

Annex J

Report of the Standing Working Group on Environmental Concerns

Members: DeMaster (Chair), Aguilar, Baldwin, Bando, Berggren, Bjerge, Brownell, Burt, Butterworth, Carlson, Childerhouse, Cipriano, Clark, C., Clark, E., Deimer, Diake, Donahue, Donovan, Ensor, Friday, Fujise, Fulford-Gardiner, Funahashi, Gales, Garrigue, George, Givens, Goodman, Grønvik, Guissamulo, Hakamada, Hatanaka, Haug, Hedley, Iniguez, Ishikawa, Kato, Kawahara, Kell, Kim, Kock, Krahn, Leaper, Lens, Manzanilla Naim, Matsuoka, Mattila, Morishita, Murase, Nagahata, Nagatomo, Nishiwaki, Northridge, O'Hara, Ohizumi, Ohsumi, Okamura, Oosthuizen, Palka, Parsons, Peddemors, Perrin, Pike, Polacheck, Rademeyer, Rambally, Read, Reeves, Reijnders, Rennie, Ridoux, Rogan, Rojas-Bracho, Rose, Rosenbaum, Rowles, Sadler, Sakamoto, Santamaria, Senn, Shimada, Simmonds, M., Sohn, Stachowitsch, Sutaria, Suydam, Swartz, Tamura, Tanaka, Taylor, Thiele, Tregenza, Tynan, Urban-Ramirez, Van Waerebeek, Vikingsson, Wade, Wakako, Walløe, Weinrich, Williams, Wilson, Yamamura, Yasunaga, Yoshida, Zeh, Zenitani, Zerbini.

1. CONVENOR'S OPENING REMARKS

DeMaster directed members of the Standing Working Group (SWG) on Environmental Concerns to the remarks of the SC chair regarding Commission directives and mandates from their last meeting (IWC 53). The following resolutions are particularly relevant to the workings of SWG:

1. *IWC Resolution 2001-4 on the Incidental Capture of Cetaceans* commended the work of the SC on the estimation of bycatch and other human-induced mortality and asked that it continue. This resolution also requested the SC to provide to the Commission at its 2002 meeting "a summary of its work in recent years on the most feasible methods to mitigate the incidental capture of large cetaceans in fishing gear, and ways in which entangled large cetaceans may be removed from fishing gear with minimal risk to rescuers"
2. *IWC Resolution 2001-7 on Southern Hemisphere Minke Whales and Special Permit Whaling* endorses the SC proposal to proceed with the review of SH minke abundance and to present revised abundance and trend estimates at our 2003 meeting for the full three circumpolar sets of IDCR/SOWER surveys. However, it asks the SC to provide the 2002 Commission meeting with "(i) a list of plausible hypotheses that may explain this apparent population decline," and "(ii) the possible implications that such a decline in abundance may have for the management of minke whales in the Southern Hemisphere, and for ecologically-related species, in particular other cetaceans, and the state of the Antarctic marine ecosystem".
3. *IWC Resolution 2001-9 on Interactions Between Whales and Fish Stocks* welcomes our plan to conduct a methodological/modeling workshop before the 2002 annual meetings to begin our examination of interactions between whales and fish stocks and endorses our recommendations regarding this workshop. The resolution also asks that FAO, regional fisheries management organizations, international research organizations, and other appropriate organizations be asked to cooperate in the organization and conduct of the workshop. Simon Northridge (spn1@st-andrews.ac.uk), chair of the Steering Group for the workshop, will contact FAO and ask if they can also advise on regional fisheries bodies.

Further, DeMaster noted that at last year's meeting of the SC Chairs after IWC SC/53, it was agreed that the workload of the SC members was unacceptably high. For example, at last year's meeting of the SC 98 sub-committee meetings were held in 7 days for an average of 14 sessions per day. Some sub-committees held as many as 14 sessions during the week (RMP). SWG held 12 sessions last year, which was the third most number of sessions of any of the 11 sub-committees. The chairs agreed to develop agendas for their sub-committees in such a way as to limit the total number of sessions during the week of sub-committee meetings to less than 90. Given the agenda of the SWG and the agenda of the other sub-committees, it was agreed that SWG would try to conduct all of its business during 8 90-minute sessions. As was done last year, the SWG will concentrate its efforts on addressing agenda items raised by the Commission or agreed to by the SC. Other topics (and papers) will only be discussed as time allows. As in previous years, there has been a tendency of SWG members to submit papers related to topics they are particularly interested in, but not necessarily related to topics relevant to the high priority agenda items of the working group. DeMaster asked the members of the SWG to limit the submission of SC documents to the SWG to topics on the agenda in the future.

Finally, DeMaster commented that the Chair of the SC anticipates a significant reduction in funding available to the SC in 2002/03. In particular, the special set aside for the SWG will no longer exist. Therefore, in making proposals for funding from the general SC fund, the SWG will have to be very judicious.

2. ELECTION OF CHAIR, APPOINTMENT OF RAPORTEURS

DeMaster was elected Chair. Donahue and Thiele agreed to act as rapporteurs.

3. REVIEW OF AVAILABLE DOCUMENTS

Documents relevant to the Standing Working Group (SWG) included: SC/54/E1 – 14; SC/54/For Information 14, 17, 18, 20; SC/54/O3, 17, 22; SC/54/BC2, 6; SC/54/IA 2, 6, 7; SC/54/SM5; SC/54/BRG14; and SC/54/WW 2.

4. ADOPTION OF AGENDA

The adopted agenda is given as Appendix 1.

5. COOPERATIVE RESEARCH IN THE ANTARCTIC

5.1 Results from the SOWER 2000 Cruise

There were no specific papers that pertained to results from SOWER 2000 that were not discussed in other subcommittees.

A summary of circumpolar and regional trends in Antarctic climate (SC/54/IA7) was presented by Tynan. This paper raises two important questions concerning the IDCR survey methodology relative to sea ice. A more detailed description of this paper is reported in Annex XX (IA Report). Minke whales may have moved into the pack ice and been 'missed' by the open-water IDCR surveys conducted later in the season. Information concerning this hypothesis is responsive to IWC Resolution 2001-7. Tynan noted that because trends in Antarctic sea ice are highly regionally specific, the response of minke whales is also likely very regionally specific (Jacobs and Comiso, 1993; 1997). Decadal-scale trends in Antarctic

climate show regional differences in sign, magnitude and rate of change. For example, temperature in the Antarctic Peninsula region has increased by > 2.5 C over the past 55 years, coincident with the retreat of the ice shelves. Trends of warming and loss of ice are greatest in the Bellingshausen Sea, Amundsen Sea and part of the Ross Sea. Climate change in the Antarctic has strong global connectivity on scales of seasons, years, and decades to which minke whales may be responding. Important linkages between Antarctic climate (e.g., sea ice extent and cover) and nonpolar (extrapolar) climate are documented for several oscillations: the Semiannual Oscillation (SAO), the Southern Oscillation (SO), and the El Niño-Southern Oscillation (ENSO).

In discussion of the paper, Tynan noted that the complexities and connectivity of these oscillations are a basis for discussion of the environmental factors that may relate to changes in minke whale abundance, demography and ecology. Until such relationships between minke whale abundance and changes in ice can be quantified, a precautionary approach to Antarctic resource management is advised. Given that it has been six years since the last IWC-sponsored workshop on Climate Change and Cetaceans (25-30 March, 1996) was held, Tynan further noted the need for an update on climate change issues related to cetacean ecology.

Japanese scientists stated that the past IDCR/SOWER cruise reports indicated that SSTs in Area 1 are relatively higher than in other areas but do not provide any evidence to support a decrease in abundance of minke whales. It was also stated that caution is necessary when considering the relationship between changes in the environment and cetacean abundance because the time series of sea ice concentrations within the pack ice region for all Areas for the past 20 years do not confirm a long term trend in changes in ice formation, except for Area I (SC/53/IA15). It is necessary to distinguish the scale of events (ENSO vs. more regional events such as change in ice formation) when trying to explain environmental impacts on marine living resources.

In discussion, it was suggested that sea-ice modelers might make a valuable contribution to the work of the SWG, specifically regarding the integration of climate data and information on the mechanisms mostly linked to sea ice extent and concentration. Although a mechanism for such a contribution was not readily identified, it was generally agreed that this and other topics addressed by the SWG could benefit from the expertise of climate researchers. It was also recognized that investigations of climate change on top-level predators necessarily need to be conducted in cooperation with GLOBEC and CCAMLR.

5.2 Collaboration with SOGLOBEC

Thiele presented SC/54/E12, a summary of research and preliminary results of the cetacean visual survey and biopsy and sonobuoy studies conducted on two cruises subsequent to the last report on this multi-year program (SC/53/E8).

Thiele summarized the second annual report on IWC collaborative research in the SO GLOBEC Western Antarctic Peninsula study area. In 2001 a multi-year series of collaborative research cruises began with Southern Ocean GLOBEC. The US SO GLOBEC cruises are multidisciplinary and comprise standard mooring cruises, line transect surveys over a constant grid, and process studies at selected locations, all within the Western Antarctic Peninsula study region around Marguerite Bay. A preliminary report on the first three cruises in this series was provided to the IWC SC in July 2001 (Thiele et al. SC/53/E8). In SC/54/E12 preliminary results from the IWC collaborative studies conducted on the 2001 winter survey and the 2002 late summer mooring cruise with the US SO GLOBEC program are presented. SC/54/E12 provides a summary of research and preliminary results for the cetacean visual, biopsy and sonobuoy studies conducted on the two cruises since the last report (SC/53/E8). Results from the ARP (acoustic recording package) year-long deployments are reported in Moore SC/54/O3.

The full colour version of SC/54/E12 and reports of all the IWC-SO GLOBEC collaborative cruises can be found at: http://www.ccpo.edu.edu:80/Research/globec/iwc_collab/menu.html

The NB LMG Palmer (US SO GLOBEC) survey cruise was conducted 23 July – 1 September 2001 and the LM NBP Gould mooring cruise was repeated in February 2002. Sea-ice cover was significantly more extensive earlier in the season in 2002. Only minke whales were observed in the study region in winter 2001, although humpback concentrations were seen as late as end of May. Concentrations of humpbacks were seen in Marguerite Bay and east of Adelaide Island up until late May in 2001; and at the ice edge in southern Marguerite Bay and the passages to the north in February 2002. Although geographic locations of concentrations of humpbacks are different between years, habitat remained consistent. Baleen whale calls detected on sonobuoys included blue, minke, and possible fin whales. Autumn and winter multidisciplinary research cruises conducted last year under this program will be repeated this year, and will include both passive acoustic and IWC visual/biopsy teams. Currently there are IWC visual, biopsy and collaborating sonobuoy teams on the US SO GLOBEC LMG and NBP cruises (April – May 2002).

Since the Scientific Committee meeting at IWC53 presentations of the data at different stages of analysis have been made at: CCAMLR SC meeting in Hobart, Australia (October 2001); Biennial Meeting of the Society for Marine Mammalogy in Vancouver, Canada (November 2001); US SO GLOBEC Planning Meeting in Washington USA (December 2001); and Ocean Science Meeting in Honolulu (February 2002).

In September/October 2002 a small workshop will take place in the US to assist with data integration analyses prior to the 2nd International GLOBEC Open Science Meeting in China in October. Final submissions for a special issue of Deep Sea Research are due in November. Proposals from the group will be submitted to the NSF for funding under the synthesis and analysis phase of US SO GLOBEC (2002/2004).

Thiele also summarized future plans for collaborative work by SOGLOBEC, CCAMLR and IWC under the Antarctic Program (Appendix 2). Beyond 2002/2003, one dedicated multidisciplinary survey per season for 5-10 years consisting of visual survey, biopsy sampling and fine scale ecological studies, including passive acoustics work, is planned. It was suggested that a contribution of £25,000 per year for the next 5-10 years would be a minimum amount of support to continue its partnership in this program. It was suggested that the Ecosystem Working Group of CCAMLR be approached in regards to further collaborative support of the GLOBEC cruises and data previously collected by CCAMLR in the parts of the GLOBEC study region held in the CCAMLR database.

Finally, after some discussion regarding the need for the development of a standardized data collection protocol for sea-ice observations, the SWG created an ad hoc working group, chaired by Thiele. The group was asked to report back to the SWG at IWC55 concerning progress related to the process described in Appendix 3.

6. STEERING GROUP REPORT ON POLLUTION 2000+

Reijnders presented a progress report by the Steering Group of the IWC-sponsored research programme referred to as POLLUTION 2000+ (SC/54/E14). Details of research completed in the last 12 months are summarized in Appendix 4.

Activities conducted under the bottlenose dolphin subproject of POLLUTION 2000+, which seeks to evaluate potential biomarkers of exposure to organochlorine contaminants, included: 1) analyses of samples collected in Sarasota Bay, Florida, 2) comparison of PCB-concentrations in blubber samples from the three study sites (the Bahamas Islands and Charlotte Harbor, Florida, representing sites with 'low' pollution, and Sarasota Bay, a site with 'moderate' pollution). The subproject also included a feasibility study to collect biopsy samples from the Mediterranean, where dolphins are likely to carry high levels of polychlorinated biphenyls (PCBs).

The second subproject of the POLLUTION 2000+ program involves the calibration of post-mortem time effect on changes of biomarkers and pollutants in harbour porpoise. This analysis will enable the utilization of bycaught animals throughout the North Atlantic. In the summer of 2001, samples were collected in the Bay of Fundy for this purpose. Most of the samples were collected using the detailed field protocol previously designed and Reijnders noted that the successful collection of these critical samples was very much owed to Andy Read and his colleagues.

From the funds provided by the IWC for the POLLUTION 2000+ programme, approximately £800 remains. In addition to funds provided by the IWC, substantial "in-kind" funding has been received from several cooperating institutions (over £200,000), demonstrating a strong endorsement of this IWC-initiative.

In addition to completion of analyses currently in progress, the 2002-2003 work plan for POLLUTION 2000+ will include an intersessional meeting to synthesize results among the laboratories involved, and an intersessional meeting of the Steering Group to finalize Phase I of this programme and to determine activities to be conducted under Phase II. Within this work plan, the highest priority projects are the collection of samples and PCB analyses under the bottlenose dolphin subproject, and completion of the harbour porpoise post-mortem calibration project. The budget to complete the entire 2002-2003 work plan will require £140,500, of which the majority will be sought through external direct or "in-kind" funding. To complete the highest priority projects mentioned above, a request for £54,410 from the IWC was proposed.

The discussion of this report noted that the activities of Phase I, primarily a data collection and validation/calibration stage, were successful in terms of the original goals of the programme. The synthesis of the analyses of these data and many more associated data will result in a comprehensive report on Phase I of POLLUTION 2000+ and multiple publications. To date, an enormous wealth of data has been accumulated and several findings of biological significance are emerging as well (e.g., changes in lipid content with age, and a negative correlation between testosterone and PCB levels). The post-mortem calibration studies on harbour porpoises will be of enormous value with regards to the many harbour porpoise samples collected from stranded animals.

Several in the group expressed their appreciation for enormous amount of work completed to date and recognized the importance of completing the analysis phase if the meaningfulness of Phase I is to be realized. A significant amount of development time has been invested in POLLUTION 2000+ and the programme has received continued endorsement from the Commission. It was also noted that the proposed budget to be provided by the IWC is substantially reduced, with a majority of funding being sought externally.

It was noted that in addition to reports from POLLUTION 2000+, the SWG welcomes at its next meeting other studies related to contaminant levels and health effects in large whales.

The Government of Japan expressed concern that this project is not consistent with the objectives of the IWC since the species dealt with by the current POLLUTION 2000+ are limited to small cetaceans.

7. HABITAT RELATED ISSUES

7.1 State of cetacean environment report – form of SOCER

The Commission had expressed its support for a comprehensive update on environmental events impacting cetaceans (Resolution 2000-7). Despite the difficulties experienced in obtaining submissions and compiling the initial SOCER at IWC 53, the Commission considered it an important contribution from the SWG, and reiterated support for its development in future.

During the intersessional period, a steering group from the SWG was charged with making recommendations for the development of a mechanism for the compilation, review process, style, structure and frequency of this type of report. The group had considered a wide range of proposals for the future style and content of SOCER, and these were presented and discussed within the SWG. The proposal recommended by the steering group involved taking a regional approach for each annual report (i.e., the six regions used in the original form of SOCER (Mediterranean and Black Seas, Indian, Pacific, Arctic, Southern, and Atlantic Oceans) along with a seventh 'global' category). Each region would be covered on a rolling basis every 3-5 years, with scope for the inclusion of significant events on a global scale, or repeat events from particular regions to be updated on an annual basis. This would ensure the timely receipt of recent significant 'events' from any region, and those occurring on a global scale, for the consideration of the Commission.

The steering group developed a clear set of criteria identifying an appropriate scale and scope for material for SOCER, and a submission procedure that is easy to follow. The aim of implementing a clear process is to encourage submissions to SOCER from a wide range of sources, including member governments, individual scientists and a range of agencies and organizations. In the process of developing an improved SOCER process, a new form for submission of event information was developed (Appendix 5). Invitations to make submissions to the SOCER need to cover a broad scale of sources, and the SWG agreed that a covering letter be developed to facilitate this.

The SWG will aim to produce a SOCER for the meeting in 2003. However, the SC and the Commission should view this as a preliminary attempt at a form of the report that will be developed over the years into an objective product and an easily followed submission process. Productive comments and suggestions on the first regional SOCER (2003) will be welcomed and incorporated wherever possible. The SWG regretted that it could not provide a SOCER this year and sought endorsement from the SC for its proposal for the future of SOCER.

Some members of the SWG recommended that the SOCER should be 1) consistent with the competence of the IWC, 2) conducted in an objective manner, and 3) cost-effective, and 4) reviewed by the SWG before sending to the SC for finalization. It was further recommended that the usefulness of the SOCER and the efficiency of how the SOCER was prepared be evaluated by the SWG. After some discussion, the SWG accepted all of these recommendations.

7.2 Steering group report on workshop on habitat degradation

M. Simmonds reported on intersessional work on the Habitat Degradation Workshop. Intersessionally, the first meeting of the parties to ACCOBAMS (The Agreement for the Conservation of Cetaceans of the Black and Mediterranean Seas) occurred. At that meeting ACCOBAMS recognized the importance of developing work on habitat degradation in their region. The Meeting Of Parties had established a list of priorities for the next three years and this included the Habitat Degradation Workshop proposed by the IWC. The issue of funding for the IWC workshop had not been resolved, but there is still considerable interest, and it is hoped that funding from outside sources might be found to at least contribute towards the meeting. He noted that intersessional work relating to this workshop has continued (e.g., SC/54/E10).

It was noted by members of the SWG that this workshop had been proposed and given priority in the budget for some years now. It was agreed that the workshop was still a high priority for the SWG, and although it appears unlikely that funds can be allocated this year, it is hoped that this proposal would receive very high priority for funding at IWC 55. The SWG concluded that the proposal concerning the habitat degradation workshop published in JCRM 2002 (p. 314-319) was still relevant to the SC.

Brief presentations of papers SC/54/E5, 7, 10 and 11 were made with reference only to those parts of the paper directly of relevance to the habitat degradation workshop.

E. Clark presented SC/54/E5, which described results from a study indicating that in areas where cetaceans are still harvested locally and there are public retail outlets, tissue samples are readily available for appraisals of contaminant burdens in cetaceans. Results of 17 samples of cetacean tissue from coastal waters in Japan were presented illustrating this method, which indicated that the level of contamination detected may be of concern regarding cetacean health. Sex and species identification were carried out by genetic analyses.

