

Annex M

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

Members: Berggren (Chair), Baba, Baker, Baldwin, Bando, Bjørge, Brownell, Carlson, Childerhouse, Cipriano, Clapham, Clark, E., Collins, Cooke, Dalebout, Deimer, Diake, Dizon, Donahue, Donovan, Etylina, Funahashi, Gales, Garrigue, Goodman, Goto, Guissamulo, Hammond, Hatanaka, Haug, Hester, Iniguez, Ishikawa, Kanda, Kasuya, Kawahara, Kell, Kim, Kock, Leaper, Lens, Manzanilla Naim, Martien, Mattila, Miyashita, Morishita, Murase, Nagahata, Nagatomo, Nishiwaki, Northridge, Ohsumi, Okamura, Oosthuizen, Park, Parsons, Pastene, Peddemors, Perrin, Pike, Rambally, Read, Reeves, Reijnders, Rennie, Ridoux, Robbins, Rogan, Rojas-Bracho, Rose, Rosenbaum, Rowles, Sadler, Sakamoto, Snatamaria, Senn, Shimada, Simmonds, Sohn, Stachowitsch, Sutaria, Swartz, Tamura, Tanaka, Taylor, Thiele, Tomita, Trezenza, Urban-Ramirez, Van Waerebeek, Wade, Wakako, Walloe, Weinrich, Williams, Wilson, Yamamura, Yasunaga, Yoshida, Zeh, Zelensky, Zenitani, Zerbini.

1. CONVENERS OPENING REMARKS AND TERMS OF REFERENCE

Berggren welcomed the members of the sub-committee and referred to 52nd meeting of the Commission when the Scientific Committee (SC) was instructed 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. 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. In order to address this task the Terms of Reference given in Appendix 1 were developed for the sub-committee by the SC convener group. Berggren also reminded the sub-committee that 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 RAPORTEURS

Berggren was elected chair. Leaper and Northridge agreed to act as rapporteurs.

3. ADOPTION OF AGENDA

The adopted Agenda is given in Appendix 2.

4. REVIEW OF DOCUMENTS

The following documents were relevant to this sub-committee: SC/54/BC1-6, SC/54/For Info 11, SC/54/RMP 8, 20, SC/54/SD2 and SC/54/SM12.

5. BYCATCH ESTIMATION METHODS

5.1 Report of the working group on the collation of information from fisheries

Last year the sub-committee reviewed a list of categories of information that might appear on a form that could be distributed to identify certain fisheries where bycatch is thought to take place, in order to assist in the future design of appropriate sampling schemes. Northridge chaired an inter-sessional group in order to design a suitable form to achieve this task. Northridge reported that during the inter-sessional period it became apparent that this exercise might either generate a vast amount of information, or very little, depending on how the first field of the query (fishery category) was interpreted. Moreover, it was recognised that an initial request for such a large amount of information, much of it difficult to collate, might be poorly received and result in a poor return of data. Each country is likely to categorise fisheries in an individual manner, based on some combination of target species, gear type and geographical area. Given this, the inter-sessional group thought the best way to approach the collection of data would be to ask each IWC member state to provide a list of fisheries and details of how fisheries are categorised. This would provide a first step that might assist in developing a sampling strategy for monitoring bycatch. The sub-committee **recommended** that the Secretary of the Commission write a letter to the relevant authorities in each member country requesting a list of fisheries, broken down by gear type, target species and geographical area, to the extent to which this is routinely done in each country. It was noted that in order to encourage co-operation, the objectives of collecting this information needed to be clearly specified. A small group (Kim, Morishita, Northridge, Perrin, Read and Rogan) agreed to develop suitable text to form the basis of a letter that might be sent out to member states (Appendix 3). Data would also be welcomed from non-member states that may be willing to volunteer information even if a formal request from the IWC is not appropriate.

This information gathering exercise could be used to identify fisheries for which there is little or no information on whale bycatch but which share common characteristics with fisheries where bycatch has been monitored. The sub-committee **agreed** that it was important to consider such fisheries as well as fisheries where bycatch is known to occur. Consideration of these data might suggest the relative priority of monitoring programmes to assess incidental takes for different fisheries.

Data on bycatch by category of fishery are also needed. It was noted that information on the type of fishery involved in cetacean bycatch was not sufficiently detailed in the National Progress Reports. The sub-committee **recommended** that data in Progress Reports should be amplified to include detail on the type of fishery involved in large whale bycatch. The level of detail should ideally include not only gear type, but the way in which this gear is being used and the target species. For example, the same gear might be used for either bottom or mid-water trawling, but the risk of bycatch might be different between the methods of operation. As a minimum the gear description should correspond to an item listed in the response to the request for information on fishery categories.

Kim questioned the need to consider estimation of bycatch given that he believed the mandatory bycatch reporting system in the Republic of Korea resulted in all bycatch being reported. He suggested that if there was reason to believe that bycatch was occurring in a particular fishery within a country then the Commission could ask that member government to establish a bycatch reporting system rather than ask for fisheries information. Other members noted examples of where independent observer schemes had been established for fisheries that already had reporting schemes. In several cases these revealed much greater levels of bycatch than had previously been reported.

