

List of documents (and available Abstracts) for the 58th Annual Meeting of the Scientific Committee as of 11 May 2006

(Please note: those marked with + are available on our website.)

SC/58/AWMP – Aboriginal Whaling Management Procedure

1. BRANDON, J.R., BREIWICK, J.M., PUNT, A.E. AND WADE, P.R. Implications for alternative resampling schemes in Bayesian stock assessments of marine mammals.
2. WAPLES, R.S. Evaluation of a genetic method for estimating contemporary population size in cetaceans based on linkage disequilibrium. +

In all natural populations, random linkage disequilibrium (LD; non-random associations of alleles at different gene loci) occurs, with magnitude inversely proportional to effective population size, N_e . By measuring LD from a population sample, one can estimate N_e and (if the ratio N_e/N is known or can be estimated) the census population size, N . In contrast to the more commonly used temporal method, the LD method requires only a single sample. However, the LD method has seen relatively few applications, and its performance has not been evaluated with highly variable genetic markers. I use simulated data to evaluate bias and precision of the LD method as a function true N_e , the number of individuals sampled, and the number and frequencies of alleles included in the analysis. Results show that using a typical number of microsatellite markers, the LD method can estimate N_e very precisely in small populations and can provide useful information about the lower bound of population size for large populations. When true population size is large ($N_e > 1000$), estimates of effective size are largely unbiased if sample sizes are large enough (100 or more individuals), but precision is low, particularly for the upper bound of N_e . Restricting the analyses to alleles with frequency = 0.02 appears to provide a good balance between maximizing precision and minimizing bias.

3. WITTING, L. A sex ratio based assessment of common minke whales off West Greenland. +

The sex ratio in the West Greenland catch history of the common minke whale (*Balaenoptera acutorostrata*) is used to assess the current status of the common minke whale population that supplies the West Greenland hunt. The female fraction in common minke whale fetuses is around 1/2, but the fraction in the West Greenland catch has varied around since the beginning of the hunt in 1948. This difference is likely to reflect sex specific behaviour, where females tend to occur in other areas than males, but it may also reflect a female selective hunt and/or a female bias in the sex ratio at birth. These hypotheses were examined by trial simulations, where an age- and sex-structured population model with density regulated dynamics were set to cover a maximum sustainable yield rates between 1% and 7%, a current abundance between 800 and 50,000 females, different degrees of female bias in the sex specific dispersal, a sex specific hunt, a female bias in the sex ratio at birth, increasing trends in the female bias of a sex specific dispersal and a sex specific hunt, and a uniform, increasing and decreasing age-selectivity in the hunt. Given the trials and the data it is concluded that a current abundance in the order of 20,000 individuals is a conservative estimate, and that a current catch of 175 individuals most likely is sustainable.

4. WITTING, L. Initial SLA simulations for West Greenland minke whales.

5. WITTING, L. Some assessment runs for West Greenland fin whales.

6. HEIDE-JØRGENSEN, M.P., SIMON, M.J. AND LAIDRE, K.L. Estimates of large whale abundance in Greenland waters from a ship-based survey in 2005. +