SC/54/E10 was presented as an implementation of the framework for assessment of habitat degradation advanced by the workshop in SC/53/E16. It was suggested that environmental trends could be integrated into a population model to serve assess degradation effects. A wide spectrum of potential trends in environmental impacts on southern resident killer whales was reviewed. Possible scenarios of reduced survival and fecundity were explored in simulations with the VORTEX population viability model package. It was argued that demographic stochasticity and climate-driven oscillations in prey abundance were insufficient to explain recent declines in survival and fecundity. The southern resident killer whales were recommended as a good model for implementation of the framework owing to the excellent record of life history data, their confined coastal habitat, their well-studied major prey species and the possibility for comparisons with other populations that experience different habitat conditions. Projections of recent declines into the future predicted high probabilities of extinction in the short term.

Taylor also summarized the relevant parts of SC/54/E11. He presented this as another example of a modeling approach that incorporates environmental variables, particularly habitat. He uses the Bering Chukchi Beaufort (BCB) stock of bowhead whales in this example. The BCBs contrast sharply with the case reported in SC/54/E10 in that habitat conditions are relatively undisturbed, but could change drastically with the onset of global warming, with consequent reductions in the amount of their preferred sea-ice habitat and increased shipping, oil development and changes in other factors. Population simulations predicted significant population declines, under the assumption that a combination of environmental factors would lead to reductions in calf and juvenile survival (e.g., episodic mortality due to oil spills). It was noted that the exercise was largely heuristic in value, but showed the value of an integrative approach bringing together diverse sources of data and evidence. More specific data and better incorporation of uncertainty were necessary to make the predictions of such models of specific value to the management of cetaceans.

During discussion of E10 and E11 it was noted that these models are preliminary, and were reported here as possible approaches, which may, in time, be capable of integrating all of the data available on species and their environments. Analyses presented here have not integrated all of the possible environmental variables. Further, uncertainty associated with relationships among demographic parameters and environmental variables cannot be quantified at this time. It was recognized that the coefficient of variation (cv) associated with various demographic parameters in the model were underestimated. Further, incorporation of cumulative stochastic events would result in even higher cv's of demographic parameters in these analyses. Given the importance of incorporating environmental data into population models used in the management of marine resources, the author was encouraged to publish these results in peer reviewed journals as possible.

7.3 Review of information regarding whalewatching activities and noise impacts

A summary of this discussion is reported in Annex L (Whale Watching).

7.4 Competition between cetaceans and fisheries

The steering group chair (Northridge) provided an update on the status of plans for the workshop. Due to a number of changes in the planning process, some only recent, the workshop will now be held in La Jolla, California USA (25-27 June 2002). The agenda for the meeting is provided in Appendix 6. The meeting has been planned to include an introductory overview on the modeling approaches currently being used to address related issues, followed by a discussion on aspects of data availability and reliability. Specialists have been invited to present their modeling work covering a range of approaches (e.g., food web models, mass balance models and minimum realistic models). The workshop will determine how best these approaches can be taken forward by the SC. The report of the workshop will be available for IWC 55. It was also noted that the £10,000 from last years SC budget is still available for the workshop and, therefore, additional funds were not needed. However, several members of the SC noted that one of the original purposes envisioned by the SC in supporting a venue of St. Lucia for this workshop was to encourage the participation of scientists from developing countries. Therefore, the SWG recommended that the SC raise this issue with the Commission during IWC54 and consider providing additional funding to support travel of scientists from developing countries to the workshop in La Jolla, CA.

Brief presentations of SC papers E1, E6, E13, F117, O6, E7 and O17 were made, detailing content that had a direct bearing on the content of the proposed workshop.

SC/54/E1 provided an update on the status of the Ecopath/Ecosim model for the Eastern Bering Sea, which is being refined by a group at the National Marine Fisheries Science Center/Alaska Fisheries Science Center. The model is being calibrated to fit fisheries and food habits data from 1979 to present and is therefore particularly relevant to the planned workshop. A variety of steps are being taken to test and improve the model. Species groupings, which combined a number of similar species, have been modified to provide greater consistency in the diet composition of each grouping. Species of interest with sufficient data are being removed from species groupings and are being modeled as individual species groupings. Predictions from Ecosim simulations are being compared to available trend data for several species and projected diet composition results are being compared to current diet composition data. Sensitivity analyses of parameter values are being conducted, and the effects of environmental forcing are being explored. For Eastern Bering Sea cetaceans, model input data on abundance, biological parameters, distribution, seasonality, and diet composition have been reviewed and updated for as many species as possible. Information on the diet composition of eastern Bering Sea cetaceans was used to determine new species groupings in the model. The model will be used evaluate the effect of events such as the removal of large whales by commercial whaling over the past 50 years and the removal of groundfish by commercial fisheries since the 1970s.

Haug presented SC/54/E6, which give a review of Norwegian studies of the feeding ecology of northeast Atlantic minke whales (*Balaenoptera acutorostrata*) during the past decade. The review demonstrated how scientific whaling under special permit and subsequent establishment of a routine sampling scheme during commercial whaling operations have yielded a time series (1992-2001) that permits assessment of spatial, seasonal and year-to-year variations in diets, of foraging behaviour, of prey selectivity, and of the total annual consumption by the whales. The collected data have also permitted multi-species modeling exercises with minke whales involved. The dietary composition of the northeast Atlantic minke whales varies considerably both in space and time, presumably because of geographic differences in the distribution and abundance of potential prey. The whales exploit a multiplicity of species and sizes of fish and crustaceans. In general, they find capelin, herring and, occasionally, krill more preferable than other prey, which may have several contributory explanations such as mobility, schooling behaviour, prey refuge use and other anti-predator responses. Apparently, minke whales switched to other prey in years of low densities of herring and capelin, thereby reducing the mortality on these two fish species. Although results from the multi-species modeling exercises should be taken as tentative, they all point in the same direction, i.e., that minke whale abundance may affect important fisheries. They show that, for the Barents Sea, it is possible to make predictions regarding ecosystem changes, following a specific management manipulation or change in the ecosystem, that are accurate within an order of magnitude of the actual response. The results given demonstrate the usefulness of performing ecological investigations over a range of scales. To assess the large scale variations on population level, information about the body condition of the whales are also of interest. To put the large scale results in an ecological perspective, information about population size and structure is needed, and, of course, large scale information about the resource base. However, more detailed small scale studies of prey selection must be supported with resource mapping studies that occur concurrently and synoptically with the sampling of whale diet data. Tamura noted that this study was a very useful study in understanding the feeding ecology of cetaceans.

In discussion Haug noted that they had conducted some studies using both acoustic and net sampling and these were reported in the published literature (see Lindstrom and Haug, 2001).

Paper SC/54/E13 by Clarke et al. described the possible impacts on sperm whales of a squid fishery off northern Peru that targets the main prey of these whales, the Humboldt Current squid (*Dosidicus gigas*). Sperm whale sighting records were compared between surveys conducted in the late 1950's and more recently in 2001. An apparent reduction in sperm whale numbers is proposed as being directly related to overexploitation of the squid fishery.

Paper SC/54/O6 from Whitehead et al. on the population status of sperm whales is relevant here because sperm whales are such a dominant element in ecosystem models (including Ecosim and Ecopath). The paper highlights areas where data can be found for models and the need for some abundance information for sperm whales to be reassessed in light of recent information.

Gales provided information in SC/54/E7 on a novel DNA based method for identifying krill species present in the faeces of baleen whales (SC/54/E7). This method uses polymerase chain reaction (PCR) amplification of short DNA sequences that only occur in krill. The technique has been applied to blue whale faeces collected from two locations, and has successfully identified krill components of the diet down to species level. Based on the success of this group-specific approach, attempts are underway to develop similar techniques for identifying species from other key groups, including myctophidae, clupeiformes, gadiformes, cephalopods and amphipods. Feeding trials using a dolphin model will be conducted to test the efficacy of the techniques. The collection and storage of whale faeces was reported to be a simple exercise, its main limitation being the necessity to directly observe the defecation event. This limitation can largely be overcome through broad collaborations with scientists who routinely spend time working in the vicinity of feeding (and therefore defecating) whales. Collections made via such collaborations have few (if any) implications for permits, and can facilitate the accumulation of large sample sizes across a strategically targeted range of cetacean species, locations and times. The authors believe that continued development of this technique will provide a widely applicable, non-invasive method capable of unambiguously determining the entire assemblage of species represented in cetacean diet. Furthermore, the application of this technique, in conjunction with other diet assessment techniques, will address some of the significant problems associated with biases found in techniques such as stomach content analysis.

There was some discussion about the difficulty of collecting faecal samples from large whales. Some considered the method described in SC/54/E7 practical, while others did not. It was noted that when large whales feed they defecate, and this takes place at or near the surface for physiological reasons. The rate at which an animal is feeding will determine the rate at which it defecates. It was also recognized that there are biases associated with any of the techniques used to investigate the food habits of cetaceans, and that a combination of methodologies was likely the only way to circumvent biases associated with particular techniques. The comment was made that though the collection of faeces by netting may be considered difficult at present, a similar concern was raised relative to the collection of skin samples from cetaceans by netting, and yet, the latter proved a very effective method.

Appendices 1-4 of SC/54/O17 were presented by Tamura and described the food habit of common minke whales sampled by JARPNII 2000 and 2001 in western North Pacific. Seven prey species consisting of 5 fishes, 1 squid and 1 euphausiid were identified. There were geographical and seasonal changes of prey species of minke whales. In the sub-area 7, spatial segregation was observed between minke and Bryde's whales. Both species feed mainly on Japanese anchovy and krill. However, the size composition of Japanese anchovy consumed by two whale species was reported to be different. Tamura noted that there was direct interaction between minke whales and fisheries (e.g., Pacific saury from summer to

autumn in the western North Pacific). In addition the food habits of Bryde's whales sampled by JARPNII 2000 and 2001 in western North Pacific were described in Appendix 2 of SC/54/O17. Nine prey species consisting of 6 fishes and 3 krill were identified. Monthly differences in prey use by Bryde's whales were reported. Tamura noted that there was some indirect interaction between Bryde's whales and fisheries (i.e., competition for prey species, such as skipjack tuna from summer to autumn in the western North Pacific). Thirdly, the food habit of sperm whales sampled by JARPNII 2000 and 2001 in western North Pacific were described in Appendix 3 of SC/54/O17. Thirty-three prey species consisting of 29 squid, 1 octopus and 3 fishes were identified. There were geographical and temporal differences in stomach contents of sperm whales. And it was estimated that the contribution rate of squid in the surface layer ranged from 0 to 96 %, where the average percentage was 17 %. The stomach contents weight ranged from 9.0 kg to 236.7 kg. These weights were equivalent to under 1.0% of the body weight of sperm whales. Appendix 4 of SC54/O17 reported on estimates of the prey consumption of minke whales and Bryde's whale using two methods. One method was calculated from diurnal change in stomach content weight. The other method was calculated from basal metabolism. Estimates of the daily prey consumption rate obtained by the first method were 4.6 and 4.0 % of body weight of minke whale and Bryde's whale, respectively. Estimates of the daily prey consumption rate obtained by the second method ranged from 1.4 to 8.2 % and 3.3 to 8.2 % of body weight of minke whale and Bryde's whale, respectively. The average estimated total prey consumption weights of minke whales during the feeding period in each sub area were 22 tones for immature males and females, and 33 tones and 43 tones for mature males and females, respectively. For Bryde's whales, the average estimated total prey consumption weights were 68 tones and 61 tones for immature males and females, respectively and 101 tones and 115 tones for mature males and females, respectively.

Murase presented a summary of SC/54/O17, Appendix 5. Preliminary analysis of prey preference of common minke and Bryde's whales in the western North Pacific was conducted using 2000 and 2001 JARPN II feasibility study data. Whale sighting and sampling survey and prey survey using quantitative echo sounder and mid-water trawl were carried out concurrently in the study. The aim of the analysis was to estimate prey preference of cetaceans, which is an important parameter in most ecosystem models. Biomasses of Japanese anchovy, walleye pollock and krill which were major prey species of minke and Bryde's whales were estimated. Cheeson's index was used to assess the prey preference of cetaceans. Preliminary results indicated that minke whales prefer to forage on Japanese anchovy, and seem to avoid krill. Preference for pelagic shoaling fish was similar to that in the eastern North Atlantic as in SC/54/E6. Foraging success is measured by maximization of energy intake rate and minimization of time necessary to obtain nutrient. Caloric values of Japanese anchovy, walleye pollock, and krill were 6,402, 6,192 and 3,556 kJ/kg, respectively as described in Appendix 4 of SC/54/O17. Japanese anchovy was concentrated shallower than 50m water depth, while walleye pollock and krill were distributed deeper than 100 and 150m water depth, respectively. Considering that the usual foraging depth of minke whale is in the upper 100m, the authors predicted that Japanese anchovy would be the preferred prey species, which would maximize the energy intake with minimum dive time. Bryde's whale were reported to prefer feeding on Japanese anchovy in August in 2000, but such a preference could not be detected from May to July in 2001. In the earlier season, Japanese anchovy was less abundant, except for their larva in the area occupied by Bryde's whales. Though results of the prey preference study are preliminary, it suggests that the concurrent whale and prey surveys adopted in the JARPN II feasibility survey could establish whether cetaceans have specific prey preference. It was also noted that during feasibility survey, the autumn season when Pacific saury were abundant could not be surveyed. Because Pacific saury are consumed extensively by minke whales, it will important to conduct whale and prey surveys in September and October to assess whether minke whales prefer to feed on saury. Further, because pelagic fish biomass is known to fluctuate widely, the authors noted the importance of developing an ecosystem model appropriate for the western North Pacific.

In discussion, Tynan commented that the prey preferences of fish species and the changes in prey preference with ontogeny of fish need to be incorporated in modeling efforts. Many fish species are cannibalistic on their eggs and larvae. The removal of older, and larger fish by whales may lessen intraspecific predation by fish on eggs and juvenile stages, thus promoting survival and recruitment of larval juvenile fish. In addition, predation by whales on fish could affect interspecific predation by fish on eggs and juvenile fish. Predation by whales on zooplankton could lessen grazing pressure on phytoplankton patches upon which larvae of some fish species depend. The complete role of whales in the structure, function and productivity of ecosystems should be incorporated into any modeling efforts of cetacean-fisheries interactions. The presenters stated that they would take this into account in future studies.

Other questions were raised regarding estimates of the whale biomass, prey biomass and whale consumption rates in the western North Pacific, and how these estimates compare with similar estimates for minke whales from the NE Atlantic. Haug and Walloe replied that both Japanese methods of assessment have resulted in higher daily rates of intake than Norwegian studies. In the Norwegian studies the estimated consumption rate was 120kg per day for minke whales. They noted for reference a recent NAMMCO workshop held in September 2001. The details and report of this workshop can be found on the web at: <http://www.nammco.no/news.htm>.

7.5 Mitigation of incidental capture of large cetaceans in fishing gear

This item was discussed in a joint session of the SWG on Environmental Concerns (Item 7.5) and the Bycatch Working Group (Item 5.6). It was noted that this agenda item was in response to IWC Resolution 2001-4.

During the intersessional period a number of scientists with expertise in cetacean bycatch issues attended a meeting (convened by WWF) in Annapolis, Maryland (USA) in January 2002. The objectives of the meeting were to produce a strategy to eliminate unsustainable by-catches of cetaceans and to ensure over the long term that cetacean populations are restored to, or maintained as, functional components of their ecosystems. The strategy was developed in recognition of bycatch as a major threat to whales, dolphins and porpoises and is summarized in SC/54/BC6. A section of the report deals specifically with the release of entangled whales, but it was noted that the information included in the report would be covered in the discussion of SC/54/BC2. Read commented that a final report will be available in the near future.

Clapham summarised SC/54/BC2 the report of the intersessional working group on large whale entanglements. The report outlines advice on the handling of large whale entanglements, developed from the experience of personnel involved in long-term disentanglement programs, particularly from the East Coast of the USA. Examples of entanglement rates for some species of large whale have been calculated for this region (North Atlantic). For instance 71% of humpbacks and 62% of N Atlantic right whales had been entangled at some stage in their lives, with an annual rate of entanglement of 10 – 31% for humpbacks and 10-28% for right whales (SC/54/BC2).

Appendix 7 is a summary of information on disentangling large whales from fishing gear found in SC/54/BC2.

There have been few studies to quantitatively measure the survival of disentangled large whales, although some efforts have been made to monitor the survival of stranding cetaceans after release. Although this is only a qualitative measure of the effectiveness of the procedure, it appears that the release may be successful in many instances. The likelihood of a successful release on an animal that has been entangled and stranded for a significant period of time to cause internal damage is low (as it is for otherwise healthy animals that have been beachcast for long periods). However, disentangling procedures on entangled southern right whale (*Eubalaena australis*) calves in South Africa, appear to have been successful. In these cases the calves had been entangled for less than 24 hours and their mothers appeared to wait offshore. It was suggested that photographs of the scarring patterns on entangled animals be recorded as a matter of course to assist with the assessment of survival. Small whales, like minke, are more likely to die quickly if entangled in nets, while larger whales can carry off even heavy gear that eventually causes immobilisation, infection and/or death.

Disentanglement programs exist in a number of regions, including Oman, South Africa, Eastern Canada, Gulf of Maine and the Western Mediterranean. It was clear from the discussion that disentanglement is a very dangerous task, with great potential for serious injury or death of persons involved. It was clear that disentanglement of entangled cetaceans should only be attempted by experienced personnel. It was noted that Dave Mattila's group in the western North Atlantic has extensive experience in disentangling large whales and has held training/advisory workshops in the past.

Reports of disentangling large whales were included in the Progress Report of the Government of Japan. Some members of the SWG requested information on disentanglement strategies. Reference was made to a brochure on disentanglement of large whales, which is only available in Japanese. Some members of the SWG requested that a translated copy be made available to the SWG at IWC 55.

Many countries are currently making efforts towards developing effective marine mammal conservation and rescue measures and many member countries and individual scientists are likely to benefit from the information contained in SC/54/BC2 and 6. The SWG agreed that the authors of these reports should ensure widespread distribution of the recommendations to key government agencies.

Further information sources

- Information on disentangling methods has been extracted from SC/54/BC2 (Appendix 7)
- The conveners of the recent workshop in Annapolis, MD (USA) are developing a web site for the strategy
- Japan fisheries whale web site – disentanglement strategy (only available in Japanese)

8. OTHER

8.1 Review of Arctic Issues

George presented a summary of a research proposal on biocomplexity in the Arctic (SC/54/E3) submitted under a U.S. National Science Foundation program called Biocomplexity in the Environment. The proposal promotes comprehensive, integrated investigations of environmental systems. The proposed study seeks to understand how climate variability influences the distribution of bowhead whales and ultimately the continued existence of traditional lifestyles for native communities that hunt marine mammals in Arctic Alaska. It is a multi-faceted and multi-disciplinary study. On the local scale, the results of the research will provide a greater understanding of the factors influencing the dynamics of bowhead whales and the subsistence whaling tradition, which is particularly vulnerable to changes in resource availability in response to both environmental changes and human-generated pressures. On a wider scale, the proposed research will address how multiple physical, biological and anthropogenic factors are linked in a coupled natural-human system that may be critically affected by climate variability. The interactions in this coupled system will be quantified using a combination of retrospective analyses coupled with biological-physical modeling of the atmosphere-ice-ocean system and the climatic variability therein and local monitoring of oceanographic conditions to verify model predictions during the study. Two major climate regimes that have been identified in the western Arctic Ocean and are associated with wind driven circulation patterns modulated in part by the Arctic Oscillation (AO) will be modeled. The proposed study will focus on two communities, Barrow and Kaktovik, near where bowhead whales traditionally aggregate and where regular, sustained subsistence harvests are integral to the culture and viability of the communities. To understand the linkages between climate variability, bowhead whale distributions and subsistence whaling, the following set of questions will be addressed in the study:

- 1) What are the oceanographic conditions favorable to the development of zooplankton aggregations in the study areas?
- 2) How does zooplankton species composition differ at each location between the two climate regimes (positive Arctic Oscillation phase versus negative phase)?
- 3) Can bowhead residence time near whaling villages be predicted by the phase of the Arctic Oscillation, resultant oceanographic conditions and concomitant prey availability)?
- 4) How does whale distribution impact the success of bowhead whaling and the subsistence economy of the whaling villages?