The sub-committee **recommended** that modelling studies should be encouraged to try and estimate how much observer coverage of a particular fishery would be required to allow reliable estimates of large whale bycatch. These studies might assist in assessing how best to utilise data as it becomes available from the information gathering process discussed above. B. Taylor noted that modelling had been undertaken for gill-net fisheries in California and the sub-committee **agreed** to encourage papers on these types of statistical studies.

5.2 Independent observer programmes

The sub-committee briefly considered SC/54/SM12 but no further information was available as to methodology within this or other papers this year.

5.3 Mandatory or voluntary reporting schemes

Records of large whale bycatch were extracted from National Progress reports for the statistical year 2001. Several large whale species had been recorded as bycatch in fisheries during 2001 and in previous years, but not all such incidents had been fatal (see Table 1). Minke whales are by far the most often recorded bycatch species, with over 230 recorded in 2001.

Rose noted that records of minke whale bycatches were very clumped, notably in Japan and in eastern Korea, and wondered whether this could be due to better reporting in these areas, with under-reporting elsewhere, or whether there might be some aspect of fisheries in these two regions which made bycatch more likely than elsewhere.

Sohn replied that the relatively higher bycatch in Korean waters is related to cetacean distribution and to the distribution of fishing gear. The results of Korean whale sightings surveys, as presented in SC/53/RMP21 and SC/53/RMP23, demonstrate that cetaceans including minke whales are distributed along the coast of the East Sea. In the East Sea the migration corridor of minke whales is along the narrow continental shelf where coastal fishing gears are set. In the West Sea the distribution of minke whales is further offshore compared to where most fishing gear set. There is little overlap between the two, and this results in lower bycatch rates. Minke whales are rare in the South Sea as demonstrated by previous whaling records.

The Japanese progress report for 2001 records that all minke whale bycatches were in trap nets. Similar nets in Newfoundland are also known to entrap large whales, and Lien et al 1994 reported 124 minke whales entrapped there over a 12-year period between 1979 and 1990.

Hester asked whether such nets might also be employed in North Korea or China. The sub-committee had no information regarding fishing gear types used in these countries, though it **noted** that the proposed request to the Commission to send a letter asking for details of fishery categories to member states and other states might help elucidate this point.

The issue of reporting efficiency, and how current reporting schemes are implemented, were discussed in detail, as such matters are crucial to providing advice to the Commission on how best to estimate total large whale mortalities in fishing gear.

Sohn pointed out that in Korea all large whales whether bycaught, stranded or floating at sea, have been subject to a national reporting scheme since 1996. All such animals have to be reported to the marine police agency located in every port. The marine police assess the cause of death and make a thorough report. The Prosecutor then judges whether the law has been breached based on the report. Domestic disposition of bycatch is only allowed through this system, which now works routinely.

Biological sampling in Korea has proven difficult because it requires appropriate expertise. Kim stated that starting this year a biological sampling programme is being implemented by hiring experts to sample whale carcasses in collaboration with the regional authorities and the marine police. Furthermore, guidelines on bycatch reporting will soon be incorporated into the fisheries law. Sohn asserted that the existing mandatory reporting scheme in Korea made any further attempts to estimate bycatch unnecessary there. He further pointed out that whale bycatch is highly sporadic in a range of coastal fisheries and occurs mainly within 3 miles of the coast. Fisheries operating in this area are small scale and there are few relevant data that could help in any bycatch estimation methods.

Nagatomo reported that all bycatches of large cetaceans also had to be reported in Japan. It was noted that recent changes in domestic legislation (since July 1st 2001) now make it possible for Japanese fishermen to market bycaught whales, provided each was recorded and a DNA sample taken. More information on this can be found in last year's report of the sub-committee (*J. Cetacean Res. Manage.* 4 (Supp.): 363). Prior to July 1st, Mitsutomi reported, it had not been compulsory to report bycaught whales, but Ministry guidance encouraged the reporting of any such events.

The sub-committee noted that the number of minke whales recorded as bycatch in Japan in 2001 (79) was considerably higher than in 2000 (29). In response to a question whether there was any known reason for this increase, and whether there was a breakdown of the number of records by month for 2001, Goto replied that it was known that there had been 54 minke whales reported over the six months since the new legislation was introduced and 25 in the preceding six months. There was some discussion as to why there had been an apparent increase since the introduction of the new legislation, but Nagatomo stated that it was not clear if this was a significant increment, and that several more years of data would be needed to determine this.

Rose noted that bycatch reports in Japan and Korea might be more complete than in other countries because there was no disincentive for reporting. However, in the USA and some other countries there were possible longer-term penalties for reporting bycaught whales which might impede accurate reporting. Mattila confirmed that in the USA records of bycaught whale numbers seemed to be declining in some fisheries, possibly because fishermen were becoming aware of the potential threat to their livelihood posed by the accidental capture of whales.

There was some discussion as to whether incentives for reporting bycatch might actually lead to increases in whale mortalities. The sub-committee recalled that at last year's meeting it had been stated that the new fisheries Ministerial Ordinance and related guidelines would allow fishermen to kill animals that could not be released from nets in order to market them. Nagatomo stated that even though fishermen are now able to market whale meat from bycatches, they must still make best efforts to release whales from nets when caught, and only if they cannot be released can they be killed. It was not known how many bycaught minke whales had died as a direct result of entanglement and how many had needed to be killed to remove them from the nets and the operating body can decide how to deal with an entangled whale.

