, and on developing simulation frameworks for sensitivity analyses and to test sampling designs prior to the Workshop. Before holding the follow-up Workshop the following tasks should first be completed:

(1) improve information on pathways for markets through short contracts to market experts to conduct appropriate studies to address the data needs outlined in section 8 of SC/57/Rep4;
(2) improve classification and estimates of number of wholesalers and outlets according to the data needs outlined in section 8 of SC/57/Rep4;
(3) collate available temporal and spatial information on bycaught whales destined for markets;
(4) conduct further concordance analysis between labelling and genetic identification of whale products;
(5) simulation trials:
    (a) conduct initial simulations to investigate the performance of different sampling designs and sensitivity to assumptions about market structure based on current knowledge;
    (b) based on results of initial simulations and improved data from Items 1-4 above, specify the development of a simulation framework to be contracted to appropriate specialists.

The simulation framework would need to be adaptable to incorporate new data as it became available. In addition, the simulation framework would be intended to allow an iterative process to both identifying critical information needs and testing sampling designs. The simulation framework would be reviewed further at the follow-up Workshop and any suggested changes would be included.

Once these tasks have been addressed, the objective of the proposed workshop would be to address the 3rd objective of the two-stage Workshop.

Steering group and timing of follow-up Workshop

A Steering Group (Berggren, Donovan, Hammond, Zeh) has been established which will determine when and if a second-stage Workshop will be held depending on the progress of the intersessional work that needs to be concluded. It is not anticipated that the follow-up Workshop will be held before next year's SC meeting.

Draft budget

The funding has already been allocated for the follow-up Workshop.

Draft Agenda for the proposed Workshop

An Agenda will be developed when the intersessional work has been concluded.

REFERENCE

International Whaling Commission. 2005. Report of the Scientific Committee. *J. Cetacean Res. Manage. (Suppl.)* 7:1-62.