The study will be conducted in close coordination and consultation with the native communities and a community and include community outreach and education components. If funded, the program described in SC/54/E3 would last on the order of 3-5 years. A funding decision is likely prior to IWC 55.

Thiele summarized the parts of SC/54/O3 relevant to this agenda item. She noted that the National Marine Fisheries Service had undertaken research using autonomous, underwater recording devices that are capable of recording the vocalizations of large whales for periods up to 12 months. To date instruments have been deployed in the eastern Bering Sea, the northern Gulf of Alaska, and the Southern Ocean in the vicinity of the Antarctic Peninsula. It was also noted that because an array of these instruments is deployed, not only is it possible to gather presence-absence type information for large whale species, but it is also possible to estimate the location of vocalizing whales. In waters off Alaska, these instruments have been deployed to address the seasonal distribution of the North Pacific right whale.

In the brief discussion of this paper, it was noted that cost for each unit is several thousand pounds, the recorders have to be retrieved to obtain the data, and there are plans to make them record at higher frequencies (currently they record up to 500 Hertz), which would be more appropriate for medium to small sized cetaceans.

8.2 Preparation for review of Arctic research at SC/55

After some discussion, it was recommended that a mini-symposium (i.e., 2-3 sessions) on the high latitude climate change research and the effects of such changes on cetacean populations should be recommended to the SC as a primary focus of the SWG during IWC 55. An intersessional steering group, chaired by Theille, was established to organize the mini-symposium.

8.3 Procedures for contaminant data submission

IWC resolution 1999-4 expressed concern about human health effects related to the consumption of cetacean products. Considerable uncertainty exists about how the World Health Organization (WHO) would like concentrations of contaminants in cetaceans reported, because WHO has high standards for submissions to its Global Environment Monitoring System (GEMS). There is a new manual that provides details of the requirements for data to be submitted to the WHO/GEMS. Krahn briefly reviewed the information presented in this manual and summarized the steps necessary for data submission (SC/54/E2). Although data could be formatted manually, it would be more efficient for laboratories to automate the procedures if large quantities of data need to be submitted. Thus, if the IWC would like to have cetacean contaminant data submitted on a large-scale or regular basis to the WHO/GEMS database, Krahn recommended that IWC provide funds for creation of a spreadsheet or database to automatically convert chemical contaminant data for cetaceans into a format that would be acceptable for WHO.

The SWG expressed its appreciation to Krahn for the considerable time spent collating and simplifying a very complex submission process.

8.4 Other

Several papers on a variety of topics were reviewed on an ad hoc basis by the SWG.

E. Clark presented SC/54/E4, which considered the current status of the ozone layer and the success of the "Montreal Protocol on Substances that Deplete the Ozone Layer." It was noted that there was a general trend of decreasing Antarctic ozone levels since the early 1980s, with the largest ever "ozone hole" (28.4 million km²) occurring in the 2000/1 season. The "ozone hole" in the 2001/2 season was greater than 25 million km². Despite the success of the Montreal Protocol in curbing the worldwide consumption and production of ozone depleting substances, the ozone layer remains extremely vulnerable and some considerable challenges remain to be resolved. Antarctic ozone depletion is predicted to increase over the next 5-20 years and level off in the first half of this century. Following this, recovery is expected to take several more decades. Arctic ozone depletion is predicted to become more severe in the near future, with the possibility of an ozone hole occurring within 20 years or so of similar magnitude to the hole that currently develops annually over the Antarctic. E. Clark suggested that recovery might be significantly delayed by other factors such as a predicted increase in atmospheric nitrous oxide, volcanic activity and interactions with climate change and other stratospheric meteorological phenomena. Recovery predictions generally assume full compliance with the Montreal Protocol, which E. Clark suggested was not a realistic scenario. SC/54/E4 concluded that it was a matter of great concern that cetaceans would be exposed to both direct and indirect effects of increased exposure to ultraviolet radiation corresponding to current predictions of ozone depletion. A member of the group asked E. Clark if there were indications that skin pathologies are becoming more evident in stranded cetaceans. E. Clark noted there were a few observations of pox marks in southern right whales that had been reported previously to the SWG and that these were thought to be related to ultraviolet exposure and changing levels of ozone, but only through inference.

Aguilar presented a study on the distribution of retinoids (Vitamin A) in tissues of the common dolphin (SC/54/E9). In mammals, retinoids are essential for many physiological functions, for example, the immune system, growth and reproduction. Some pollutants, PCBs in particular, are known to induce depletion of body retinoid levels, and consequently to have an adverse impact on populations. Because of this, retinoids have been selected as target biomarkers in the IWC's POLLUTION 2000+ program. However, baseline studies are needed to understand the patterns of retinoid distribution in the body of cetaceans in order to design sampling protocols. Results of the study show that blubber is a main site for retinoid storage. In terms of quantity, this location was found to be even more significant than the liver for retinoid storage. Biopsy samples of blubber can therefore be used to monitor the retinoid status of free-ranging individuals. Because some anterior-to-posterior and dorsal-to-ventral variability in retinoid concentrations has been observed, it is recommended that sampling be standardized with respect to body location as much as possible.

In the discussion of this paper, Yasunaga raised three issues. The first issue concerned the possibility of sample treatment prior to analysis affecting measured retinoid concentrations. Aguilar responded that although vitamin A is critical constituent of the skin's outer layer, it does not reach very high levels in the epidermis. Rather, this constituent is more abundant in the layer under the epidermis, which is very rich in fat. Thus, analysis of retinoid concentrations in blubber samples is not likely to be confounded by the presence of epidermis in the samples. The second issue argued for the necessity for verification that retinoid concentrations detected in blubber are correlated with concentrations in target organs and accurately reflect retinal status of the animal. Aguilar explained that the described study did not address this more complicated issue but that future work will examine the correlations between retinoid levels in serum, organs and blubber, the latter being a significant place for retinol deposition in the body. The final issue raised by Yasunaga emphasized the importance of studying the relationship between retinoid concentration in blubber and thyroid disorders. Aguilar noted that he did not know of any such studies relating retinoid concentrations in the blubber and thyroid disorders, although he commented that there are many studies in the literature indicating that low levels of retinol are associated with skin, reproduction, growth and immune disorders and certainly has the capacity to influence other functions.

Rose provided a brief summary of Morton and Symonds (2002), which was considered more fully in the sub-committee on Whale Watching. A long-term study was conducted in two areas of British Columbia, Canada, to determine the effects on killer whales of acoustic harassment devices (AHDs) used by fish farming operations in one of the study areas to deter predation on fish pens by harbor seals. The area where AHDs were employed showed a significant decline in killer whale occurrence, while other parts of the study area not impacted by AHDs, did not. Killer whale occurrence returned to original levels when the use of AHDs was discontinued. The study concluded that noise from the AHDs caused the displacement of killer whales in this area.

Results from a portion of the JARPN feasibility studies were also discussed (SC/54/O17, appendices 13-15). As part of a comprehensive monitoring system of pollutants in the marine ecosystem, appendix 13 described preliminary results on accumulation and temporal trends of trace elements, such as Mn, Fe, Cu, Zn, Se, Cd, Pb, Hg (total and organic form) in minke whales collected from the western North Pacific during JARPN and JARPN II surveys between 1994 and 2000. The relationship between trace element concentrations and biological data, such as sex, body length and age were examined in addition to the temporal trends in these concentrations. Appendix 14 described the preliminary results of persistent organochlorine measurements in the air and the sea surface waters in the western North Pacific during the JARPN II survey that are

being monitored to determine global transport of these substances. Persistent organochlorine levels (PCBs, DDTs, HCHs, HCBs and CHLs) were monitored in western North Pacific minke whales during the JARPN survey. The objective of the study described in Appendix 15 sought to address a SWG request made during SC52 to compare the concentrations of trace elements in skin tissue with those found in liver, kidney and muscle tissues. Concentrations of Mn, Cu, Zn, Se, Cd, Pb, and Hg (total and organic form) were determined in the liver, kidney, muscle and skin of 15 minke whales taken in the western North Pacific during JARPN surveys in 1995-1999. There was a significant correlation between levels of toxic elements and iron in some organs and skin. No such correlation of essential elements between these organs and skin was found. Results pertaining to toxic elements in the liver were consistent with those from Antarctic minke whales; however, regarding essential elements there was no consistency between concentrations in the skin and internal organs. The authors recommended that the use of biopsy methods to monitor for trace elements in cetaceans needed further examination.

In the discussion of these appendices, it was asked if the reason was known for why concentrations of mercury between some organs and skin were correlated in minke whales from the western North Pacific but not in Antarctic minke whales. It was noted that investigation of this result was still being explored. One factor that is being examined further is the potential effect of prey types consumed by minke whales in these two areas. Also being considered is the possibility that the relatively low concentrations found in Antarctic minke whales may preclude the detection of such a correlation. It was suggested that information be presented on DDT derivatives (i.e., DDE and DDD) and PCB congeners. Also, this information was considered to be relevant in assessing the effect of contaminants on the health of stocks because PCB congeners vary in their toxicity. In response, it was indicated that some information on congener-specific concentrations were available and would be provided at the next meeting of the SC.

In response to a question from Fujise about the scope of POLLUTION 2000+, M. Simmonds noted that in discussions of the Working Group considering the JARPN II proposal, the relationship of the proposed pollution work to the POLLUTION 2000+ research programme arose. He noted that it had always been his understanding that the POLLUTION 2000+ project was carefully developed over a number of years and based on a number of cetacean species, which existed along a gradient of pollution levels and where suitable samples and data were available, such that progress could be made within a reasonable amount of time. He added that the suggestion that JARPN II program might compensate for the lack of direct data in baleen whales collected under POLLUTION 2000+ to date was not appropriate because the POLLUTION 2000+ programme was already aimed at developing results applicable to all cetaceans. Some members of the SWG did not agree with this position, and considered the results on contaminant levels from JARPN II important in regards to the effect of pollution on the management of large whales. In addition it was noted that the POLLUTION 2000+ programme currently does not include any direct study involving any large whale species.

Peddemors presented a report on the recent categorization of South African cetaceans according to the 2001 IUCN Red List Criteria (SC/54/O22). Under these recent IUCN criteria, environmental factors influenced many categorizations, and several cetaceans were classified as vulnerable because of environmental factors.

Rojas-Bracho presented information on a potential major tourist development (called "Nautical Steps") being proposed in Baja California, Mexico. The proposed development would involve more than 4,000 km of coastline and would include a system of new marinas along the entire coastline of the Baja California Peninsula and the coasts of Sonora and Sinaloa in mainland Mexico. Both the Pacific coast of Baja California and the Sea of Cortez are considered important breeding and feeding grounds for many species of marine mammals. Many baleen whales occur in these waters, including fin, sei, Bryde's minke, humpback, gray, right and blue. A distinct resident population of fin whales is found in these waters, which are also one of the two known breeding grounds for North Pacific blue whales. Potential impacts of the "Nautical Steps" development should be carefully considered and possible threats to cetaceans and other marine life in the area identified and minimized. One author specifically noted the potential for major physiographic disturbance during construction and maintenance of this development, especially with respect to numerous proposed marinas, whose exact locations and configurations have not been identified yet. Additional information on the Nautical Steps development is reported in Appendix 8.

The SWG **recommended** that the SC recommend that the Commission request information from the Government of Mexico on the specific locations and types of construction that comprise this development project (i.e., Nautical Steps). Further, the SWG **recommended** that the SC recommend that the Commission request the Government of Mexico to take steps to ensure the maintenance of this important cetacean habitat.

Weller briefly summarized a paper concerning observations of western gray whales on their feeding grounds in relation to seismic exploration in this area (SC/54/BRG14). This paper was addressed primarily in the BRG sub-committee, and specific recommendations resulting from their discussions can be found in the report of that group.

Regarding the seismic exploration referred to in this paper, the authors were asked whether they had measurements of the noise caused by the seismic exploration. It was reported that data concerning these seismic activities were being collected but remain confidential property of the company conducting the activities. The SWG agreed that when considering the potential adverse effects to cetacean populations from exposure to seismic exploration activities associated with oil and gas development that it would be useful to exchange information on the specific biological concerns for cetaceans with the oil and gas industry operating in a given area. Therefore, the SWG **recommended** that scientific experts on the western North Pacific stock of gray whale and oil and gas industry experts regarding operations off Sakhalin Island hold one or more workshops to identify specific potential risks to this population from oil and gas exploration activities and to identify potential alternative methodologies to mitigate any potentially harmful effects.

SC/54/SM5, presented in the sub-committee on Small Cetaceans, also contained information relevant to the work on habitat degradation by this SWG and is noted here as a cross-reference.

9. WORK PLAN FOR SC/55

The following intersessional groups were agreed:

1. SOCER: Rose and Stachowitsch
2. Whale-Fish Interactions: Northridge
3. CCAMLR/SO-GLOBEC: Thiele
4. Pollution 2000+: Reijnders
5. Arctic Issues: O'Hara
6. Habitat Degradation Workshop: M. Simmonds
7. Mini-Symposium on High Latitude Climate Change Effects: Thiele
8. Noise-related Issues: Rowles.

The SWG outlined the main items for consideration at next year's meeting. The following work plan for SC/55 was agreed:

1. Report from Whale-Fish Interactions Workshop (priority: major topic with 2-3 sessions)
2. High latitude climate change mini-symposium (priority: major topic with 2-3 sessions)
3. Review progress on the State of the Cetacean Environment Report (SOCER) (priority: minor topic with less than 1 session)
4. Review results from workshop on habitat degradation (priority: minor topic with less than 1 session)
5. SO-GLOBEC/CCAMLR update (priority: minor topic with less than 1 session)
6. POLLUTION 2000+ update (priority: minor topic with less than 1 session)
7. Arctic issues (priority: minor topic with less than 1 session)
8. Other (e.g., preparation for workshop on the effects of noise on cetaceans)

The SWG agreed the following budget request:

Title	Funds Required (£)	Justification
POLLUTION 2000+	54,410	(see SC/54/E14)
SO-GLOBEC	25,000	(see Appendix 9)
Habitat Degradation Workshop	15,500	(see JCRM 2002: 314-319)
Preparation of SOCER	3,000	2 months salary, copying charges, phone costs

M. Simmonds commented that as was the case last year, he and other members of the SWG were hopeful that they would be able to secure and additional £15,500 for the Habitat Degradation Workshop from sources outside of the IWC.

The Chair (DeMaster) was asked to note for the record the reservation of the SC delegates from the Government of Japan regarding budgets for some of the programmes supported by this working group that are not related to the purpose of the IWC, including SO-GLOBEC, POLLUTION 2000+, the habitat degradation workshop, and the preparation of the SOCER.

10. ADOPTION OF REPORT

The report was approved on 5 May 2002 at 1715 hrs. The SWG thanked DeMaster, Thiele and Donahue for all of their effort in running the meetings of the SWG and preparing the report.

REFERENCES

- Jacobs, S.S. and Comiso, J.C. 1993. A recent sea-ice retreat west of the Antarctic Peninsula. *Geophysics Research Letter* 20: 1171-1174
- Jacobs, S.S. and Comiso, J.C. 1997. Climate variability in the Amundsen and Bellingshausen Seas. *J. Climate* 10:697-709.
- Lindstrom, U. and Haug, T. 2001. Feeding strategy and prey selectivity in common minke whales (*Balaenoptera acutorostrata*) foraging in the southern Barents Sea during early summer. *J. Cetacean Res. Manage.* 3(3):239-249.
- Morton and Symonds 2002. *ICES Journal of Marine Science* 59:71-80.

Appendix 1 (Agenda)

1. CONVENOR'S OPENING REMARKS
2. ELECTION OF CHAIR, APPOINTMENT OF RAPORTEURS
3. REVIEW OF AVAILABLE DOCUMENTS
4. ADOPTION OF AGENDA
5. COOPERATIVE RESEARCH IN THE ANTARCTIC (*2.0 sessions*)
 - 5.1 Results from SOWER 2000 cruise
 - 5.2 Progress on development of joint research program with SO-GLOBEC
6. STEERING GROUP REPORT ON POLLUTION 2000+

7. HABITAT RELATED ISSUES
 - 7.1 State of Cetacean Environment
 - 7.2 Steering group report on workshop on habitat degradation
 - 7.3 Review information regarding whalewatching activities and noise impacts
 - 7.4 Competition between cetaceans and fisheries
 - 7.5 Mitigation of incidental capture of large cetaceans in fishing gear
8. OTHER
 - 8.1 Review of Arctic issues
 - 8.2 Preparation for review of Arctic research at SC/55
 - 8.3 Procedures for contaminant data submission
 - 8.4 Other
9. WORK PLAN FOR SC/55
10. ADOPTION OF REPORT

APPENDIX 2 (AGENDA ITEM 5.2)

COLLABORATION BETWEEN THE IWC AND SOGLOBEC AND CCAMLR IN THE ANTARCTIC PROGRAM FOR THE NEXT DECADE AND BEYOND

Thiele, D. and Moore, S.

Current 2001 and 2002 field work

Multidisciplinary research was conducted under national Antarctic programs at two focus areas: the Western Antarctic Peninsula (WAP); and East Antarctica. The US SO GLOBEC effort consisted of six survey and process cruises (three each year) to the Marguerite Bay WAP study area. The German program consisted of one cruise in April/May 2001 to the WAP study area, and an area of oceanic ice edge to the west of Alexander Island. Off East Antarctica, Australia conducted a fine-scale krill survey (early 2001). The IWC participated in the US and German programs and reports of this work and preliminary findings have been presented in SC/53/E8, SC/54/E12, and SC/54/O3. Cetacean research conducted under the Australian program will be presented to the IWC by Thiele in future.

This initial two year field season for SO GLOBEC will be completed in late winter 2002. **Preliminary analysis of data from the two year field season has quickly revealed that the ecological processes we are attempting to study are long-term in nature and thus require a research effort on a similar temporal scale. A follow on SO GLOBEC effort is being planned.**

Timetable for publications and presentations for current 2 year SO GLOBEC

Presentations and papers on the current cruises have been made at:

2010 and 2002 US SO GLOBEC Planning meetings;

Vancouver Marine Mammal Science Meeting (Nov 2001);

Honolulu Ocean Science Meeting (February 2002).

Mini krill – whale data integration workshop

Planned for August – September 2002 in US

October 2002 Second International GLOBEC meeting in Qingdao, China

Presentations from all disciplines involved in US SO GLOBEC, and Australian and German programs will be made here.