Some further points were also made about whale entanglement procedures in both Japan and Korea. Mitsutomi reported that Japanese fishermen were able to apply for compensation for nets damaged by bycaught whales. Sohn reported that Korean plans to introduce a scheme to collect dna samples from all bycaught whales had been delayed due to difficulties in implementing the legislation, but that it was hoped that the scheme could run from next year.

The sub-committee **concluded** that there was no clear explanation as to why recorded bycatches of minke whales are so much more frequent in some areas than others. It was clear that the total number of animals as recorded in all National Progress Reports and Table 1 was unlikely to represent an accurate estimate of the total number of such mortalities. To take this matter further the sub-committee **recommended** that member states be encouraged to report more details about the type of fishing gear involved in large whale bycatch in National Progress Reports, and further **recommended** that the Commission should consider the proposal put forward by the sub-committee to ask member states and others to supply some preliminary information on how they classify fisheries nationally (Appendix 3).

5.4 Strandings and Questionnaire surveys

The use of strandings data to assess bycatch were discussed last year. The various factors that might determine whether stranded carcasses of incidentally caught whales are recovered and attributed to incidental takes were discussed. It was also suggested that pathology based methods used to identify whether sirenians had been incidentally caught might also be relevant to cetaceans. It was reiterated that strandings data can indicate where bycatch is occurring but should not be relied upon to estimate the magnitude of the incidental take.

Simmonds noted some stranding events involving large numbers of small cetaceans that occurred in Europe in 2001 that had been attributed to incidental takes from pair trawl fisheries. He asked whether these events had involved any large whales. Ridoux commented that 350 animals had stranded on the coast of France over a period of 10 days. The species included common dolphin, striped dolphin, harbour porpoise, and pilot whale. Of these, 95% of the individuals were common dolphins and there were no large whales. Simmonds noted that there is some evidence of large whales stranding under similar circumstances in the UK.

5.5 Genetic analyses

5.5.1 Bycatch workshop feasibility working group

Berggren reported on the inter-sessional activities of this group. The use of market survey data to improve on minimum estimates of bycatch and provide more realistic unbiased estimates of whale bycatch will require information not only on reported bycatch rates but also on market structure and produce pathways, as well as design input for the collection, storage and analysis of genetic samples in an appropriate manner. To investigate the feasibility of holding a workshop to address these issues, the inter-sessional group concluded that it would be helpful to: (1) outline the types of information needed in order to design an effective sampling scheme, (2) begin locating potential sources of such information, (3) develop contacts with access to the needed information or who could assist in developing methods to obtain such information, (4) locate experts in the design of market surveys and (5) locate experts who could actually conduct the surveys. It was recognized that, of necessity, such a process would have to be iterative and that a full list of information needed for design of such a system would require the assistance of experts as noted in points (4) and (5) above. Some members of the Steering Group also met in Vancouver, Canada, in November 2001 during the Biennial Conference on the Biology of Marine Mammals where an initial list of needed information was drawn up which included, for example, that it would be important to find sources of information detailing how the products from bycaught whales are distributed from the bycatch location to the market where the product eventually is sold. It was also agreed that a paper would be prepared for SC54 which summarizes the information available from earlier DNA identification market surveys on sample and market distribution in Japan (SC/54/BC3). Further, during the inter-sessional period an initial search to identify experts on food/market surveillance systems and the statistical design and analysis of markets was also conducted. This resulted in a list of companies with such expertise and who can give advice on best practice (statistical design) to sample the markets in Japan. Further searching for information sources and experts in the pertinent areas resulted in an expanded list plus an initial bibliography (SC/54/BC5).

Given the information obtained intersessionally the Steering Group concluded that it would be feasible to hold such a workshop. However, more information should be gathered and the experts from the companies with market sampling expertise contacted and with this additional information it would be possible to develop a draft proposal for the workshop at the next meeting of the Scientific Committee.

Cipriano presented SC/54/BC5 in which he had identified numerous commercial companies capable of undertaking some of the task required to design an appropriate market sampling strategy. One or more of such companies could now be contacted for information that could be used to prepare a proposal for the workshop.

Cipriano also noted that information relevant to the development of a food surveillance system in Japan was published in the day's Japan Times, which mentioned that the Codex Alimentarius Commission had met in Yokohama in March 2002, and that the Japanese Ministry of Agriculture, Forestry and Fisheries had expressed its intent to introduce a traceability system for food products beginning in 2003 (Uranaga, T., Japan Times, 2 May 2002).

The sub-committee agreed that the working group should continue its work in this area and report back next year. Morishita re-iterated his concern that the workshop would be unlikely to achieve anything useful, and stated that Japan does not endorse the workshop.

5.5.2 Data from market samples

Baker presented SC/54/BC1, an update of previous work, which lists the species of cetaceans determined from DNA analysis from market samples in both Japan and Korea. There were several species found that were considered unlikely to have been derived either from scientific whaling or from bycatch. Baker noted an error in the alignment of Bryde's whale sequences used in SC/54/BC1. After correction of this error the four Bryde's whale samples were found to be consistent with the assumption that these products originated from the North Pacific (see SC/54/SD1).