Moore and Thiele will be involved in the planning meeting of SO GLOBEC national program leaders for the follow on SO GLOBEC design

November 2002 Deep Sea Research Special Issue

Manuscripts for this special SO GLOBEC issue will be submitted

2002/2003 Synthesis and modeling phase

The scale and complexity of data from the wide range of disciplines collected through SO GLOBEC studies will require a significant effort if useful integration of data series is to occur. This integration process is essential to understanding ecosystem processes and to the development of future research programs. Therefore, the US National Science Foundation will be supporting a synthesis and modeling phase as the immediate follow on to the SO GLOBEC field work. The IWC will be included in this process at extremely low cost to itself.

Future SO GLOBEC – the follow on program

Planning will take place at International GLOBEC meeting in China (Hofmann, other national program leaders, Thiele and Moore). US plan to conduct 5 – 10year (at least) multidisciplinary program in Amundsen and Bellingshausen Seas. Australia plan to conduct a similar long term effort at a new CCAMLR Ecosystem Monitoring Program site based at sea off Mawson base in East Antarctica (~60 70E). Germany are planning 3 cruises over one year 2004/05 as their SO GLOBEC contribution.

Field work planned for 2002/03 and beyond

2002/03 - IWC and passive acoustics collaboration (4 berths) confirmed for UK British Antarctic Survey (BAS) combined CCAMLR/SO GLOBEC Scotia Sea in January – February 2003. At least one year deployment of passive acoustic recorders, possibility of long term passive acoustics and other field work in this area. Visual survey, possible biopsy, sonobuoy deployment.

2002/3 to 2012/13 – Visual survey, biopsy and fine scale ecological studies with passive acoustics collaboration on one dedicated multidisciplinary survey per season for 5-10 years. Year round acoustic moorings to be deployed long term. Six berths confirmed for Australian SOCEP program under Antarctic Marine Living Resources Program (AMLR) at annual CEMP site (off Mawson). CCAMLR and SO GLOBEC related multidisciplinary studies.

2004/05 – IWC participation under development with a series of three SO GLOBEC cruises over one year to a study site in the Weddell Sea. At least one full year deployment of passive acoustic recorders, possibility of long term. Visual survey, possible biopsy, sonobuoy deployment. These cruises planned for December/January 04/05 and March/April and July August in 2005.

IWC collaboration and funding

We (Moore, Hildebrand, and Thiele) have formed a collaborative group to access significant external funding. Currently we have proposals in to fund the majority of IWC participation in field and analysis work for the next 5-10 years (National Governments and Private Trusts). IWC participation forms a core part of these proposals. The proposals have been developed in collaboration with SO GLOBEC (Eileen Hofmann), CCAMLR and national Antarctic program leaders. We will continue to build on the existing network of national programs and international organisational links to provide extensive opportunities to utilize platforms of opportunity for work of importance to the IWC in this region.

This collaboration has been formed to facilitate the development of an integrated approach to cetacean ecological research which can in time provide us with a significant increase in our understanding of seasonal and interannual changes in distribution and movements of baleen whales in relation to physical and biological processes and system variability at all scales, throughout the Antarctic. It incorporates the use of year round Acoustic Recording Devices (ARPs see SC/54/O3) around the Antarctic; visual survey, biopsy and sonobuoy field programs on deployment vessels; and at least two fine scale ecology sites (USA Amundsen and Bellingshausen Seas, Australian at sea Mawson CEMP site) which will provide the opportunity to return to one study area every year and conduct experimental ecological studies in a multidisciplinary context. These field sites will allow ground truthing of data collected from moorings and deployment cruises.

The program will:

- ensure the continued collaboration of the IWC in SO GLOBEC and CCAMLR national field and analysis efforts;
- ensure that passive acoustic and visual/biopsy and biological oceanography field studies are conducted simultaneously and in a standardized manner;
- facilitate the deployment of passive acoustic recorders (ARPs) see SC/54/O3 on a circum-Antarctic scale, and throughout the Indian Ocean (where there appears to be a greater diversity in possibly geographically distinct blue whale calls);
- facilitate the simultaneous collection of visual/biopsy/sonobuoy field work on vessels deploying ARPs;
- addition to conduct a range of cetacean been invited to submit proposals to NSF to participate in this process and ensure the continued integration of cetacean data in ecosystem analysis and modeling.

In order to maintain IWC collaborative status within these programs it is essential that a small core of funds be allocated on an annual long term basis from the budget. These funds will be used to support coordination of IWC participation, planning and involvement in analysis.

Appendix 3 (Agenda Item 5.2)

A PROCESS FOR DEVELOPING AND EVALUATING A DATA COLLECTION SYSTEM FOR ICE DATA ON ANTARCTIC CETACEAN FIELD PROGRAMS

Thiele, Ensor, Hedley, Moore, Peddemors, Shimada, Tynan

The importance of understanding the linkages between ice-ocean processes, whale distribution, abundance and movements, and the dynamics of other Antarctic marine biota, particularly whale prey species has been highlighted in several presentations the SC. Our field experience in this region and work alongside sea-ice and other marine science disciplines have convinced us of the need for a standardized ice data collection method for use on whale research platforms in the ice. The development and implementation of a standardised method for these data would provide comparability between data sets (many of which have common standardized methods of sighting survey data collection), which are not currently possible. The implementation of this system will also provide scope for ensuring that biologically useful ice information is collected routinely.

This interseasonal group proposes to develop a relatively simple and practical standardized data collection system from sea-ice observation protocols developed by sea-ice physicists (currently available in cd format and used by national programs throughout the Antarctic). We will assess the complexity and practical application of the whole, or parts of this program for whale research on the basis of our experience on sighting survey platforms and qualitative understanding of the components of sea-ice that may be influencing whale ecology. After initial assessment of the cd, and comments from this group, a series of pull down menus might be developed and adapted for inclusion in the current Wincruz Antarctic computer based sighting program. This program is used extensively in the Antarctic, and is both practical and amenable to the inclusion of some additional pull down menu functions.

We expect that this form of data collection will result in the production of an extremely useful data series to be used in studies explaining the observed distribution of high latitude whale species. For example, these data will allow the formulation of hypotheses based on quantitative data of both a biological and physical nature. These hypotheses should assist with designing research programs to address issues relating to the seasonal and interannual variability in whale distribution and abundance in sea-ice habitat, and the role of climate change impacts over time.

Field trials using the system will be conducted in the 2002/03 on a number of Antarctic cruises where possible (IWC-CCAMLR, SOCEP, IWC-SO GLOBEC). Changes may be made to the protocol after the trial. A document will be presented at IWC55 for discussion in relevant sub committees. We would hope to obtain approval for the protocols to be recommended for use by the IWC Scientific Committee once discussions in Sub Committees have been taken into account.

These data should prove to be of considerable use to the work of the IWC SC, as there are very few simultaneously collected whale – ice data series available for analysis from this region at present.

Outline of tasks for group:

1. Thiele to distribute Australian Antarctic Division Sea Ice Data Collection CD to group members
2. Thiele to consult with Moore re ice data collection methods in Arctic and assess usefulness/applicability to Antarctic
3. Thiele passes these on to Peddemors to include in his review
4. Peddemors to conduct initial review of cd material and make recommendations for content of pull down menus for Wincruz Antarctic and/or possible simultaneous use of CD
5. Tynan will consult with sea-ice groups and other disciplines to determine their definitions of the 'ice edge'. These will be reported in the assessment to IWC55.
6. Members of group receive Peddemors recommendations and make comments
7. Group decide on a system to trial before October 2002
8. Members to test any adjustments to Wincruz Antarctic before field trials in time to have possible bugs removed.
9. Time to be allowed before field trials to have any bugs corrected.
10. Hedley to liaise with Rob Holland to allow inclusion of pull down menus in Wincruz Antarctic prior to field season (austral summer 2002/03). Adjustments to be made by November 2002.
11. Members and colleagues use trial system
12. Report of trial program to group compiled by Thiele
13. Appropriate amendments made to protocols
14. Paper and example of protocols/system finalized prior to IWC55

Appendix 4 (Agenda Item 6)

Not to be cited without prior permission from the authors

PRELIMINARY RESULTS OF ACTIVITIES UNDER POLLUTION 2000+

based on contributions by

ALEX AGUILAR, ASSUMPCIO BORRELL, GREG DONOVAN, RUTH EWING, CHRISTINA FOSSI, GINA YLITALO, HEATHER KOOPMAN, MICHAEL MOORE, TODD O'HARA, ANDY READ, PETER REIJNDERS, HOWARD RHINEHART, TERI ROWLES, ANNA SELLAS, URSULA SIEBERT, JEFF STOTT, VICTORIA TORNERO, RANDY WELLS, JOANNA WILSON.

1. INTRODUCTION

The Steering Group (SG) for the POLLUTION 2000+ further implemented the programme during the year, mainly through e-mail. For the bottlenose dolphin sub-project, activities centred on: (1) analyses of bottlenose dolphin samples from Sarasota Bay (2) comparison of PCB-concentrations in blubber samples from the three study sites: Bahama Islands and Charlotte Harbor (representing 'low polluted' sites) and Sarasota Bay (representing a 'moderately polluted' site). Under the harbour porpoise post-mortem calibration study, activity centred on the collection and initial processing of samples from bycaught porpoises.

2. BOTTLENOSE DOLPHIN SUBPROJECT PROGRESS DURING 2000-2002

Introduction

Original plans called for biopsy darting of bottlenose dolphins in: (1) the Mediterranean Sea to obtain samples from dolphins likely to carry high concentrations of PCBs in blubber; and (2) the Bahama Islands to obtain samples from relatively "clean" dolphins. Blubber (and other) samples were also to be obtained during capture/release operations in Sarasota, Florida (a site presumed to be intermediate in terms of PCB pollution). The small sample masses obtained from biopsy darting do not permit sufficient testing for the full suite of potential biomarkers. Problems encountered in access to the Bahamian field site following initial sampling led to exploratory biopsy darting to obtain blubber samples from bottlenose dolphins in Charlotte Harbor, Florida, a less-developed estuary south of Sarasota Bay.

Capture-release operations in Sarasota Bay provided detailed information on health and body condition, as well as the larger blubber sample masses and samples of blood and urine needed for "ground-truthing" the potential biomarkers.

A major feature of the Sarasota Bay study is that research on that bottlenose dolphin community has been ongoing since 1970 and a wealth of information is available for each individual (and the genetic relationships between individuals). The Sarasota-based research program has also been developing methods for assessing the population status and health of coastal bottlenose dolphins, not only to monitor the risks to the populations themselves, but also to assess their use as sentinels of the health of marine ecosystems. At least 60% of inshore dolphins on the west coast of Florida are individually identifiable from dorsal fin features, facilitating direct counts and mark-recapture estimates. Using photographic identification techniques (Scott *et al.* 1990b) it is possible to define individual home ranges (*e.g.*, relative to contaminant sources) and measure female reproductive success as well as monitor population-level trends in abundance, losses, and other vital rates (Wells and Scott 1990).

Methods

Biopsy Dart Blubber Sampling, Charlotte Harbor -- Samples were obtained using a modified .22 caliber rifle (Geiges Instruments). Lightweight, untethered darts were fired from the rifle using blank power loads of a medium charge level. Dart shafts were approximately 45cm in length and made of either aluminum or carbon fiber. Aluminum dart shafts were outfitted with a stainless steel sampling adaptor and sampling head as described in Palsbøll *et al.* (1991) (designed by F. Larsen). Carbon fiber shafts were outfitted with slightly different stainless steel adaptors and sampling heads (Geiges Instruments). Samples consisted of a piece of epidermis approximately 5-10mm in diameter, and a piece of blubber from directly adjacent to the epidermis of approximately 1cm³. Prior to each use, the rifle was loaded with a dart containing a clean shaft and unused sampling head. Following dart recovery, biopsies were extracted from the dart tip using sterile hemostats and placed in a clean glass petri dish. The epidermis portion of the sample was dissected from the blubber using a disposable scalpel blade and stored in a separate, cryogenic vial.

Photo Identification, Charlotte Harbor -- A mini digital video camera was mounted onto the barrel of the gun to record the biopsy shot, bottlenose dolphin response to the darting and possible identifiable marks on the sampled dolphin. Photographs taken throughout sightings enabled some biopsy samples to be linked with distinctive animals. Previous photo-identification studies provided an existing catalog of distinct bottlenose dolphins for comparison (*e.g.*, Wells *et al.* 1996b, 1997 for Charlotte Harbor). When distinctive sampled animals were matched to an existing animal in the catalog, a four-letter identification code and a sighting history were then associated with the biopsy. Sighting histories contain information on sighting dates and locations and other bottlenose dolphins identified in the same group. Individual identifications are crucial for identifying the animal's region of residency (for evaluation of history of exposure), and for minimizing the possibility of sampling a single individual more than once.

Sex Determination of Darded Dolphins, Charlotte Harbor -- Following collection, samples were stored either in a 20% DMSO solution saturated with NaCl or frozen at -80°C. Genomic DNA was extracted from approximately 25mg of tissue using standard proteinase K digestion and phenol/chloroform extraction protocols as outlined in Rosel and Block (1996). DNA quality was estimated by applying 2µl of the final extraction

product to a 1% agarose gel and the DNA concentration was quantified using fluorometry. Primers designed to amplify ZFX and SRY sex-chromosome-specific regions were used in a polymerase chain reaction (PCR) to determine the sex of biopsy samples (Palsbøll *et al.* 1992). Amplification reactions (25µl) contained 100ng DNA, 20mM Tris-HCl, pH 8.0, 50mM KCl, 1.5mM MgCl₂, 0.3µM of each primer, 150µM dNTPs and 1.5 units of Taq DNA polymerase. The thermal cycler profile consisted of initial denaturation at 94°C followed by 35 cycles of denaturation at 94°C for 30 seconds, annealing at 51°C for 45 seconds and extension at 72°C for 45 seconds. Amplified products were run on a 2.5% agarose gel and photographed. One known male and one known female sample were run per gel to serve as positive controls. A negative control was run to test for contamination.

Capture/Release – Bottlenose dolphins are captured for examination and sampling by encircling them with a 500 m x 4 m seine net in shallow waters where handlers can safely stand and support dolphins as necessary. Initially, adult females undergo ultrasound examination for pregnancy before deciding to bring them aboard the examination vessel. Each dolphin considered suitable for further examination out of the water is transferred to foam pads on the shaded deck of a boat, where it is weighed and a standard series of length and girth measurements is collected. Throughout the examination, behavior and respiratory patterns are closely monitored, and water is applied liberally externally. Blubber depth is measured ultrasonically at standard sites. Abdominal and thoracic organs are evaluated via diagnostic ultrasound. Core body temperature is measured using a colonic probe. Blood samples (serum and plasma, up to 320 ml) are collected via venipuncture of the fluke. Blood samples are used for 1) standard clinical chemistry, hematology and reproductive hormones, 2) immunological studies, 3) genetic studies including paternity analyses, 4) circulating levels of environmental contaminants, and 5) retrospective investigations of disease processes. Urine is collected using sterile catheterization of the urethra. Milk is expressed using a custom suction collection system for compositional analyses and measurements of environmental contaminants. Sterile swabs are used to collect samples from the blowhole, feces, and genital tracts for microbiological analyses. Small blubber wedges (4 cm long x 3 cm wide x up to 1.5 cm deep) are obtained for contaminant analyses following local anesthesia from a standard location below the dorsal fin. Most of the Sarasota Bay residents are of known age through observation, but a tooth is collected under local anesthesia from individuals of unknown age for sectioning and counting of growth layer groups (Hohn *et al.* 1989). A full examination and sampling program typically requires about one hour, and then the dolphin is returned to the water and released. More than 180 individuals have been handled in Sarasota Bay since 1970.

Blood Sample Analyses – Blood samples (serum and plasma) were shipped daily following collection processing, and analyzed by Cornell University Diagnostic Laboratory for chemistry, hematology, and thyroid and reproductive hormones.

Blubber Organochlorine Pollutant Concentrations – Blubber samples were placed in liquid nitrogen immediately following collection, stored in an ultracold freezer (-80°C), and then shipped in a batch from Florida to Spain in a liquid nitrogen shipping container. In Spain, the blubber samples were stored at -30°C until analysis. Samples weighing about 0.2-1 g were ground with anhydrous sodium sulfate and extracted with n-Hexane (residue-free quality) in a Soxhlet apparatus for 5 h. The solution obtained was concentrated to 10 ml. A portion of this extract (2 ml) was used to determine the quantity of extractable fat per gram of blubber. A further quantity was mixed with sulfuric acid for the clean up, and the resulting extract was concentrated to 0.1-1 ml and centrifuged for five minutes.

Chromatographic analysis was carried out on a Hewlett-Packard 5890-II G.C., equipped with an electron capture detector (ECD) at 350 °C. A fused silica capillary column (length 60 m, 0.25 mm ID) coated with SPB-1 was used as the stationary phase (0.25 µm film thickness). The splitless technique was used to inject 1µl of the purified extract. Pure Nitrogen gas at a flow rate of 1 ml/min was used as a carrier. Temperature was programmed as follows: injection at 40 °C for one minute and increased to 170 °C at a rate of 25 °C/minute; one minute constant, to 250 °C at a rate of 2 °C/minute and then to 280 °C, at 5 °C/minute. Heptachlor and congener 199 were used as internal standards.

Blubber Retinol Concentrations -- The blubber samples, weighing about 0.1 g each were saponified overnight in an ethanolic KOH solution (1 g KOH, 2ml distilled H₂O, 2 ml ethanol, 20 µg. ascorbic acid) in a mechanical shaker under a nitrogen atmosphere. Retinol was extracted by adding 8 ml diethyl ether and shaking for 30 minutes. After separation from the aqueous phase, the organic extract was cleaned three times with 4 ml of aqueous phosphates buffer (pH 7.4). The extract was dried under nitrogen and reconstituted with 1 ml methanol (with internal standard) and 0.1% butylated hydroxy toluene (BHT) as antioxidant. Reconstituted samples were filtered (0.45 µm mesh) and a 40 µl sub-sample automatically injected (Waters 700 Satellite wisp) on a HPLC (Waters 600 E system Controller pump) equipped with a Restek column (Trascer excel 120 ODS-A, 10 cm length, 5 µm beds, 0.46 cm internal diameter) and a UV detector (Waters 486 Tuneable absorbance D) set at 326 nm. The retinol was eluted at a flow rate of 1 ml/min using a mobile phase of methanol/water (90/10 by volume) for 1.5 min followed by a linear gradient of 0.5 min to methanol 100% for 18 min. Retinyl acetate was used as an internal standard for recovery determinations.

Immunohistochemistry – Biopsy samples were fixed in 10% neutral buffered formalin for assessment of Cytochrome P450 1A (CYP1A) expression. The samples were embedded in paraffin and sectioned at 5µm. Sections were deparaffinated, hydrated and stained immunohistochemically using a peroxidase anti-peroxidase detection system (Signet Laboratories, Dedham, MA) with the monoclonal antibody 1-12-3 to scup (*Stenotomus chrysops*) CYP1A as the primary antibody. This antibody recognizes CYP1A in a variety of taxonomically diverse vertebrates including cetaceans (Stegeman and Hahn 1994). Amino-9-ethylcarbazole (AEC) was used as the chromogenic substrate for visualization of CYP1A. Stained slides are counterstained with hematoxylin for visualization of nuclei. For each sample, a duplicate slide is treated with a non-specific antibody, MOPC31, to control for background staining. Control slides, which contain a series of livers from scup treated with chemicals that induce CYP1A, are included in each run to control inter-run variability.

Stained sections are being evaluated under light microscopy for stain occurrence and intensity in each cell type. Slides are examined with no indication of sample origin or history. Stain occurrence and intensity are scored on a scale of 0-3 and 0-5, respectively. CYP1A expression will be calculated as the product of the stain occurrence and intensity to generate a semi-quantitative index (scale of 0-15). In other cetacean biopsy samples examined to date, including bottlenose dolphins, CYP1A expression has been identified in vascular endothelial cells, vascular smooth muscle, macrophages and peripheral nerves but not in connective tissue, epidermis, and adipocytes in the skin of cetaceans

(unpublished data). The predominant cell type expressing CYP1A was vascular endothelial cells of the arterial system, including capillaries (unpublished data). There are no preliminary data to report at this time since slide reading is not yet complete.

Immunological Analyses – Blood samples are analyzed relative to inflammation, lymphocyte function, and leucocyte phenotype (for details see Reijnders *et al.* 1999)

Luciferase Analyses, Porphyrin Analyses, and Enzyme Induction analyses (for details see Reijnders *et al.* 1999).

Results

Sample Collection

BIOPSY DART SAMPLING –

Eleven samples were collected from the Bahama Islands (7 m : 4 f) during 2000, and from Charlotte Harbor (9 m : 2 f) during 2001. Three samples (sex is not yet determined) were collected from the Mediterranean Sea (Aguilar and Borrell 2001). All samples have been analysed for PCB concentrations, remaining sample quantities are stored for further biomarker analyses.

CAPTURE-RELEASE SAMPLING

Matched blubber, blood, and urine samples were collected from 47 dolphins from Sarasota Bay during June 2000 and 2001. The sample includes a representative cross-section of the resident dolphin community (~120 individuals), with sampled dolphins ranging in age from 2 to 50 years (Table 1).

Table 1
Sarasota Bay bottlenose dolphins sampled during 2000-2001

Age Class	Females	Males
0 – 10	11	10
11 – 20	5	5
21 – 30	1	2
31 – 40	4	3
41 – 50	4	2
TOTAL	25	22

Sample Analyses

Many of the proposed analyses have been completed. The central analyses for evaluation of the biomarkers, measurement of PCB concentrations in blubber, have been completed. These analyses resulted in data on total PCB as well as specific PCB-congeners, along with measures of % lipid.

The numbers and masses of samples available for each of the specific analyses varied with the type of tissue required, the difficulty of obtaining the sample, and the timing of identification of the analysis as part of the program. For the Sarasota Bay dolphins sampled during capture/release, analyses of blood samples for chemistry, hematology, reproductive hormones, thyroid hormones, and immune function are either underway or have been completed; the remaining blood, blubber, and urine sample analyses remain to be completed (Table 2).

Table 2
Status of analyses supported by samples collected from Sarasota Bay

Tissue	Analysis	Total	Females	Males	Status
Blubber	PCB Concentration	47	25	22	Complete
	Immunohistochemistry	47	25	22	In progress
	Enzyme Induction: Activity	21	11	10	In progress
	Luciferase	16	9	7	Pending
	Retinol (Vitamin A)	47	25	22	Complete
Blood	Chemistry, Hematology	47	25	22	Complete
	Reproductive Hormones	47	25	22	Complete
	Thyroid Hormones	47	25	22	Complete
	Immune Response	47	25	22	Nearly complete
	Total PCBs	21	11	10	To be decided
	Coplanar PCBs	21	11	10	To be decided
	Porphyryns	47	25	22	To be decided
	Luciferase	47	25	22	To be decided
	Vitamin A	47	25	22	To be decided
Urine	Porphyryns	38	16	22	To be decided

Immune Response

Blood samples obtained from Sarasota Bay bottlenose dolphins have been assayed for inflammation (serum levels of IL-6), lymphocyte function (mitogen-induced proliferation) and leukocyte phenotype (analytical flow cytometry).

Inflammation -- Thirty seven animals had no detectable IL-6, twelve animals had low levels of IL-6 (low-level inflammation) and two animals had high levels of IL-6 (substantial levels of inflammation).

Lymphocyte Function -- Lymphocyte function was tested using three mitogens, Concanavalin A (ConA), Phytohemagglutinin (PHA) and Pokeweed (PWM), each at two concentrations. We define three levels of lymphocyte function using the optimal concentration of mitogen as suppressed, depressed and normal. No animals demonstrated suppressed function; two animals demonstrated depressed function (depressed response to the mitogen ConA only) and the remaining animals (55) gave normal responses.

Analysis was also employed using differences between optimal and suboptimal concentrations of the mitogens ConA and PHA; such an analysis permits identification of what we term "*reduced T cell function*" (not normal and only giving healthy responses to the optimal concentration of each mitogen). The criteria used to identify reduced lymphocyte function included:

Absorbance of Suboptimal (Lo) Concentration <1.0

Difference in Absorbance : Optimal (Hi) – Suboptimal (Lo) >1.0

Ratio : Optimal (Hi) – Suboptimal (Lo) >1.5

Animals were ranked relative to how many criteria for reduced T cell function were met. Two animals met all three criteria for reduced T cell function for both mitogens; 12 met some criteria for reduced T cell function for at least one of the mitogens; 36 animals had normal responses to both concentrations of mitogens.

Responses to PWM were highly variable and the data do not allow for easily definable criteria. Analysis of this mitogen will be best performed when all other animal data (health assessments, toxicology, etc) are available.

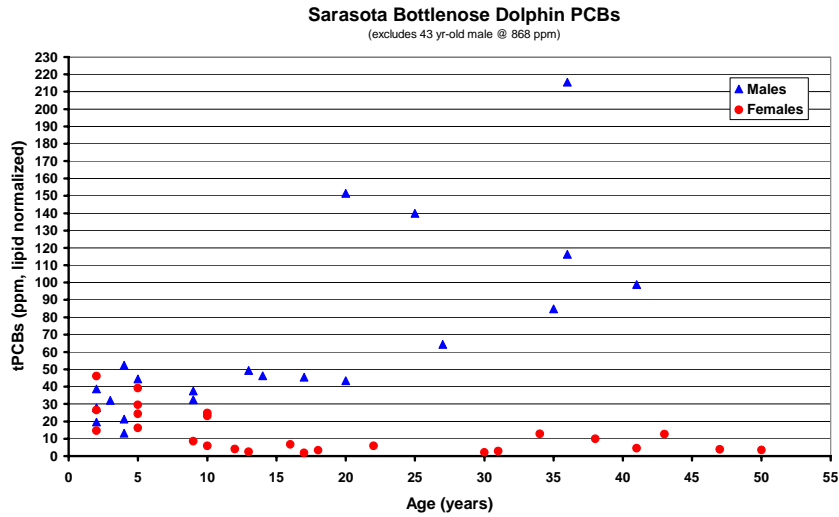
LEUKOCYTE PHENOTYPE -- Analysis of the various leukocyte subpopulations is not yet complete; expected completion date is June 1. However, preliminary observations of the animals analyzed to date would indicate we will find several outliers. Animal age affects the values and this will have to be factored into our final report associating contaminant levels with abnormal leukocyte profiles.

Discussion

In depth interpretation of the IWC POLLUTION 2000+ data relative to biomarkers and PCB concentrations will occur upon completion of sample analyses – it would be premature to present interpretation of initial results at this time. Many of the data have become available only recently, while some of the analyses remain to be completed. Once all of the sample analysis data are available, it will be necessary for the principal investigators to reach consensus concerning statistical analyses of the data to the level of evaluating potential biomarkers, and to collaborate on analyses, interpretation, and report preparation.

The dynamics of PCB accumulation in the Sarasota bottlenose dolphin community appear to follow classical patterns described from other studies (Cockcroft *et al.* 1989, Aguilar *et al.* 1999). In general, males accumulate PCBs in their blubber throughout their lives, while females begin to depurate PCBs when they begin nursing their first calf. As a result, older males have high concentrations of PCBs, while older females have lower concentrations in their blubber. For both young males and young females, the apparent maternal contribution of PCBs appears to be quite significant.

Figure 1. Lipid normalized concentrations of total PCBs in the blubber of Sarasota Bay bottlenose dolphins sampled during capture/release operations during June 2000 and 2001, relative to the individual's age. Males are indicated by triangles (note that a 43-year-old male with a PCB concentration of 868 ppm is not included due to scaling); females are indicated by circles.



Interpretation of the patterns in Figure 1 are complicated by several factors. First, the data are presented as "lipid normalized" in order to account for the variability in lipids (and associated organochlorines) in the blubber of different individuals. However, the % lipid in blubber differs greatly between genders and across ages (Figures 2, 3). The effects of age, % lipid, sex, and reproductive condition need to be examined more rigorously to determine the most appropriate way to present the PCB data for pending analyses, as lipid normalized, or as wet weight measures.

Figure 2. Percent lipid in blubber of Sarasota Bay male dolphins.

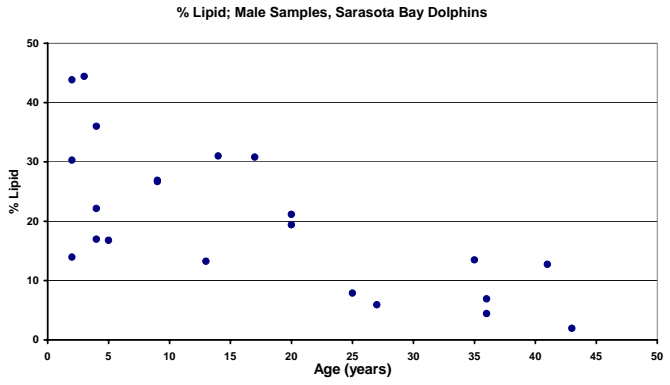
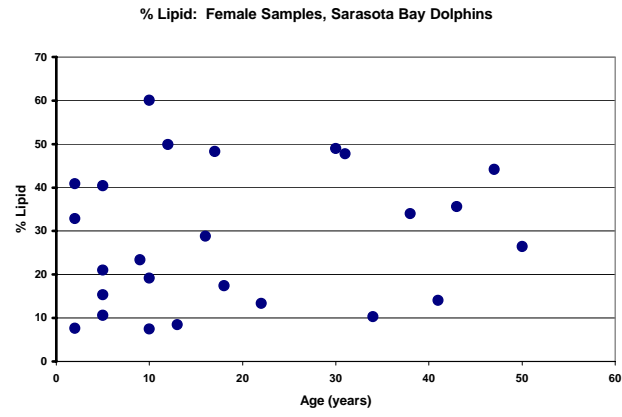


Figure 3. Percent lipid in blubber of Sarasota Bay female dolphins.



Mean PCB concentrations of biopsy dart samples collected from dolphins in Charlotte Harbor were compared to those from the Bahama Islands (Table 3). This was done to evaluate the potential for Charlotte Harbor to serve as an alternate "clean" study site to replace the Bahama Islands site. During the first year of the POLLUTION 2000+ program, Paul Thompson's team collected eleven biopsy samples by darting. However, we were informed that continued sampling would not be feasible in the Bahamas, for political and logistical reasons, so we investigated the possibility of an alternative site. Charlotte Harbor, about 50 km south of Sarasota Bay, is considered to be one of the most pristine estuaries remaining in Florida, and is currently the site of an intensive, long-term research program by Mote Marine Laboratory. Comparison of PCB concentrations between these sites suggested that bottlenose dolphins from Charlotte Harbor and the Bahama Islands were not significantly different in their PCB loads in blubber, but Charlotte Harbor male concentrations were significantly lower than those in males from Sarasota Bay.

Table 3

Preliminary PCB concentrations in dolphin blubber from three study sites: Bahama Islands (BI), Charlotte Harbor, Florida (CH), and Sarasota Bay, Florida (SB).

	Total PCBs (ppm, lipid)	
	Mean	N
MALES		
Bahama Islands	9.5	7
Charlotte Harbor	10.1	9
Sarasota Bay: all males	102.0	22
Sarasota Bay: males > 5 years old	142.4	14
FEMALES		
Bahama Islands	5.1	4
Charlotte Harbor	7.6	2
Sarasota Bay: all females	13.5	25
Sarasota Bay: females > 5 years old	7.8	18

Interpretation of the comparisons between sites are complicated by several factors. Biopsy darting resulted in a skewed ratio of male to female samples both in the Bahamas and Charlotte Harbor. At least in Charlotte Harbor, this bias is related at least in part to selection criteria for sampling. Calves (and therefore closely associated adults = females) were specifically avoided to minimize risk of injury to young animals. Recognizing that this bias led to potential age-related confounds, the comparisons in Table 3 of Sarasota Bay to Charlotte Harbor were further stratified to compare only individuals old enough to be independent of their mothers (> 5 years old). Significant differences between Sarasota Bay and Charlotte Harbor continued to be evident.

Based on these initial analyses, Charlotte Harbor (and the Bahamas) appears to meet the criteria for selection as a "clean" site for comparative purposes in males, but not in females. However, a further potential complication exists in the nature of the remote biopsy sample collected. Biopsy wedges collected during capture/release operations include effectively the full depth of blubber, while biopsy darts often sample only the outermost portions of blubber. Furthermore, the dart head used in the Bahamas was designed to collect a smaller (less deep) sample than was the head used in Charlotte Harbor. The characteristics and dynamics of PCB storage and mobilization vary at different depths of blubber, with the innermost layers likely demonstrating the greatest activity (Aguilar and Borrell 1991). Histologically, bottlenose dolphin blubber has more adipose tissue (and less connective tissue) in the innermost layers, and far fewer adipocytes (and more connective tissue) in the outermost layers. Differences in blubber sections sampled are further supported by differences in mean % lipid between the Sarasota Bay blubber wedges and the Charlotte Harbor and Bahama Island dart biopsies may be suspect (Table 4). As a further potential confound, Charlotte Harbor samples were collected during February, while Sarasota Bay samples were collected in June, after significant blubber thinning. The effect of season and age on % lipid needs to be investigated. Thus, it may be premature to conclude that significant differences in PCB loads exist between the three sites.

Table 5. Comparison of % lipid between study sites.

	Mean	S.D.	N
Males			
Bahama Islands	27.0	12.07	7
Charlotte Harbor	13.7	8.62	4
Sarasota Bay (males > 5 years of age)	15.9	10.08	14
Females			
Bahama Islands	22.8	13.29	4
Charlotte Harbor	11.7	1.35	2
Sarasota Bay (females > 5 years of age)	29.9	16.76	18

3. HARBOUR PORPOISE SUBPROJECT DURING 2001-2002

Harbour porpoises are frequently bycaught throughout the North Atlantic area. In order to utilise samples from bycaught animals, it is of basic importance to calibrate the effect of post-mortem time on the variables to be studied. Sampling of harbour porpoises for this purpose has been possible in the summer of 2001 in the Bay of Fundy.

Sampling

Table 5

Summary of Bay of Fundy harbour porpoises sampled during summer 2001 for the post-mortem calibration study.

Estimated age class*	Females	Males
< 1		1
Sexually immature 1-3		3
Mature	1 (pregnant)	1
Total	1	5

*based on length; age estimation using growth layer groups in teeth will be done

Table 6.

Types of samples collected from the Bay of Fundy harbor porpoises in summer 2001.

Sample	Analysis	Number of samples collected at each time point					Status
		Immediate	3 hr	9 hr	24 hr	48 hr	
Blubber	PCB	5	6	5	6	6	Pending
	Immunohistochem	5	6	6	6	6	Pending
	Enzyme Induction	5	6	6	6	6	Pending
	Luciferase	5	6	6	6	6	Pending
	Retinol	5	6	6	6	6	Pending
Blood	Miscell. Analyses*	5	0	0	0	0	Pending
Liver	Enzyme Induction	1	0	0	0	6	Pending
	Porphyrins	1	0	0	0	6	Pending
	Retinol	1	0	0	0	6	Pending
Histopath		0	0	0	0	6	Pending

* chemistry, reproductive hormones, thyroid hormones, immune response, PCB, Co-planar PCB, porphyrin, retinol, luciferase

Methods

According to the Field Protocol for Pollution 2000+, samples were collected from animals with known time of death. Due to biological challenges, blood was only obtained at the initial time point. There were also difficulties in obtaining liver samples at all timepoints prior to necropsy without compromising the integrity of the carcass. Only on one animal was a liver biopsy obtained immediately after retrieving the sample; in all 6 animals a liver sample was collected at 48 hours. Animals were by-caught in the weir fishery in Grand Manan, and carcasses were immediately retrieved for sampling (see protocol for specific sample handling and storage). Initial blood and tissue sampling was done as soon as possible after retrieval. Animals were then placed at a depth of 2 meters underwater and suspended beside the dock and periodically sampled. A full necropsy was done and tissues were collected 48 hours post-mortem. Water temperature and carcass temperature were monitored throughout the holding period. Carcass temperatures were obtained using a needle temperature probe.

Results

Six animals died during the Grand Manan weir fishery from August 6 to August 27, 2001 and were sampled according to the protocol. Table 5 shows the sex and age class distribution of the animals. There were 5 males and 1 female. The adult female was pregnant and the fetus was archived. The initial blood and tissues samples were taken within an average of 37.4 minutes post mortem (range 25-63) (n=5 animals). However, in one case the time for carcass retrieval was too long and the immediate samples were not collected. Six animals were sampled over 48 hours post-mortem at specific time points (0, 3 hour, 9 hour, 24 hour, 48 hour). Table 6 shows the tissues and samples collected at each timepoint. Holding water temperature ranged from 11.1 to 14.5 C. Carcass temperature (degrees Celsius) ranged from 35.4-36.6 at zero timepoint, 25-29.9 at 3 hr, 16.6-22 at 9 hr, and 12.3-14.8 at 24 hr.

The collected samples were processed and stored according to the Field Protocol and will be shipped to the identified laboratories for analysis.

4. ACKNOWLEDGEMENTS

Sample collection and analyses of Florida bottlenose dolphins would not have been possible without the support of the National Marine Fisheries Service, the Chicago Zoological Society, Mote Marine Laboratory, the Conservation Medicine Center of Chicago, and Dolphin Quest. These groups funded the first year of Florida sample collection for the IWC project and analyses entirely, and supplemented IWC support for the second year. Aleta Hohn (NMFS) determined the ages of the dolphins for which ages were not already known from long-term observational

studies. Anna Sellas collected biopsy dart samples from Charlotte Harbor dolphins, and conducted the genetic analyses of these samples. Kim Parsons collected the Bahama Island samples and analyzed them genetically. Stephanie Nowacek, Sue Hofmann, and the staff and volunteers of the CZS Sarasota Dolphin Research Program were essential to the collection of the samples from the Sarasota Bay dolphins. Sampling was conducted under permit from the National Marine Fisheries Service.

Sample collection of harbour porpoises would not have been possible without the co-operation of the weir fishermen of Grand Manan. Funding was provided by Duke University and various sources. Tara Cox assisted sample collection and processing.