Dalebout presented SC/54/For Info11, in which microsatellite DNA profiling of North Pacific (NP) minke whale products from the Japanese and Korean market is used to determine the minimum number of whales available for sale and to track the movements of products from individual whales through these markets. This paper is in press in the May 2002 issue of Animal Conservation. Dalebout also discussed SC/54/RMP8, which is an update of SC/54/For Info11, limiting her discussion to results from the Korean market, while SC/54/BC3 focuses on results from the Japanese market (see below).

The same methods were used in all three papers (SC/54/BC3, SC/54/For Info11, SC/54/RMP8), and are very similar to those used in tagging and recapture studies to investigate populations of living animals. Six microsatellites were used to profile market products identified as derived from NP minke whales through phylogenetic analyses of mitochondrial DNA control region sequences. These loci are a subset of those specified in the Norwegian DNA registry and those used by Japanese researchers. These six microsatellite loci, in combination, gave a reasonably low probability of a match (identity) between products by chance for the Japanese market. The probability of a match by chance was higher for the Korean market due to the lower genetic diversity of the J stock (East Sea/Sea of Japan) NP minke whales.

For Korea (SC/54/RMP8), eight market surveys were conducted between March 1999 and November 2001. Whalemeat products were purchased in southeastern coastal cities (Pusan, Ulsan and Pohang) in short periods of a few days in each survey. Surveys yielded a total of 122 NP minke whale products, which, based on comparisons of microsatellite profiles, represented at least 97 unique individuals. Over 90% of these animals were J-stock based on diagnostic nucleotide substitutions at the mtDNA control region (e.g., Baker *et al.* 2000). Products from the same individual whales were generally only found within the same survey. In a small number of cases, replicate products were found in consecutive surveys (two to seven months apart), and in very few cases, replicate products from the same individual were found in surveys greater than seven months apart. These results suggest that products from individual whales are not stored long-term in Korea, and in general pass through the market in a period of less than seven months. Given the conservative nature of these censuses, it appears that the total yearly Korean bycatch of minke whales remains high. This conclusion is supported by this year's Korean Progress Report in which 148 NP minke whales are reported as bycatch, 132 of which were taken off the East Sea/Sea of Japan coast.

Funahashi presented SC/54/BC3 in which 167 minke whale samples, purchased in Japanese markets between December 1997 and January 2002, were found to represent 142 individuals. J-stock products, presumed to come from bycatch in the Sea of Japan, contributed 41% of these, while the remainder were O stock animals assumed to have come from scientific whaling in the North Pacific. There was no significant difference in the proportion of products from the two stocks among different prefectures.

Pastene noted the interpretation of market samples is very difficult. Last year he had prepared a document summarising several molecular surveys conducted in the Japanese retail market (SC/53/RMP13). He had identified several factors affecting the estimation of the mixing proportion between O and J stocks in the market:

- (a) randomness of the survey
- (b) geographical variation in the distribution of J/O stock products across Japanese prefectures
- (c) duplicate sampling
- (d) period in which products from an individual remain in the market.

On point (d) it was recognized that processed products will stay in the market for a longer period than fresh meat.

In addition he noted that samples obtained in surveys should be weighted according to the availability of the whale products across the different prefectures.

Baker thanked Pastene for his suggestions, but noted that in SC/54/BC1 and SC/54/BC3 they had conducted analyses to evaluate biases. For example, after eliminating replicate products from the sample of Japanese markets there were no significant differences in the ratio of J:O stock animals by prefecture. He suggested that a larger sample size would still be helpful, but concluded that bycaught whale meat appears to be treated by the market in the same way as JARPN products.

Questioned about the sampling strategy, Funahashi stated that prefectures tended to be visited at least once a year, that it was usually the same retail outlets that were visited, as there are a limited number of these, and that sampling would be expanded to further retail outlets and to other prefectures in future surveys.

The sub committee **agreed** that sample design was something that required attention, and that the purpose of the proposed workshop would be to do develop appropriate sampling strategies for the Japanese whale meat market.

There was general agreement that there were currently too few reference samples to assign sei whale samples uncovered in SC/54/BC1 to individual populations or geographical areas. Baker agreed, but expressed concern as to where any such samples might have come from, with no current legal whaling of sei whales.

Questioned about the individuality of sei and Bryde's whale products uncovered in the sampling, Baker responded that these had mostly been unique individuals. This does not support the suggestion that these samples could have been in the supply chain for a longer period of time than the minke whale products, as might be expected for stockpiles.

Morishita noted that meat from pre-moratorium whaling is still held in cold stores, as shown in BC5, so that meat from such animals is still being marketed, though there are decreasing amounts of it available. It was noted that the data in SC/54/BC5 on whale meat stockpiles had been updated in 2001.

Baker asked whether there had been any recent attempts to verify the origin of sei and other larger whale products in the stockpile. Morishita responded that verification has been conducted but the report on this was not yet available.

There was some discussion about the apparent increase in bycatch of minke whales including J stock animals. Trends in the population size of J-stock minke whales are unknown but combined Japanese-Korean joint surveys (e.g. SC/54/RMP20) stock surveys had shown very few J-stock animals, although population sizes had not been estimated. Ohsumi pointed out that the survey timing may not have co-incided fully with J-stock residence within the survey area, and that a proper J-stock survey was required.

Baker suggested that if samples from reported bycaught minke whales could be compared with samples found in the market, it would be possible to determine what proportion comes from undocumented sources. The sub-committee **agreed** that this was a promising approach to improve estimation of total bycatch over time.

5.5.3 Analytical tests for assigning stocks

Baker introduced this topic by informing the sub-committee that assignment procedures are becoming more widely used now, so that the geographical provenance of individual samples could be determined. Dizon cautioned that this is only possible where there has been sufficient directed sampling to ensure a baseline of comparative genetic samples. Referring to work ongoing to identify stock origin of beluga whale samples, Dizon noted that in this specific case there had been a lot of directed sampling, and the stocks of interest showed significant genetic differences, but that these two circumstances were unusual for most cetaceans. The sub-committee **concluded** that there were insufficient reference samples to take this very much further at present.

5.5.4 Other methodological advances

Baker drew attention to SC/54/SD2, in which a web-based programme for phylogenetic species identification is described. This software arose after a forensic identification workshop (La Jolla, California 1999) at which the need for a database of DNA sequences had been highlighted (Dizon *et al.* 2000). The web-based software (<http://www.dna-surveillance.auckland.ac.nz>) provides sequence matches, but keeps the reference sequences hidden unless permission is granted by the owner. The sequences are held in a hierarchical structure and the software will provide a closest match. One of the advantages of this approach is that it overcomes the need to export and import samples for comparison, thereby avoiding lengthy permit application procedures (see report of DNA sub-committee).

5.6 Other

Read presented SC/54/BC6, a bycatch reduction strategy emanating from a workshop held in Annapolis in January 2002. The strategy includes a suggestion that formal national Plans of Assessment to estimate bycatch rates should be developed. Such Plans would include collection and analysis of data to describe fishing fleets, including the size of the fleet (number of vessels), fishing methods, fishing areas and measures of fishing effort. They should also include where appropriate bycatch monitoring schemes based on independent observations when possible. Mattila noted that the workshop had, however, also recognized the utility of rapid appraisals based on other methods to gauge the nature and overall likely extent of bycatch problems. The strategy is currently in draft form for review but was intended to be presented at FAO's next Committee on Fisheries (CoFi) meeting.

Palazzo stressed that international collaboration and exchange of information would be vital to enable developing countries to develop such plans.

Discussion focused to some degree on the entanglement and freeing of large whales from fishing gear, especially in the Northwestern Atlantic. In this context, and with due regard to the sub-committee's terms of reference to examine methods to estimate large whale mortalities due to bycatch, Leaper suggested that for large whales that were seen at sea entangled in fishing gear, the experience of researchers in the Northwestern Atlantic working with several species of large whale might be useful in providing a photographic or diagrammatic catalogue of the types of damage likely to prove ultimately fatal and the types that might be reasonably assumed to be non-fatal. Mattila responded that there were some types of damage that were clearly potentially fatal, including those where young animals were entangled and could be expected to 'grow into' ropes that could ultimately result in their death.

Clapham presented SC/54/BC2, the results of an inter-sessional group's deliberations on the release of large whales from entanglement. The sub-committee heard that where large whales are concerned any type of rope or net in the water column represented a potential danger. On the US East Coast the primary dangers are from lobster pot lines and gillnets, and entanglement can involve virtually any part of the gear and several parts of the animal including the head, mouth, pectoral fins, caudal peduncle and flukes. A high proportion of large whales on the US east coast have evidence of previous entanglement events through scarring and the sub-committee was reminded of last year's discussion on this topic (SC/53/NAH25).

Minke whales, as the smallest of the baleen whales are the most likely to die as a result of entanglement in the short term, whereas larger whales may swim away with gear attached and succumb at a later date if feeding is impaired or if the entanglement leads to serious infection.

Berggren asked whether there was any indication of the proportions of animals that become entangled that ultimately are known to have died as a result, and any relationship with fishing effort or gear density. Clapham suggested that colleagues in Newfoundland might have such information given the length of time (more than 30 years) that they have been involved in such research, and it was **suggested** that the sub-committee should contact this group (at Memorial University) to see if a working paper could be prepared for next year's SC meeting.

6. ESTIMATION OF MORTALITY FROM SHIP STRIKES

6.1 Mandatory or voluntary reports

Rose presented a summary of ship strikes (includes hull strikes and propeller strikes) from National Progress Reports in 2001 (Table 2). There were ten such records, but for many countries there were no records at all.

Parsons reported that the Royal Navy had agreed in principle to collate any records of naval ship strikes annually and report them to the UK's responsible ministry and copy this to the IWC.

M. Simmonds commented that ship-strikes in Europe were being under-reported. He agreed that asking agency like the Navy, which might be able to provide effort related data, for information would be a good idea.

Rowles noted that US Navy protocol includes routine recording and reporting of whale collisions.

Mattila noted that since the US had introduced necropsy protocols that included 'flensing to the bone' an increased number of severe traumas and suspected ship strikes had been uncovered among stranded whales. Furthermore as this work progresses it may be possible to ascertain whether

the ratio of known ship strike casualties to cryptic ship strike casualties among stranded animals is consistent enough to use this as an estimator of cryptic ship strike mortalities among stranded animals elsewhere.