5. LITERATURE CITED

- Aguilar, A. and A. Borrell. 1991. Heterogeneous distribution of organochlorine contaminants in the blubber of large whales: implications for sampling procedures. *Marine Environmental Research* 31: 275-286.
- Aguilar, A., A. Borrell and T. Pastor. 1999. Biological factors affecting variability of persistent pollutant levels in cetaceans. *In: P.J.H. Reijnders, A. Aguilar and G. P. Donovan (eds), Chemical Pollutants and Cetaceans. Journal of Cetacean Research and Management. (Special Issue I), 83-116.*
- Aguilar, A. and A. Borrell. 2001. Results of the bottlenose dolphin biopsy feasibility fieldwork and pollutant level assessment for the Pollution 2000+ programme. *International Whaling Commission SC/53/E20.*
- Cockcroft, V. G., A. C. DeKock, D. A. Lord, and G. J. B. Ross. 1989. Organochlorines in bottlenose dolphins *Tursiops truncatus* from the east coast of South Africa. *South African Journal of Marine Sciences* 8:207-217.
- Hohn, A.A., M.D. Scott, R.S. Wells, J.C. Sweeney and A.B. Irvine. 1989. Growth layers in teeth from known-age, free-ranging bottlenose dolphins. *Marine Mammal Science* 5(4):315-342.
- Irvine, B. and R.S. Wells. 1972. Results of attempts to tag Atlantic bottlenose dolphins (*Tursiops truncatus*). *Cetology* 13:1-5.
- Irvine, A.B., M.D. Scott, R.S. Wells and J.H. Kaufmann. 1981. Movements and activities of the Atlantic bottlenose dolphin, *Tursiops truncatus*, near Sarasota, Florida. *Fish. Bull. U.S.* 79:671-688.
- O'Shea, T.J. 1999. Environmental contaminants and marine mammals. Pp. 485-563 *In: J.E. Reynolds, III and S.A. Rommel, (eds.), Biology of Marine Mammals. Smithsonian Institution Press, Washington, DC. 578 pp.*
- Palsbøll P.J., F. Larsen, and E. Sigurd Hansen. 1991. Sampling of skin biopsies from free-ranging large cetaceans in West Greenland: Development of new biopsy tips and bolt designs. *Report of the International Whaling Commission (Special Issue 13), 71-79.*
- Palsbøll P.J., A. Vader, I. Bakke, and M. Raafat El-Gewely. 1992. Determination of gender in cetaceans by polymerase chain reaction. *Canadian Journal of Zoology*, 70: 2166-2170.
- Reijnders, P.J.H., A. Aguilar, and G.P. Donovan. 1999. Chemical Pollutants and Cetaceans. *J. Cetacean Res Manage. (Special Issue I). 273 pp.*
- Rosel P.E. and B.A. Block. 1996. Mitochondrial control region variability and global population structure in the swordfish, *Xiphias gladius*. *Marine Biology* 125, 11-22.
- Scott, M.D., R.S. Wells, and A.B. Irvine. 1990a. A long-term study of bottlenose dolphins on the west coast of Florida. Pp. 235-244 *In: S. Leatherwood and R.R. Reeves (eds.), The Bottlenose Dolphin. Academic Press, San Diego. 653 pp.*
- Scott, M.D., R.S. Wells, A.B. Irvine and B.R. Mate. 1990b. Tagging and marking studies on small cetaceans. Pp. 489-514 *In: S. Leatherwood and R.R. Reeves (eds.), The Bottlenose Dolphin. Academic Press, San Diego. 653 pp.*
- Stegeman, J. J. and M. E. Hahn. 1994. Biochemistry and molecular biology of monooxygenases: current perspectives on forms, functions and regulation of cytochrome P450 in aquatic species. *Aquatic Toxicology: molecular, biochemical, and cellular perspectives. G. K. Ostrander. Boca Raton, Lewis: 87-206.*
- Wells, R.S. 1991. The role of long-term study in understanding the social structure of a bottlenose dolphin community. Pp. 199-225 *In: K. Pryor and K.S. Norris (eds.), Dolphin Societies: Discoveries and Puzzles. Univ. of California Press, Berkeley. 397 pp.*
- Wells, R.S. and M.D. Scott. 1990. Estimating bottlenose dolphin population parameters from individual identification and capture-release techniques. Pp. 407-415 *In: P.S. Hammond, S.A. Mizroch and G.P. Donovan (eds.) Individual Recognition of Cetaceans: Use of Photo-Identification and Other Techniques to Estimate Population Parameters. Report of the International Whaling Commission, Special Issue 12, Cambridge, U.K. 440 pp.*
- Wells, R.S., M.K. Bassos, K.W. Urian, W.J. Carr and M.D. Scott. 1996a. Low-level monitoring of bottlenose dolphins, *Tursiops truncatus*, in Charlotte Harbor, Florida: 1990-1994. *NOAA Tech. Mem. NMFS-SEFSC-384, 36 pp. + 8 Tables, 10 Figures, and 5 Appendices.*
- Wells, R.S., M.K. Bassos, K.W. Urian, S.H. Shane, E.C.G. Owen, C.F. Weiss, W.J. Carr and M.D. Scott. 1997. Low-level monitoring of bottlenose dolphins, *Tursiops truncatus*, in Pine Island Sound, Florida: 1996. *Final Contract Report to National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, FL. Contr. No. 40-WCNF601958. 86 pp.*
- Wells, R.S., K.W. Urian, A.J. Read, M.K. Bassos, W.J. Carr and M.D. Scott. 1996b. Low-level monitoring of bottlenose dolphins, *Tursiops truncatus*, in Tampa Bay, Florida: 1988-1993. *NOAA Tech. Mem. NMFS-SEFSC-385, 25 pp. + 6 Tables, 8 Figures, and 4 Appendices.*
- Wells, R.S., H.L. Rhinehart, L.J. Hansen, J.C. Sweeney, F.I. Townsend, R. Stone, D. Casper, M.D. Scott, A.A. Hohn, and T.K. Rowles. *In review. Bottlenose dolphins as marine ecosystem sentinels: Developing a health monitoring system. Ecosystem Health.*

**On a scale of 1 to 5, with 1 being lowest and 5 being highest, indicate with a check mark numbers of animals involved in event relative to estimated stock/population numbers.

III. ECOLOGICAL SCOPE

Relative ecological impact*:	1	2	3	4	5

*On a scale of 1 to 5, with 1 being least and 5 being most, indicate with a check mark the relative impact on the environment, based on numbers of habitats and numbers of species (including non-cetacean species) affected.

Other marine species affected, if known:

Scientific name(s)	Common name(s)

IV. GEOGRAPHIC EXTENT

Name of geographic area affected	Coordinates if known	Area affected in km ²				
		<10	11-100	101-1000	1001-5000	>5000

V. TEMPORAL EXTENT

Duration*	Days	Weeks	Months	Years	Decades

*relative duration – check appropriate box

VI. PRINCIPAL CAUSE

- Natural
- Anthropogenic
- Unknown

VII. SOURCE OF INFORMATION

Published: peer-reviewed non-peer-reviewed (circle one)

Full citation: _____

Unpublished*

Web based: URL _____

*If unpublished, state origin of information (e.g., personal observation, second-party observation)

VIII. ADDITIONAL INFORMATION AND REMARKS (ADD ADDITIONAL SHEETS/SPACE AS NECESSARY):

IX. REPORTER

Name:

Address:

Phone:

Fax:

Email:

Appendix 6 (Agenda Item 7.4)
IWC Modeling Workshop on Cetacean-Fishery Competition
June 25th-27th 2002

SWFSC, LA JOLLA, CALIFORNIA

INTRODUCTION

At its 51st Annual Meeting, and in response to a request by the Commission, the Scientific Committee considered how it might best address the subject of competition between whales and fisheries. An inter-sessional email group began the development of a central objective and terms of reference for the Scientific Committee's work on this subject. These were finalized at the 52nd Annual Meeting in Adelaide it was agreed that the Scientific Committee's future work on this subject would be guided by a central question, also the main objective of future deliberations:

How are changes in abundance of cetaceans likely to be linked (in the short term and the long term) to changes in fishery catches?

Guidelines for the SC's work on this topic were also agreed, and these were:

- 1) Review the past work of the Scientific Committee on competition between cetaceans and fisheries, giving attention to the questions asked, the data reviewed, the conclusions reached and the advice given.
- 2) Review recent published literature and contributed papers relating to competition between marine mammals and fisheries: critique methods, determine whether conclusions are supported by the data, summarise and synthesise conclusions.
- 3) Review all relevant case studies of marine biological interactions
- 4) The Committee agreed that it is only appropriate to study such issues on a case specific level, not a global level. Because of logistical constraints work should focus on one or two regions where sufficient data are likely to be available, and where there is the potential for significant competition. Consider portion(s) of the Southern Ocean as ecosystem(s) for which research on the competition issue can be carried out/sponsored by the Scientific Committee. Develop detailed recommendations for relevant items of research that could be potentially carried out as part of the current Scientific Committee-sponsored ecosystem research in collaboration with CCAMLR and other agencies. Also consider the Barents Sea or a larger portion of the North Sea as an area in which the Scientific Committee could augment or cooperate with ongoing research to model ecosystem structure and function with respect to competition between cetacean and fisheries.
- 5) Select multi-species modeling approach(es) for the selected region(s) and identify data needs, considering, for example, all or some of the following components, not necessarily in the order (various modeling approaches may have different components, data requirements and uncertainties):
 - a. Estimating removals by cetaceans and other predators
 - b. Estimating removals by fisheries
 - c. Assessing dietary overlap with humans
 - d. Methods for assessing links between cetacean abundance and fishery catches emphasizing quantitative modeling approaches.
 - e. Estimating effects of changes in cetacean populations on fisheries
 - f. Estimating effects of prey reduction by fisheries on cetaceans.

WORKSHOP

Some of the above terms of reference were initially intended to have been addressed by a Symposium and Conference on competition between cetaceans and fisheries during 2001, but funding was not obtained to pursue this. Instead, at the 53rd meeting of the Scientific Committee, a more focused workshop was proposed in order to address specific modeling approaches that the SC might find useful in addressing the main objective. The terms of reference for the workshop were agreed at the 53rd meeting of the Scientific Committee and a steering group was formed to oversee the implementation of such a workshop. The steering group consists of Northridge, Donovan, Friday, Tamura and Walloe. The US government, at very short notice, kindly agreed to host the workshop at the Southwest Fisheries Science Centre in La Jolla, California. The dates of the workshop will be June 25-27th 2002.

Workshop Terms of Reference:

- Review existing modeling approaches that might be used to address the overall objective.
- Identify the constraints and data requirements in the existing models or modeling approaches that limit our ability to answer the above question.
- Describe the advantages and disadvantages of the various approaches, bearing in mind the areas for which they were developed.
- Identify those approaches that seem most likely to be able to answer the above questions, and provide some guidelines as to when and where they might be used (for example, depending on the level of data availability).

Draft Agenda

Day 1:

1. Overview of existing models:
Including structure, function, data requirements. (John Harwood)
2. Data requirements:
Review of the types of data available – considering limitations, availability, reliability and natural variability (see notes).
 - a. Marine mammal population size and structure
 - b. Fisheries catch data and effort data
 - c. Prey species population size and structure
 - i. Commercial species
 - ii. Non-commercial species
 - d. Consumption rates by marine mammals
 - e. Diet composition
 - f. Linkages – inter/intra-species predation
 - g. Other data requirements?

Day 2:

3. a) Individual model structures:
A critical review of individual modeling approaches and their likelihood of meeting their own objectives:
Mass balance / energy flux models:
 1. Ecosim – ‘bottom up’ – Kerim Aydin
 2. Ecosim – ‘top down’ – [Alida Bundy]Minimum realistic models
 1. Bormicon - ?
 2. Multspec - Sigurd Tjelmeland
 3. Multispecies VPA – Morten VintherFood web models
 1. Extended food web models – Peter Yodzis
 2. Antarctic food web model – Andrew Constable

Day 3:

4. Synthesis:
 - a. Predictive abilities:
 - i. Cetacean effects on fisheries
 - ii. Fishery effects on cetaceans
 - b. Validation – verification/falsification of predictions
5. Review approaches likely to meet the IWC objective
 - a. Identification of key modeling approach(es) that require further modeling work to meet the IWC objective
 - b. Identification of key data requirements
6. Identification of further work
7. Review of report

Appendix 7 (Agenda Item 7.5)

THE FOLLOWING INFORMATION HAS BEEN EXTRACTED FROM SC/54/BC2: REPORT OF THE INTERSESSIONAL WORKING GROUP ON LARGE WHALE ENTANGLEMENT

Clapham (Chair), Berggren, Leaper, Mattila, Robbins. Also participating: P. Hamilton, W. Ledwell, J. Lien, C. Mayo, G. Salvador, S. Todd.

The Working Group was convened in response to a Commission resolution (2001-4) from the London meeting, viz that the Commission:

REQUESTS the Scientific Committee to provide to the 54th Annual Meeting of the Commission a summary of its work in recent years on the most feasible methods to mitigate the incidental capture of large cetaceans in fishing gear, and ways in which entangled large cetaceans may be removed from fishing gear with minimal risk to rescuers.

INTRODUCTION

Entanglement in fishing gear of cetaceans and other wildlife is a major problem worldwide (Perrin *et al.* 1994). The introduction of synthetic net and rope in the middle of the 20th century, together with enhanced fleet and gear mobility, greatly exacerbated this problem. Entanglement may be a serious factor affecting the recovery of small populations. For example, it is known to be a significant source of mortality among the critically endangered North Atlantic right whale (*Eubalaena glacialis*), whose failure to recover is largely attributable to anthropogenic impacts (IWC 2001, Knowlton and Kraus 2001). There is also evidence from scarification data that the reproductive success of female humpback whales (*Megaptera novaeangliae*) is negatively impacted by a history of entanglement (Robbins and Mattila 2001).

Concerns have also been expressed about the status of the minke whale stock in the Sea of Japan due to the levels of fisheries bycatch (Baker *et al.* 2000).

Several types of fishing gear are involved in entanglement. These include a number of different types of gillnet fisheries and trap fisheries (e.g. for crab and lobster) involving bottom set gear marked by surface floats. In the North Atlantic, at least, these are probably the two single-largest types of fishery involved in entangling whales. In Japan and Korea, set or trap net fisheries have the highest reported levels of large whale entanglement. Fishing weirs, seines, trawls, long line, scallop cable and other gear have also been implicated in some cases. Fixed or anchored gear of almost any type represents the major entanglement threat; this can also include gear used for non-fishing purposes, such as shark exclusion nets off beaches.

In a recent study of entanglements of humpback and right whales in trap and gillnet gear (Clapham, unpublished), it was found that any part of the gear can be involved in a serious (life-threatening) entanglement. This includes the groundline (the line between each trap or between the net and the anchors), the endline (the line going from the end of the string of traps or net panels to the surface), and the buoyline (the end section of the endline which terminates in one or more buoys at the surface). Figure 1 shows a diagram of a typical set-up for trap gear and gill net. Furthermore, many parts of an animal's body can be involved in the entrapment. This includes the mouth, head, flippers, peduncle and tail.

Disentanglements of large whales have been attempted on an occasional basis in several places in the world, from Oman to New Zealand. Extensive dedicated rescue programs are in place only in eastern Canada (primarily Newfoundland), as well as in the Gulf of Maine and elsewhere on the U.S. east coast; these programs have undoubtedly reduced large whale mortalities in the areas concerned. Canadian disentanglements began in the 1970's, while the U.S. program was started in 1984; these efforts are led by Memorial University (St John's, Newfoundland) and the Center for Coastal Studies (Provincetown, Massachusetts), respectively. It is recommended that anyone with a serious interest in establishing a disentanglement program elsewhere in the world contact both of these institutions for advice, since they have freed well over a thousand large whales from entanglements in various types of gear.

The Natal Sharks Board in South Africa have also developed specialist whale rescue teams to assist in releasing whales from shark nets. These teams have been successful in releasing approximately 80% of entangled baleen whales alive (Peddemors 2001). Another disentanglement network has been established in west Australia.

Attempts to establish disentanglement programs also need to take into account the legal implications of the regulations regarding cetaceans for each country. In countries where there is a market for cetacean products, education programs to enable fishermen to identify protected species (which should be released alive if possible) may also be required.

Because of the considerable experience with this problem in eastern North America, this document briefly reviews entanglements in this region, with an emphasis on methods of disentangling large whales. It should be noted, however, that some members of the Working Group were concerned that producing a "manual" for whale disentanglement would encourage inexperienced individuals to undertake this work, at considerable risk to themselves. The Group noted that it is very difficult to "teach" disentanglement without providing hands-on experience. Consequently, this report is written with these major caveats in mind.

ENTANGLEMENT: RATES AND MORTALITIES

Entanglement of large whales in fishing gear is a major problem on the eastern seaboard of the United States. In particular, entanglement affects humpback whales and North Atlantic right whales. Other species are also observed entangled to a lesser extent, including minke whales (*Balaenoptera acutorostrata*), fin whales (*B. physalus*) and blue whales (*B. musculus*).

Off Newfoundland, humpback and minke whales are the two species most involved in entanglements. However the past several decades a total of eleven different species have been entrapped and released from fishing gear. Between 1978 and 2000, approximately 1,150 reports of entangled whales were received by Memorial University. Prior to 1990 most entanglements of humpback and minke whales were in cod traps (47%). Groundfish gillnets entrapped 37% of reported humpback entanglements and 30% of minke whales (Lien 1990). The nature of the Newfoundland fishing industry is changed since the collapse of groundfish fisheries in the early 1990s. Effort has been dramatically reduced through reducing the number of fishermen, quotas and fishing seasons and continuing moratoria on groundfish stocks. The industry has changed focus from traditional small boats under 35 feet in length that used fixed fishing gear near shore to bigger offshore boats that fish snow crab and turbot to the 200 nautical mile limit and beyond. There are now approximately 10,000 fishermen registered in Newfoundland holding a variety of licenses. Because of reduced quota few cod traps have been fished since the early 1990's and almost all inshore entrapments occur in gillnets. However, an entrapment problem is emerging with the offshore fleet. Throughout the 1990's reports in offshore turbot and crab gear have been increasing.

Two studies have used photographic documentation of entanglement scars on the bodies of live whales to estimate the rate at which whales become entangled. Robbins and Mattila (2001) estimated from scarring around the caudal peduncle that at least 71% of humpback whales in a sample of 99 animals from the Gulf of Maine had been entangled at one time or another, and that, on average, between 10% and 31% of the population had such encounters each year. Using similar methods, Hamilton *et al.* (1998) estimated that 61.6% of the North Atlantic right whale population has been entangled in fishing gear. A subsequent study by Knowlton *et al.* (2001) indicates that between 10% and 28% of the right whale population contacting fishing gear each year (a remarkably similar percentage to that from the humpback whale study). Both studies found that while juvenile whales were significantly more likely than adults to become entangled, animals from the latter age class were also susceptible to such events.

Entanglements vary in severity from trivial to lethal. Mortality due to entrapment may vary by species. Mortality in Newfoundland humpbacks reported entrapped was 16% but 70% in minke whales (Lien 1994). Robbins and Mattila (2001) estimated from scarring data that 1% to 3% of humpback whale entanglements in the Gulf of Maine were severe; however, the mortality rate from entanglement is unclear, since studies of this type can observe only surviving whales. It is apparent from the scarring data that, in many cases, humpback and right whales become only briefly entangled in line or other gear which is quickly shed, leaving minor rope scars. For large whales, it is likely that many entanglements are not immediately fatal, since the animals are often powerful enough to carry large amounts of gear away with them. In these cases, however, the ability of the whales to move and feed may be compromised by the weight of gear, and death may eventually occur months later as a result of starvation. In other cases of severe entanglements, the line or other gear may create a pathway for chronic infection, and this can also lead to the eventual death of the animal.

Some fishing gear (notably that involving long strings of large traps) is heavy enough to render an entangled whale immobile, and if the entanglement occurs below the surface, death will inevitably result. This has been frequently observed off eastern Canada, where significant numbers of humpback and minke whales have been killed by such entanglements.

DISENTANGLEMENT

General approach and caveats

First and foremost, it is absolutely critical to recognize that disentangling large whales from fishing gear is a dangerous task that should never be undertaken lightly or by inexperienced individuals.