The sub-committee **agreed** that the existing records of ship strikes, as reported in National Progress Reports, were likely to be a gross underestimate of the total number of actual ship strike mortalities among large whales globally.

6.2 Observational data

Peddemors presented data on shipping levels in South African waters in relation to ship strikes of right whales. He found no evidence of any centrally-held information on shipping densities around the world. However, the South African Defence Intelligence Agency held information on ships within South African territorial waters and had provided a summary. This showed very high levels of shipping activity in South African waters including those adjacent to KwaZulu Natal and the southern Cape in the austral winter when right whales are most numerous locally, with 1574 ships recorded passing through territorial waters around the southern Cape during the months of peak right whale abundance July to November.

However, despite high levels of shipping only four known and seven suspected ship-strike mortalities of right whales in 30 years although full necropsies had not been undertaken (Best *et al.* 2001). Oosthuizen suggested that right whales were mainly confined to coastal waters and that the main shipping lanes are further offshore, thereby reducing the likelihood of ship strikes. The sub-committee agreed that in South African waters the most likely area of ship strikes would be off the eastern Cape and coast of Natal, where migrating humpbacks would cross shipping lanes.

There was some discussion of what factors might lead to ship struck animals being unrecorded:

- Offshore winds and currents would likely limit beaching of many casualties
- Sharks in some areas could be responsible for preventing ship-struck whale carcasses from reaching shore
- Large ships would be most unlikely to notice hitting a whale
- Even if a struck whale was noticed it would be unlikely to be recorded by many mercantile naval officers, unless noticeable damage had been caused, as striking an obstacle is the fault of the officer on watch and he would be held responsible.

Van Waerebeek reported a ship-struck humpback whale in Togo last year (2001).

Tregenza introduced SC/54/BC4 in which he explained a simple modelling approach to ship strikes. The model attempts to predict a maximum likely strike rate for a given density of ships and whales, assuming a random orientation of the whales and no behavioural response to an approaching ship. Applying the model to the Canary Islands, where ship strikes, mainly on sperm whales, have been recorded for several years, the model predicted at most seven large whale strikes per year in the Tenerife – Gran Canaria Channel. There have been seven large whales recorded as struck and killed by fast (30nm/h and above) ferries in this location during the last three years of observation, but this may be a minimum estimate as not all would have been noticed or recorded as stranded animals. Tregenza noted that behavioural responses of a whale would greatly influence the predicted strike rate. Ship avoidance would likely be prompted by acoustic cues but sound propagation from an approaching ferry will depend on water depth and stratification. If avoidance responses to such cues are learned over time, then calves and recent immigrants to an area (such as this migration zone) would be most at risk of collision.

The sub-committee recognized the value of this approach for setting an upper bound on likely strike rates, and also noted that the work of Aguilar and colleagues in the Canary Islands probably represented the best such dataset in the world, and encouraged them to continue to collect this type of data to improve our understanding of ship strikes, and to provide a basis for quantifying actual collision rates. The sub-committee also encouraged similar work in other parts of the world to be undertaken. The sub-committee briefly considered what other areas and what other data might be most usefully collected. Although it is clear that the Commission's interest in ship strikes is in relation to how the numbers of animals killed might impact on any future implementation of the RMP – most likely in the Northwestern Pacific or the North Atlantic – the sub-committee recognized that by examining other areas of the world and even protected species such as northern right whales, useful insights into the rates at which animals are struck might be gained.

The sub-committee heard that some years ago a fast-ferry line had been introduced between one of the Islands in the Sea of Japan and a western Japanese port. Jet-foil ships had suffered collisions with whales. The ship owners had tried to avoid collisions by introducing some acoustic warning systems. It was not clear whether this method had worked, but they had also increased the number of people watching out for whales on the trackline and the numbers of collisions had decreased. The report of this work was published in Japanese. The sub-group welcomed this information and asked whether this information might be made available to the SC, where a paper to the Standing Working Group on Environmental Concerns would be very useful next year. It was also suggested that the recorded numbers of animals struck would be usefully included in National Progress Reports.

Weinrich suggested that another useful approach might be to compile a catalogue of fast ferry routes elsewhere, and that fast whale-watching vessels should also be included in future studies as they occurred, by definition, in areas of high whale density.

The sub-committee recommended that data be collected intersessionally on the amount of high speed ferry and other similar fast-moving vessel traffic. Weinrich agreed to chair a group to collate this information. Emphasis will be placed on two areas, the Northeast Atlantic and western North Pacific. Additional information will be gathered in the western North Atlantic, South America (with a special emphasis on Venezuela where there are reports of collisions with high-speed vessels) and Southeast Asia. It was noted that data relevant to estimating mortality due to ship strikes are so sparse that data from all areas would contribute to understanding the various factors involved. In addition, a list of areas where high-speed vessels are used for whalewatching should be developed, along with a catalogue of known collisions between vessels and whales where data on the type of vessel involved in the collision are available.

6.3 Other

The sub-committee recalled two suggestions from last year's meeting that biopsy samplers might be fitted to vessels in high-risk areas, and secondly that a decelerometer might be developed that could detect whale strikes on large vessels, including fast ferries. Tregenza reported that

he had formulated the technical specifications for a decelerometer and that he was in consultation with engineers about its construction. He would report back to the sub-committee next year.