Whales are very large, powerful animals. Errors in judgment on the part of either the whales or the people attempting to help them can result in serious injury or death. In recent years, the press has reported several incidents in which well-intentioned but inexperienced individuals have attempted to remove fishing gear from humpback whales, notably by getting into the water with the animal concerned. That no one has yet died from such an encounter is more a matter of good fortune than anything else.

Anyone attempting to disentangle a large whale should, at a minimum, possess great seamanship skills and common sense. Indeed, seamanship - which includes the ability to safely handle lines and other equipment, as well as the boats being used - is equally important in whale rescue as experience with whale behavior. With appropriate care and knowledge of some of the techniques outlined below, competent fishermen can successfully disentangle whales of some species as long as they attempt this with caution and common sense. However, having some knowledge of whale behavior is obviously desirable in such situations.

Before any attempt is made to disentangle a whale, an objective assessment should be made of the seriousness of the entanglement. *It is important to realize that not all entanglements are serious.* Attempting to free a whale from an entanglement that is not life-threatening is unnecessary and potentially dangerous - the more so because the whale is likely to be stronger and healthier than an animal that has been involved in a protracted and serious entanglement event. "Non life-threatening" is not always easy to define in the field, but broadly includes entanglements involving simple, non-constricting wraps of line or net that do not appear to pose an infection risk and which are not accompanied by a quantity of heavy trailing gear.

Other factors to consider in such an assessment include the age (relative size) of the animal (e.g. the potential for it to grow into a loose wrap of gear); where the gear is on the animal (considering the relative risk to rescuers versus the risk of the process making the situation worse); and - even if the gear is not heavy - does the existing gear pose a significant threat to further entanglement, either on another body part or in other gear that the whale may swim through.

If, in the best judgment of the individuals on the scene, the entanglement is not serious, no attempt should be made to remove the gear. Such attempts represent too great a risk to the people (and the whale) involved, for no good reason.

The reactions of whales to rescue efforts vary considerably by species. When properly dealt with, humpback whales can be relatively tractable, particularly if they have been the victim of a prolonged entanglement and are thus tired or otherwise in sub-standard physical condition. Considerable experience with this species off the eastern coast of North America has indicated that most humpbacks are unlikely to react to rescue efforts with overt aggression and evasion; however, some animals have proven to be exceptions to this. Minke whales are always evasive. However, any animal of this size, no matter how docile it may seem, has the potential to inadvertently kill or injure a human being; a startled whale may thrash or make some other sudden unexpected movement of the tail, flippers or head, and the sheer size of the moving body part involved represents a serious danger to anyone in close proximity to the whale.

Some other species may not be as cooperative as humpback whales. Experience has shown that right whales often respond with considerable aggression to disentanglement attempts; this behavior, together with the fact that right whales are much more powerful than most other mysticetes, makes this species particularly dangerous for potential rescuers. Indeed, in one case in the Gulf of Maine in 2001, a disentanglement team from the Center for Coastal Studies would not consider a rescue attempt on an adult male right whale unless the animal was sedated¹.

It is strongly recommended that, where possible, potential rescuers wear appropriate protective gear. This includes a helmet (a U.S. football helmet with the face guard removed is a good option), and a life jacket; immersion suits (e.g. those manufactured by Mustang or Stearns) provide both flotation and protection from cold. In addition, the individuals concerned as well as the rescue boat should be as free as possible of any non-essential gear that could become entangled in a line. They should also carry with them a small closed knife (such as a parachute knife) attached to their body with a lanyard capable of extending to arm's length; this would be used to cut oneself free of gear in an emergency situation.

Many individuals involved in disentanglement strongly advise against getting into the water with an entangled whale under almost any circumstances, and note that no whale is worth the risk involved in such a scenario. The potential for a diver to become entangled in the fishing gear on the animal is very real, with obvious fatal consequences should the whale decide to dive.

Whenever possible, the vessel involved in the disentanglement operation should be accompanied by a second, standby boat. This is very important for safety reasons, and in case additional assistance is required.

Approaches to disentanglement

Anyone reporting an entanglement should be encouraged to stand by the animal concerned if this is possible. Many entangled whales cannot be freed because their location is not monitored after the initial report, and the whale is lost.

Methods of disentangling large whales depend in part on the type of entanglement, notably on whether the whale is stationary or free-swimming. In the Gulf of Maine, most entangled whales fall into the latter category; off Newfoundland, there have been many cases of whales which were essentially anchored in gear. In Newfoundland if a whale is freely swimming the first step in any rescue effort is to stop the whale. This has been done by attaching additional ropes to entangling lines on the animal and attaching them to a large vessel. When assistance was not available from a large vessel, depending on the bottom characteristics, an anchor was used. Other techniques for dealing with free-swimming whales are described in a separate section below. General approaches to disentanglement are given here.

Many entanglements involve the mouth of the animal. In mysticetes, line tangled in the baleen is quite common; while this is sometimes pulled through the baleen from the drag of the trailing line or other attached gear, this process may be arrested by knots, floats or some other obstruction on the line.

Tight wraps of line or net around an appendage are also very common. These presumably result from the whale rolling as a reaction to the initial entanglement, with constriction effected by the weight of attached gear. For example, a whale becoming entangled in a floating loop of groundline between lobster traps may well cause the line to wrap around the flipper; the considerable weight of the traps on either side will then cinch the line tightly around the appendage, in many cases embedding it into the tissue.

¹This right whale had thick rope deeply embedded in the rostrum, presumably as a result of rolling after contacting a ground line from offshore trap gear. The rope created a pathway for chronic infection and the animal's condition deteriorated over the summer. Sedation was then successfully applied repeatedly over several attempts, in increasing doses, with only minimal observed effect at the highest dose. Unfortunately, the disentanglement efforts failed and there is no doubt that the whale is now dead. It should be noted that sedation of whales remains a largely undeveloped technique, and its use is not generally recommended at this time.

Approach, assessment and cutting the gear

Entangled whales should be approached slowly and carefully so as not to startle them. Moving down from the whale's head (where it can more easily see the boat when the latter initially gets close) may be a better strategy with some animals than approaching from behind, but this will vary with the whale. Use of a small but stable vessel (e.g. an inflatable boat) which is low to the water is helpful since it allows easier access to the animal. Inflatable boats are less likely to be damaged if a whale lashes out in a startle response, and the lack of a keel on these and some other vessels is useful in cases where a whale comes up under the boat. Inflatables are also easily towed behind a whale when attached to the gear, and they appear to minimize startle reactions relative to other types of boat.

Initial approach to the whale should not be directly behind until the extent of any trailing gear has been determined; the driver of the vessel should be continually vigilant to ensure that there is no possibility of a line becoming entangled in the propellor(s). Furthermore, if an outboard engine is being used, the driver should be constantly aware of what is happening and be ready to release and immediately pull up the engine out of the water at any moment; again, this is to prevent any line from becoming entangled in the propellor or shaft housing. Lightweight engines are preferable in this regard. Rescuers in Canada consider it essential that a haul-back line is available, attached to a nearby boat or anchor, which can be used to quickly move the rescue boat back away from the whale if it becomes aggressive or active.

An initial assessment of the entrapment is essential. Determining exactly how the animal is trapped will allow the release crew to plan a release strategy. This phase of a release effort was particularly important in Newfoundland as fishermen cooperated with the release program because a skilled release of the entrapped whale would save their fishing gear. To do this, precisely placed cutting had to be based on good information. Hence, a good survey around the whale with a mask and snorkel while leaning over the side of the boat is an important first step. It is very useful to have a second person monitoring and even sometimes holding onto the individual engaged in the assessment or cutting, especially if these actions require the latter to lean out of the boat.

Randomly cutting gear from a whale is a bad idea. Removing some net or a few lines without attempting to first determine the full nature of the entanglement may make it more difficult to free the whale completely and may do little to remove those parts of the gear with the potential to kill the animal in the long run. For example, if a whale is dragging a number of heavy traps behind it, cutting the trap line will make it much easier for the whale to swim away, but may leave the animal with line that tightly constricts an appendage (notably the flippers or tail). In this case, the whale may die from infection if the line is not removed - but it will now be much more difficult to disentangle because it has been freed of much of its burden and so can easily "escape". Consequently, it is important that rescuers attempt to determine the full nature of the entanglement and plan a strategy *before* any gear is removed. Aerial photographs, when available, are also a very useful (albeit limited) means of assessing entanglements.

Equipment used in disentanglement is sometimes specially designed, but for the most part consists of items available to any fisherman. These include small sharp knives, a variety of gaffs, and small grappling hooks (thrown to grab onto the gear on a free-swimming whale; see Figure 2). Knives used in cutting gear can be anything from regular commercially available knives to custom-designed blades (Figure 3). Any knife used should be extremely sharp, allowing for efficient, rapid cutting; a sharpening device should be carried on board at all times. The Center for Coastal Studies notes that many of the looser lines on a whale can be effectively cut from a short distance away using a semi-circular knife blade welded onto the end of a long aluminum pole. Another variant of this design has the blade being detachable from the pole, and secured with a piece of line, the other end of which is made fast to the boat; in this manner, if a whale is moving the friction generated by the animal's towing of the vessel should result in the blade cutting through the line.

Tighter wraps of line may not be cuttable using a pole-mounted knife, and it may be necessary for the rescuers to get right up to the animal and cut the rope (or slip a semi-circular blade beneath it). This is frequently the situation in Newfoundland, where rescue personnel feel that having a whale within "hand's reach" is usually necessary. In such cases, the rescuers will be touching the animal and in extremely close proximity to it; thus, extreme caution should be exercised at all times. Whales are less likely to startle if all movements and approaches are slow, noise (e.g. banging on the boat) is minimized, and any touching of the animal is done as gently as possible.

With immobile whales, it is important to use buoys on the gear, and especially to buoy off the haul-up rope before it is cut from the whale; this is to ensure that the fisherman's gear is not lost after the animal has been freed. In some cases this procedure may mean that the gear can be retrieved for later analysis; knowledge of gear type on entangled whales can assist future management policy concerning this issue.

Stopping a free-swimming whale

The first issue that arises when dealing with a free-swimming entangled whale is how to stop the animal so that gear can be removed from its body. The Center for Coastal Studies employs a technique which is a modified version of what 19th century Yankee whalers referred to as "kegging". Kegging involved attaching barrels or other large buoyant objects to a harpoon line after the whale was struck; these served to not only allow the whalers to better follow the animal when it was below the surface, but also to tire the whale out.

In disentanglement attempts, a line is snapped onto some part of the entangling gear, and large plastic floats are then attached to the line to increase drag. These floats vary in diameter from 50 cm to more than a meter, and are usually the heavy-duty type that is used (for example) to mark moorings or gear, or to attach to harpoon lines used in fisheries for swordfish, bluefin tuna and other large game fish. They are attached with quick-release snap hooks, and are prevented from sliding by the presence of knots placed at intervals in the line.

As the whale tires, the floats can be repositioned on the line closer to the animal, which has the effect of further decreasing its mobility. Depending on the size and species of whale involved, the number of floats which are required to slow or stop the whale will vary from a few to

more than a dozen. Most humpback whales will eventually tire and “give up” when sufficient buoyancy has been applied to the line; they will often then remain at the surface, allowing rescuers to approach and cut the gear free. As noted above, however, this relatively placid response should not be taken as inevitable in any whale, and extreme caution should always be exercised in close proximity to the animal. Adult right whales are sometimes capable of towing many floats (and also even moderate sized vessels with engines going full astern); see the caveat above on this species.

Education and community involvement

Whenever possible, it is important to involve local fishermen in efforts to disentangle whales. There are several reasons for this. Fishermen are the individuals most likely to encounter an entanglement and be able to respond to it. They are also usually far more skilled in seamanship and the practicalities of dealing with gear and lines than any whale biologist. In addition, they can often serve as the safety boat which stands by the primary disentanglement operation. Finally, fishermen are much more likely to become involved in freeing whales if they are taught how to do this themselves, rather than having to rely on others (who frequently will not be able to get to the location concerned in a timely fashion). A long-term campaign to involve fishermen in disentanglements in Newfoundland waters has been very successful, and has resulted in the survival of many whales in that area.

Community involvement is also important in the reporting of entanglements. Fishermen and whale-watching vessels have been particularly good sources of such reports off the eastern coast of North America. Creating an expanded reporting network is highly desirable; the scarring study by Robbins and Mattila (2001) suggested that only about 3% of entanglements in the Gulf of Maine were reported, despite the existence of a reasonably well-developed entanglement network in this region.

Finally, some countries (such as the United States) have laws which prohibit individuals from working with marine mammals without a permit. Anyone who becomes involved in a disentanglement program should be aware of these regulations beforehand.

References

- Baker, C.S., Lenton, G.M., Cipriano, F. and Palumbi, S.R. 2000. Predicted decline of protected whales based on molecular genetic monitoring of Japanese and Korean markets. *Proc. R. Soc. Lond. B* 267: 1-9 Hamilton, P.K., Marx, M.K. and Kraus, S.D. 1998. Scarification analysis of North Atlantic right whales (*Eubalaena glacialis*) as a method of assessing human impacts. Final Report to the U.S. National Marine Fisheries Service under contract 46EANF60004. Available from New England Aquarium, Central Wharf, Boston, MA 02110.
- Knowlton, A.R., Marx, M.K., Pettis, H.M., Hamilton, P.K. and Kraus, S.D. 2001. Scarification analysis of North Atlantic right whales (*Eubalaena glacialis*): monitoring rates of entanglement interaction. Report to the U.S. National Marine Fisheries Service under contract 43EANF030107. Available from New England Aquarium, Central Wharf, Boston, MA 02110.
- Lien, J., Stenson, G.B. and Ni, I.H. 1986. A review of incidental entrapment of seabirds, seals and whales in inshore fishing gear in Newfoundland and Labrador: a problem for fishermen and fishing gear designers. Proceedings of the Worldwide Symposium on Fishing Gear and Fishing Vessel Design. Marine Institute/Memorial University of Newfoundland, St. John's, Newfoundland, 67-71.
- Lien, J. 1994. Entrapments of large cetaceans in passive inshore fishing gear in Newfoundland and Labrador (1979-1990). *Rep. int. Whal. Commn.* (Special Issue) 15, 149-157.
- Lien, J., Todd, S. and Guigne J. 1990. Inferences about perception in large cetaceans, especially humpback whales, from incidental catches in fixed fishing gear, enhancement of nets by “alarm devices”, and the acoustics of fishing gear. In Thomas, J.A. and Kastelein, R.A. (eds.) *Sensory Abilities of Cetaceans: Laboratory and Field Evidence*. Plenum Press, New York, pp. 347-362.
- Lien, J., Barney, W., Todd, S., and Seton, R. 1992. Effects of adding sounds to cod traps on the probability of collisions by humpback whales. In Thomas, J.A., Kastelein, R.A., and Supin, A.Y. (eds.) *Marine Mammal Sensory Systems*. Plenum Press, New York, pp. 701-709.
- Peddemors, V. 2001. A review of cetacean interactions with fisheries and management thereof in South Africa. SC/53/E17. Available from IWC, the Red House, Station Road, Histon, Cambridge, UK.
- Perrin, W.F., Donovan, G.P. and Barlow, J. 1994. Gillnets and cetaceans. *Rep. int. Whal. Commn.* (Special Issue) 15.
- Robbins, J. and Mattila, D.K. 2001. Monitoring entanglements of humpback whales in the Gulf of Maine on the basis of caudal peduncle scarring. SC/53/NAH25. Available from IWC. The Red House, Station Road, Histon, Cambridge, UK.

Figure 1. Diagram of typical lobster pot gear (above) and gill net (below). Whales typically become entangled in the ground lines between traps, the anchor lines, the endlines (to the surface) or (in a gill net) the net panels themselves. Graphics courtesy of the Center for Coastal Studies.

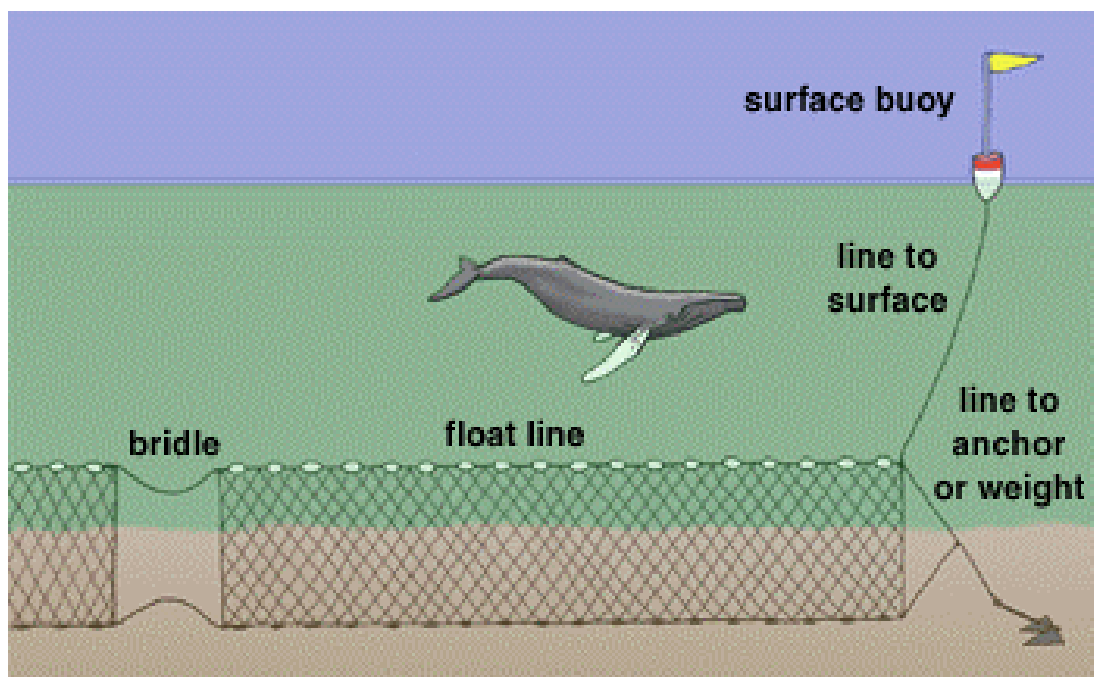
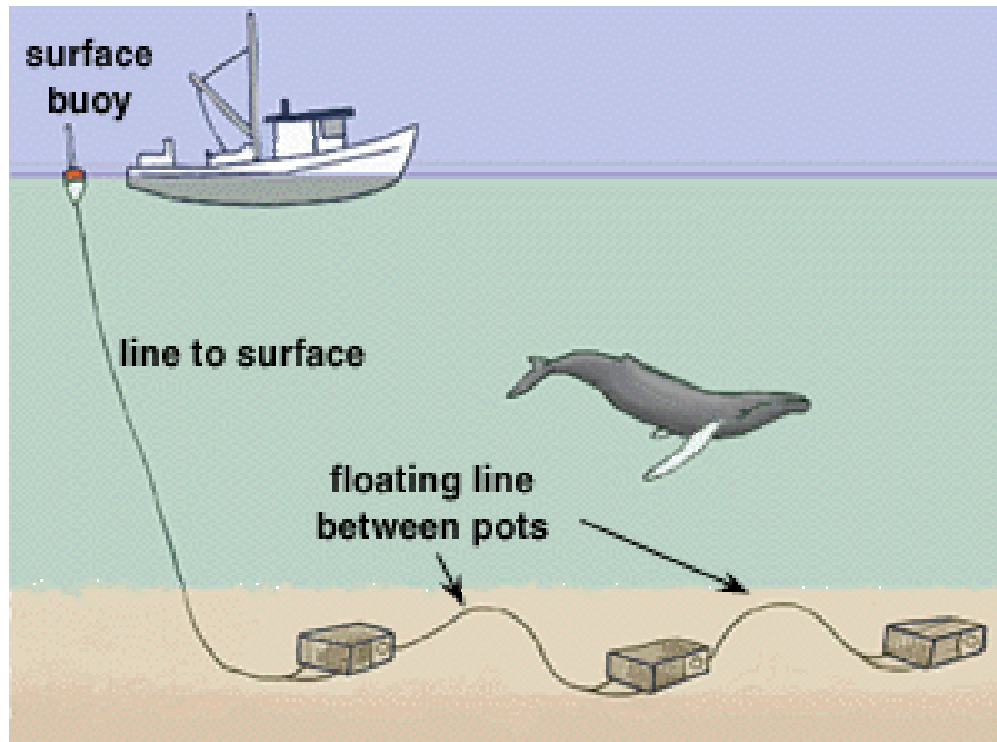


Figure 2. Grappling tools and quick-release snap hooks. Photo: Center for Coastal Studies.