The sub-committee re-iterated its request last year that necropsies on stranded animals should examine animals as thoroughly as possible for evidence of ship strikes. Cipriano suggested that some technical innovations, perhaps through the use of ultra-sound might be sought to look for evidence of ship strikes on stranded animals without having to remove all the muscle of a large whale during autopsy.

The sub-committee concluded its deliberations on ship strikes by **recommending** once again that Commissioners should be encouraged to ensure more complete records of ship strikes in the National Progress Reports.

7. METHODS FOR ESTIMATING ADDITIONAL HUMAN-INDUCED MORTALITIES

As last year, the sub-committee briefly discussed other sources of human induced mortality including entanglement in marine debris, mortality resulting from acoustic trauma, mass die-offs due to disease that might be induced through the immuno-suppressive action of pollutants, or kills due to oil spills. The sub-committee recognised that those matters were outside the terms of reference as currently drafted but agreed that to the extent that these additional human-induced mortalities could reasonably be estimated, they should be flagged for future consideration.

8. OTHER

Last year the sub-committee recommended that a request be made for further information about a planned cetacean strandings scheme in China. No information was available at this meeting but the Secretary of the Commission will contact Chinese authorities to ask if some written document on the proposed scheme, together with methods of necropsy that would be used, might be submitted to a future meeting of the sub-committee.

Kasuya commented on the surprisingly high proportion of J stock whales in the market samples. Many members of the sub-committee noted that the availability of data on the annual proportion of J stock animals taken in the North Pacific, from incidental catches and JARPN, would allow better estimation of bycatch. Many members of the sub-committee also reiterated that estimation of bycatch would be improved by the ability to compare market samples with a register of all legally caught whales. However, Nagatomo stated that monitoring, control and management of the domestic whale meat market is the sole responsibility of the government based on its sovereign right, and that matters related to their domestic market are therefore outside the jurisdiction and competence of the IWC. The Government of Japan is consequently in no position to provide its market-related genetic data to the IWC. However, Nagatomo indicated that if data from DNA sequence analyses from parties concerned were forwarded to the Institute of Cetacean Research they would compare the data with their database and provide the results.

Funahashi and Kasuya clarified that the request to the Government of Japan was not for market-related genetic data, but for information on the numbers and locations of J-stock animals from bycatch and JARPNII. This information is required to improve estimates of total takes over time from the J-stock, as required for the RMP. Funahashi also stated that she and colleagues would be glad to discuss co-operative research projects involving an exchange of genetic data. Such an exchange would require third party oversight to resolve possible conflicts in identification as already proposed in 2000 by the authors of SC/52/SD8.

9. WORK PLAN

The sub-committee 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) Review responses from letters sent out requesting a list of fishery category types
- (2) Further review of methods to estimate bycatch based on genetic data
 - (a) Review the proposal developed intersessionally for a workshop on the use of market surveys to improve on minimum estimates of bycatch
 - (b) Further development of analytical tests for assignment to stocks and/or areas considering both highly differentiated stocks (for example improving assignment of J and O stocks throughout their ranges), and stocks differentiated only by smaller frequency differences (for example improving assignment between eastern and western NP stocks of grey whales and BCB and Sea of Okhotsk bowhead whales)
 - (c) Consider methodological issues in application of capture-recapture models to estimation of bycatch from market data
- (3) Further review of information and methods to estimate mortality from ship strikes
 - (a) Review results of data collected on high speed vessels relevant to ship strikes
- (4) Consider methods for estimating additional human induced mortalities.

LITERATURE CITED

- Baker, C. S., Lento, G. M., Cipriano, F. & Palumbi, S. 2000 Predicted decline of protected whales based on molecular genetic monitoring of Japanese and Korean markets. *Proceedings of the Royal Society of London, Series B* 267, 1191-1199.
- Best, P.B, Peddemors, V.M., Cockcroft, V.G. and Rice N. 2001. Mortalities of right whales and related anthropogenic factors in South African waters, 1963-1998. *Journal of Cetacean Research and Management* (Special Issue 2):171-176.
- Dizon, A., Baker, C.S., Cipriano, F., Lento, G., Palsboll, P. and Reeves R. 2000. Molecular genetic identification of whales, dolphins and porpoises: proceedings of a workshop on the forensic use of molecular techniques to identify wildlife products in the market place. La Jolla, California, NOAA Technical Memorandum NMFS NOAA-TM-NMFS-SWFC-286.
- Lien, J. 1994. Entrapment of large cetaceans in passive inshore fishing gear in Newfoundland and Labrador (1979-1990). Rep. Int. Whal. Commn (Special Issue) 15: 149-157.

Table 1. Large whale entanglements reported in Progress Reports 2002.