Figure 3. Knives and other cutting tools used in disentanglement. Photo: Center for Coastal Studies.



Appendix 8 (Agenda Item 8.4)

A WORD OF CAUTION FOR THE NAUTICAL STEPS TOURIST DEVELOPMENT

Lorenzo Rojas-Bracho, Phil Clapham, Jorge Urban, Silvia Manzanilla, Robert Brownell, Barbara Taylor, Frank Cipriano and Steve Swartz

Both the Pacific coast of the Peninsula of Baja California and the Gulf of California are considered important breeding and feeding grounds for many species of marine mammals. It has been estimated that about 42% of all the cetacean species of the world have been reported in these waters including blue, fin, sei, Bryde's, minke, humpback, gray and right whales. At least one of these species, the fin whale, has a distinct resident population in the Gulf of California, which is also one of the two known breeding grounds for blue whales in the North Pacific. The region is also the habitat of many odontocetes species including the critically endangered vaquita.

Currently, in waters of the Pacific coast of the Baja California Peninsula and the Gulf of California, these species are relatively undisturbed due to the virtual absence of major cities, coastal development, and industry and of military exercises. However, there is a chance of potential change if the *Nautical Steps* or *Nautical Route* tourist development happens, as has been proposed by Mexico's Bureau of Tourism. The project consists of a mega-development which would cover more than 2,500 miles of coast; it is aimed at attracting 1.6 million boat owners in California and other nearby U.S. states into a new system of harbors, wharves, hotels, restaurants, golf courses, airports and airstrips. Marinas of the Nautical Steps network would link ports beginning in Ensenada, just south of San Diego, California, to marinas located along the entire western and eastern coasts of the Baja California Peninsula. No more than 120 miles apart, some of the marinas would also be along the coasts of Sonora and Sinaloa states, which face Baja across the Gulf of California, on the main coast of Mexico. Only five such marinas currently exist; others would be expanded or built from scratch.

Additionally, the plan calls for an 84-mile highway route for towing boats from one side of the peninsula to the other. This feature will allow boat travelers quick access to either body of water for those without time or interest in sailing around the southernmost tip of Baja California Sur or to facilitate the return trip due to the strong currents running south. Furthermore, the plan calls for improving the road between Mexicali and San Felipe to allow cross border access to the Upper Gulf of California for larger boat towing rigs. The plan also calls for improvements in 10 existing airports and 10 airstrips to make it easier for tourists to get to the chain of marinas. In this manner, Mexico hopes it will attract year-round mooring and rental income.

In support of the project, Mexico's FONATUR (national fund for the promotion of tourism) anticipates that once completed, no less than 52,000 American boat owners will navigate to those destinations and a significant number will permanently moor in the various marinas. Moreover the Director of FONATUR estimates that 32,500-76,400 boats will be cruising Baja coastlines by 2010 and that by 2014 there will be 5.4 million nautical tourists. (Today there are 1.65 million registered boats in the southwestern United States.)

According to FONATUR "the project is not only sustainable from an environmental point of view, but also in terms of profits, and it will improve the socioeconomic situation of the communities and local populations, which provides service in the tourist centers, as a way of fighting poverty."

It is hard to imagine that such a mega-development is "sustainable from an environmental point of view". Such a massive development is likely to represent a major blow to the conservation objectives of the natural protected areas in the region: the Biosphere Reserve of the Gulf Islands, the Loreto Bay National Park, the Vizcaino Biosphere Reserve and the Upper Gulf of California and Delta of the Colorado River Biosphere Reserve. From an environmental point of view this project seems totally incompatible with the Sustainable Development Program of the Sea of Cortez.

If the Nautical steps is not carefully planned to be a low-impact development it will represent a major threat to cetaceans and other marine life in the area. Major potential problems include:

- i) Increased vessel traffic.
The project goal is to increase the number of vessels arrivals from less than the current 8000 to 61,500 – 76,400 by the year 2014. Collision with motorized vessels is a well-known mortality factor for many species of large whales. According to Laist et al (2001) 11 cetacean species are known to be involved in collisions with ships. Mention should be made that except for the right whales (which have occasionally been reported in Mexican waters); all the other species often involved in ship strike fatalities (fin, blue, humpback, gray and sperm whales) are commonly found in the Sea of Cortez and west coast of the Peninsula of Baja California.
- ii) Increase in whale-watching activities along the Baja California coast and outside the breeding lagoons which will be difficult to control and enforce.
- iii) Noise level
Many of the man-made noise in the ocean occurs in the lower frequency range and has high level of output, which could interfere with or mask the gray whale' sounds or possibly damage their hearings (Jones and Swartz, 2002).
- iv) Disturbance of important feeding, breeding and nursing behaviors from increased boat traffic.
- v) Pollution and ecosystem disturbance from increased sewage, freshwater runoff, fuel spills and other development-related problems.

We propose that the Scientific Committee recommends that the Commission requests the Mexican government to take steps to ensure the maintenance of this important cetacean habitat, particularly in the light of the proposed Nautical Steps Project.

Appendix 9 (Agenda Item 9)

IWC-SO GLOBEC/CCAMLR COLLABORATION

Plans for long term IWC collaboration in circum-Antarctic multidisciplinary, multi-agency approaches aimed at investigating long term ecological processes in the Antarctic

Thiele, Moore

Funding request 2002/03: The plans for research are long term and require a signal from the IWC of its long term commitment. We therefore request an annual seeding fund of 25,000 pounds sterling for the next 5 – 10 years. This funding request should be acknowledged in the context of considerable outside funds from national programs in support of berths and major scientific initiatives (in the order of US\$100,000,000 per year, and funds from other sources for cetacean programs (in the order of US\$1 million per annum).

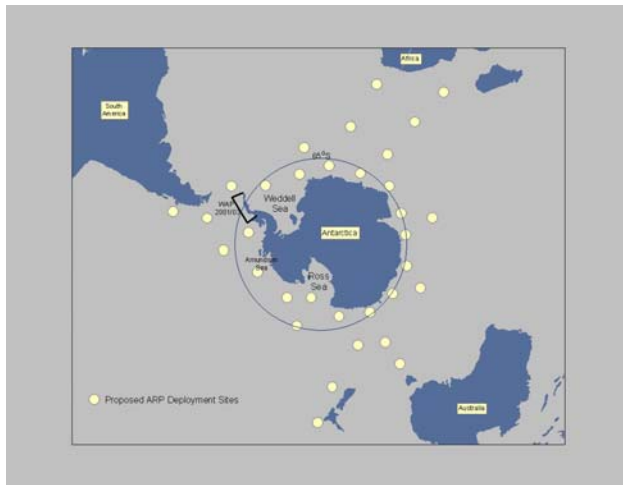


FIGURE 1. PROPOSED DEPLOYMENT OF ACOUSTIC RECORDING PACKAGES (ARPS) IN THE SOUTHERN HEMISPHERE.

What has been done and where we are planning to go?

So far, in the IWC-SO GLOBEC and IWC-CCAMLR collaborations we have been involved in a number of surveys (SC/53/E8, SC/53/E9) with national programs which did not usually include cetacean research on their marine science programs. Aside from the preliminary results of the surveys, and the involvement of IWC in analyses, we believe this participation has resulted in a reassessment of the importance of cetaceans in the Antarctic, by many individuals, program leaders and government agencies, and that this alone is a significant achievement in an area where cetaceans were previously left out of major research initiatives.

Preliminary analysis of data from the two-year field season with SO GLOBEC has resulted in one overwhelming scientific conclusion: the ecological processes we are attempting to study are long-term in nature and thus require a research effort on a similar temporal scale. It is also clear, that attempting to investigate variability in the complex and diverse environment of the Antarctic ecosystems requires efforts on a large spatial scale, with nested complimentary fine scale studies.

A follow on SO GLOBEC effort is therefore being planned by a group of nations active in Antarctic marine research US, Germany, Australia, UK). Each national program will focus some part of their field and analysis work over the next 5 – 10 year on achieving the objectives of SO GLOBEC. This provides the IWC with an enormous opportunity, particularly given the correspondence in objectives between SO GLOBEC and the IWC noted in previous reports.

Presentations, workshop participation, publications and the current timetables for these and field and analysis work under the IWC-SO GLOBEC collaboration are included in Appendix A.

Relevance to the work of the SC

The SO GLOBEC (and related initiatives ie. CCAMLR) umbrella provides a unique collaborative framework of national science programs that provide the IWC with an unprecedented opportunity to work alongside all of the marine science disciplines involved in this region, and to make considerable breakthroughs in our knowledge of the complex linkages between physical and biological processes, variability and trends in the system linked to climate and climate change scenarios. This multidisciplinary, multi-agency approach is well recognised as probably the only means by which we can obtain some predictive capacity in determining the likely impacts of climate change effects on both the physical Antarctic environment and for the marine biota, including whales.

Not only does the work outlined here directly address the recommendations of the participants in the IWC Climate change workshop held in Hawaii in 1996, it also directly addresses the directives from the Commission to the SC to investigate climate change impacts on cetaceans. It will also result in significant contributions to the Scientific Committee in many aspects of its work, particularly in a future where relatively rapid changes in climate are already having an unknown impact on processes which drive ocean dynamics, and the distribution and abundance of marine organisms.



The broader context program

The IWC has limited capacity for research funding, yet the SWG Environmental Concerns has been set the task, in a series of Resolutions from the Commission, of developing and implementing collaborations with other international organizations and research collaboratives which are necessarily large in scope, scale and therefore funding requirements. In order to maximize the potential of the IWC's collaboration in the major marine science programs in this region, funds will need to be obtained outside the IWC.

A core group has been formed from the coordinators of the steering groups for IWC-CCAMLR and IWC-SO GLOBEC and Scripps Institute of Oceanography to develop funding proposals that will cover the majority of costs of cetacean research under the national initiatives, whilst maintaining IWC presence (Moore NOAA, Hildebrand - SIO, Thiele – IWC SC). This group have some approved programs in place, and are developing proposals with national governments for berths and ship time, with the aim of integrating the latest cetacean research methods into these programs within the context of a much broader scale initiative on ecosystem research in the Antarctic.

This group has submitted proposals to a wide range of sources (national government programs, trusts etc.) to obtain funding for the majority of the costs of placing observers, sonobuoys, ARP's on a suite of cruises to areas of the Antarctic where moorings can be deployed, and to fund associated fine scale multidisciplinary cetacean ecological research on an annual basis at two sites (US SO GLOBEC Amundsen/Belingshausen Sea and Mawson at sea CCAMLR Ecosystem Monitoring Program (CEMP)). An outline of this approach is included here at Appendix B, along with a map of the proposed mooring sites and fine scale integrative study areas.

BUDGET REQUEST FROM IWC

To maintain IWC involvement in this long term research effort we require a commitment to an annual amount of 25,000 pounds for at least 5 years. This funding would support a co-ordinator for planning, logistics, input to research design, development of long term research strategy for whale component, development of funding proposals, reports, some components of analysis, collaborative workshop participation. We have conservatively estimated the funds and level of support from national programs and other funding sources to support involvement in the research structure outlined above. This figure is in the order of a billion dollars a year, and it is important that the IWC consider this context when determining funding priorities. We consider that this is a unique opportunity to make significant inroads towards resolving issues identified by the Commission and the SC as critical to conservation and management of cetaceans.

Our request for 25,000 pounds from IWC is a minor contribution to what will be an enormous multidisciplinary research effort by many nations and these funds will ensure the continued involvement of the IWC in field and analysis work, and a leading role in the utilization of significant new tools/techniques applied at a scale which is unprecedented.

Total budget request from IWC £25,000

All funds from last year's allocation have been expended.

Budget breakdown based on last year's costs :

Item	Fund allocation	Description
*Observer costs	£10,000	Travel and salary for IWC observers
Co-coordinator costs	£10,000	Salary for Thiele (3 months) to coordinate surveys, logistics, planning with international organizations and individual nations and science teams in developing programs, maximizing IWC presence and likelihood of obtaining ship time, data handling, permitting, preparation of presentations and publications in the SO GLOBEC timetable
Travel and minor equipment	£5,000	Travel (4000): for workshops and meetings for analysis and planning, conferences etc. attendance to make presentations in the SO GLOBEC/CCAMLR timetable. Minor equipment (1000): film for camera and video photo id, processing costs, scanning and archive

*Costs presented here will only support a small proportion of observer costs on the US SO GLOBEC and CCAMLR surveys planned

Addendum A

Timetable for publications and presentations for current 2 year SO GLOBEC

Presentations and papers on the current cruises have been made at:

2010 and 2002 US SO GLOBEC Planning meetings;

Vancouver Marine Mammal Science Meeting (Nov 2001) EOS publication Friedlaender et al 2002;

Honolulu Ocean Science Meeting (February 2002).

Mini krill – whale data integration workshop

Planned for August – September 2002 in US

October 2002 Second International GLOBEC meeting in Qingdao, China

Presentations from all disciplines involved in US SO GLOBEC, and Australian and German programs will be made here.

Moore and Thiele will be involved in the planning meeting of SO GLOBEC national program leaders for the follow on SO GLOBEC design

November 2002 Deep Sea Research Special Issue

Manuscripts for this special SO GLOBEC issue will be submitted

2002/2003 Synthesis and modeling phase

The scale and complexity of data from the wide range of disciplines collected through SO GLOBEC studies will require a significant effort if useful integration of data series is to occur. This integration process is essential to understanding ecosystem processes and to the development of future research programs. Therefore, the US National Science Foundation will be supporting a synthesis and modeling phase as the immediate follow on to the SO GLOBEC field work. The IWC will be included in this process at extremely low cost to itself.

Future SO GLOBEC – the follow on program

Planning will take place at International GLOBEC meeting in China (Hofmann, other national program leaders, Thiele and Moore). US plan to conduct 5 – 10 year (at least) multidisciplinary program in Amundsen and Bellingshausen Seas. Australia plan to conduct a similar long term effort at a new CAMMLR Ecosystem Monitoring Program site based at sea off Mawson base in East Antarctica (~60° 70°E). Germany are planning 3 cruises over one year 2004/05 as their SO GLOBEC contribution.

Field work planned for 2002/03 and beyond

2002/03 - IWC and passive acoustics collaboration (4 berths) confirmed for UK British Antarctic Survey (BAS) combined CCAMLR/SO GLOBEC Scotia Sea in January – February 2003. At least one year deployment of passive acoustic recorders, possibility of long term passive acoustics and other field work in this area. Visual survey, possible biopsy, sonobuoy deployment.

2002/3 to 2012/13 – Visual survey, biopsy and fine scale ecological studies with passive acoustics collaboration on one dedicated multidisciplinary survey per season for 5-10 years. Year round acoustic moorings to be deployed long term. Six berths confirmed for Australian SOCEP program under Antarctic Marine Living Resources Program (AMLR) at annual CEMP site (off Mawson). CCAMLR and SO GLOBEC related multidisciplinary studies.

2004/05 – IWC participation under development with a series of three SO GLOBEC cruises over one year to a study site in the Lavrov? Sea (Weddell Sea). At least one year deployment of passive acoustic recorders, possibility of long term. Visual survey, possible biopsy, sonobuoy deployment. These cruises planned for December/January 04/05 and March/April and July August in 2005.

Addendum B

Outline of broader program

Background: Recovery and conservation of endangered baleen whales and their habitat

Until only two decades ago, baleen whales (e.g., blue, fin, humpback) worldwide were harvested commercially and their numbers decimated. While commercial hunting has been curtailed, there remain strong threats to recovery and conservation of these species. Basic information on population size, geographic range and habitat requirements are essential to promote the recovery and conservation baleen whales.

Baleen whales migrate over vast areas of the world ocean, so estimating their number and finding concentrations of animals for ecological studies is extremely difficult. The questions are very broad in scale, yet until very recently the available research techniques (visual survey and genetics) were narrow in scope. However, we now have a new tool, passive acoustics, that has proven its capability for monitoring broad areas of the ocean under adverse conditions.

New technology: The Scripps Institution of Oceanography (SIO) in collaboration with the US Navy (USN) and the National Oceanic and Atmospheric Association (NOAA) have pioneered the development and deployment of autonomous acoustic recording packages (ARPs) for detection of baleen whales in the eastern Pacific Ocean and in Alaskan and Antarctic seas.

What the data show and how we can use it to direct research and improve conservation strategies for baleen whales worldwide

Provisional analysis of ARP data provide us with a hypothetical model, based on species-specific and/or population-specific call type, which, if applied across ocean basins, provides a means to identify areas in the world ocean where baleen whales concentrate. Broad-scale deployment of ARPs in the southern ocean would, in collaboration with international-based visual and biopsy surveys, a non-invasive means to develop effective international conservation plans for these endangered species.

The plan:

We propose hemisphere-scale acoustic sampling via ARP deployments in the Antarctic and (initially) one southern ocean basin, the Indian Ocean (Figure 1). Recordings from these instruments, in combination with visual/genetic sampling and fine scale ecological investigations conducted via international collaborations will provide a novel data set for assessment of baleen whale population status and conservation requirements. A plan of this type has never before been addressed for lack of a means to carry it out. We now have those means.

WHO:

Scripps Institution of Oceanography (SIO) is a pre-eminent oceanographic institution [<http://www.sio.ucsd.edu>]. The SIO Marine Physical Laboratory has designed, fabricated and field-tested ARPs throughout the world ocean. These achievements are detailed at: www.mpl.ucsd.edu and at www.whaleacoustic.com. SIO experience and collaborations with international research programs in the Antarctic, (i.e., SoGLOBEC, IWC, CCAMLR, Australia's SOCEP program) and individual research efforts place it in a unique position to access a variety of research platforms suitable for deployment and retrieval of moorings and complementary ecological studies.

WHAT and HOW:

The research group headed by SIO, includes collaborators affiliated with NOAA and the IWC/Scientific Committee. These affiliations provide direct links to national and international policy makers and resource managers. The team is in a unique position to develop and coordinate the proposed broad scale research effort as a follow-on to the successful study underway in the SoGLOBEC Western Arctic Peninsula (WAP) area (Figure 1). Further, team-members' personal involvement in the management of baleen whales through science and policy initiatives at international, regional and national levels will ensure a targeted flow of information.

We propose the initial deployment of 12 (of 36) ARPs in 2004/05. The remaining 24 instruments will be deployed in sets of 4-12 in years 2006/07, as survey platforms permit. Yearly rotation of instruments is anticipated, working westward from the WAP study area. Visual survey, biopsy and fine scale ecological studies are planned for 2002/3 to 20012/13 via collaborations with the Australian SOCEP program, under the Antarctic Marine Living Resources Program (AMLR).