Nation	Area	Year	Species	No	Description
Australia	NSW	2001	Humpback whale	3	2 associated with beach protection shark nets; 1 'entangled'
	SA	2001	Southern Right Whale	1	Tuna long line
Canada	G St Lawr.	2001	Humpback	1	Danish Seine
Denmark: Greenland	West Greenland	2001	Humpback whale	2	"Fishing gear"
Japan		2001	Minke whale	79	Trap nets
		2001	Fin whale	1	Other coastal fishery
		2001	Baleen whale sp	1	Trap net
Korea	East Sea	2001	Minke whale	132	Entangled
	South Sea	2001	Minke whale	11	Entangled
	Yellow Sea	2001	Minke whale	5	Entangled
New Zealand		2001	Humpback whale	2	Crayfish pot lines – <i>released alive</i>
Oman		2001	Balaenoptera sp.	1	Entangled
		1999-00	Humpback	8+	Entangled alive in gillnets, 'most' released; 'Some' stranded animals with evidence of bycatch
Spain		2000	Minke whale	1	Entangled
UK	England	2001	Minke whale	1	Entangled
USA	WN Atlantic	1999	N Atl Right Whale	1	Entangled
	WN Atlantic	1999	Humpback	1	Entangled
	WN Atlantic	1999	Minke whale	5	Entangled
	Alaska	2001	Humpback	1	Trawl
	Alaska	2001	Fin whale	1	Trawl
	Alaska	2001	Sperm whale	1	Longline (<i>injured</i>)

Table 2. Reports of large whales killed by ship strike (or suspected ship strike) in 2001 (including some reports from 1999 and 2000), as recorded in National Progress Reports submitted to SC54.

Country	Species	Number of animals etc.
Australia	Southern right whale	One animal-fatal (female-probable ship strike)
Australia ¹	Blue whale	One animal-fatal (possible yacht strike)
Australia	Humpback whale	One animal-non-fatal (boat strike apparently observed-animal probably survived)
Oman	Balaenoptera sp.	One animal-fatal (was found wrapped around the bow of a commercial container ship-could have been a post-mortem strike).
Spain (for 2000)	Sperm whale	Five animals-fatal (cause of death determined through post-mortem examination).
Spain (for 2000)	Bryde's whale	One animal-fatal (cause of death determined through post-mortem examination).
Spain (for 2000)	Balaenoptera sp.	One animal-fatal (collision observed)
Spain (for 2001) ²	Sperm whale	Three animals-fatal (cause of death determined through post-mortem examination).
USA (for 1999)	North Atlantic right whale	One animal-fatal(female)
USA (for 1999)	Fin whale	Two animals-fatal(both male)
USA (for 2001)	North Atlantic right whale	Two animals-fatal
USA (for 2001)	North Atlantic right whale	One animal-non-fatal (wound clearly healing at last sighting)

¹ It was noted that a stranding of a blue whale (or pygmy blue whale) in 2000 was also a probable boat strike.

² All of these collisions occurred in the Canary Islands.

Appendix 1

TERMS OF REFERENCE OF SUB-COMMITTEE ON ESTIMATION OF BYCATCH AND OTHER HUMAN-INDUCED MORTALITY

At its 52nd meeting, under agenda item 12.1.2, the Commission 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 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 Sub-Committee 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 chairperson and appointment of rapporteurs
3. Adoption of agenda
4. Review of documents
5. Bycatch estimation methods
 - 5.1 Report of Working Group on Collation of Information from Fisheries
 - 5.2 Independent observer programmes
 - 5.3 Mandatory or voluntary reporting schemes
 - 5.4 Strandings and Questionnaire surveys
 - 5.5 Genetic analyses (2-3)
 - 5.5.1 Report of Bycatch Workshop Feasibility Steering Group
 - 5.5.2 Data from market surveys
 - 5.5.3 Analytical tests for assignment to stocks and/or areas
 - 5.5.4 Other methodological advances
 - 5.6 Other
6. Estimation of mortality from ship strikes:
 - 6.1 Mandatory or voluntary reports
 - 6.2 Observational data
 - 6.3 Strandings
 - 6.4 Other
7. Methods for estimating additional human-induced mortalities
8. Other
9. Work plan
10. Adoption of report

Appendix 3

A RATIONALE FOR SEEKING INFORMATION ON FISHERY CATEGORIES FROM IWC MEMBER STATES

The Scientific Committee of the IWC has been asked to provide advice on the design of surveys to estimate the entanglement rate of large whales in fishing gear. Such captures are rare events that nevertheless, when summed over a large area or large fishing fleet may have significant implications on any future catch limits set by the IWC under its RMP. To this end we are attempting to gather information on the types of fishery likely to be involved, and ultimately we would like to find out more about the nature and distribution of such fisheries to advise on sampling methods.

It is well known that fisheries are complex, varying from region to region and with gear type and target species. It is also apparent that some kinds of fisheries are more prone to catch whales than other fisheries. We do not yet know exactly how to characterize such fisheries, which will of course be a first step in addressing how best to sample them.

As an initial step in addressing this issue we are therefore requesting that a simple list of fishery categories or fisheries as currently recognised by each IWC member state, broken down by gear type, target species and geographical area, to the extent that this is routinely done in each country, should be forwarded to the Secretariat.

Such a list will assist the SC in making comparisons across ocean basins to try to find commonalities among fishery types that might take large whales as bycatch. Furthermore, if and when the SC is able to identify fisheries that may be candidates for the establishment of a monitoring programme to estimate whale bycatch, such a list will assist the SC in focusing on the particular fishery-type(s) on a large scale and in seeking additional specific information for that fishery from the relevant countries.