A ship-based line transect survey of large whales in East and West Greenland was conducted in September 2005. The survey platform primarily targeted capelin, *Mallotus villosus*, using acoustic methods and systematically covered the east and west coasts of Greenland from the coast to the shelf break (approximately 200 m). The surveyed area comprised 81000 km² in East Greenland and 225000 km² in West Greenland. A total of 194 sightings of 13 cetacean species were obtained and standard line transect methods were used to derive abundance estimates of the four most commonly encountered large cetaceans. Fin whales, *Balaenoptera physalus*, were most abundant in East Greenland (3140, 95% CI 940-10492) with lower abundances estimated for West Greenland (1847, 95% CI 855-3989). Sei whales, *Balaenoptera borealis*, were frequently encountered in the same areas as the fin whale, but the estimated abundance in East Greenland (729, 95% CI 226-2358) was lower than in West Greenland (1529, 95% CI 660-3540). Humpback whales, *Megaptera novaeangliae*, were found both in offshore and coastal areas of West Greenland (1316, 95% CI 592-2927) and in low numbers in East Greenland (329, 95% CI 45-2388). Finally, minke whale, *Balaenoptera acutorostrata*, abundance was estimated at 1686 (95% CI 179-15841) for East Greenland and 4086 (95% CI 1645-10150) for West Greenland. Sighting rates for minke whales were low, resulting in low abundance estimates with low precision. Inclusion of sightings of unidentified large baleen whales in West Greenland distributed in proportion to species sightings increased abundance estimates for fin, sei, and humpback whales by 29%, 12%, and 14% respectively. Despite good conditions and considerable effort, few cetaceans were observed in the northernmost strata in West Greenland. This suggests that the southbound fall migration of large whales from Northwest Greenland had already started by the time the survey was initiated. The abundance estimates presented in this study are negatively biased: no corrections were applied for whales missed by observers or for whales submerged during the passage of the survey platform. This should cause a particularly large negative bias especially for the estimates of minke whale abundance. Abundance estimates presented in this study provide the most up-to-date and complete estimates for large whales in Greenland waters since 1993.

7. HEIDE-JØRGENSEN, M.P. Estimates of large whale abundance in Greenland waters from an aerial survey in 2005.

SC/58/BC - Bycatch

1. DI GUARDO, G., CASTAGNARO, M., MARRUCHELLA, G., MAZZARIOL, S., MIGNONE, W., OLIVIERI, V., PONZIO, P. AND COZZI, B. Human-induced mortality in cetaceans found stranded on the Italian coastline (1995-2005). +

A survey aimed at evaluating the impact of human-induced mortality (HIM) was carried out on 111 cetaceans (109 odontocetes and 2 mysticetes) found stranded between 1995 and 2005 on the Italian seaboard. Natural death causes and HIM factors accounted for 53% and 17% of all the lethality cases, respectively, while the cause of death could not be established in 30% of the cetaceans under investigation. Collision with ships or boats,

together with entanglement in fishing gears, represented the two most frequently encountered HIM factors. This study should be regarded as a preliminary evaluation of the impact of anthropogenic factors on the health status of cetaceans stranded on the coast of Italy and, more in general, of cetacean populations living in the Mediterranean Sea.

2. MATTILA, D.K. AND LYMAN, E. A note on entanglement of large whales in marine debris.

The incidence of entanglement of large whales in marine debris is poorly understood. Recent entanglement records from some areas indicate that a significant number of animals are reported to be entangled in rope and net of undetermined origin, (20% along the Atlantic coast of the U.S. and Canada). However, it is extremely rare that "marine debris" is determined to be the cause of the original entanglement. In this note several confirmed reports are discussed, indicating a possible mechanism by which certain species may become entangled in marine debris. While there are new efforts to gather data relevant to this issue, the extent to which large whale entanglement in marine debris is a problem remains unknown.

3. PANIGADA, S. AND WEINRICH, M. Report of the Workshop on Large Whale Ship Strikes in the Mediterranean Sea (Monaco, 14-15 November 2005).

During the Scientific Committee of the 57 meeting of the IWC held in Ulsan, Korea, the subcommittee on estimation of bycatch and other human-induced mortality asked to attend a workshop on ship strikes organized by ACCOBAMS, to be held in Monaco in November 2005, and to present the report of the workshop to the Committee at next year's meeting. The objectives of the workshop were to synthesize the knowledge of ship strikes of fin, sperm, and other large whales in the Mediterranean Sea, including the Pelagos Sanctuary for Mediterranean Marine Mammals, and to place them in a global and local context. This included a review of present knowledge on strikes and mortality, assessed by looking at stranded and free ranging individuals presenting evidence of ships strikes (propeller scars or other injuries on the body). In addition, the participants aimed to determine data gaps vital to a more comprehensive assessment of the issue and discussed about detection methods to be used to obtain estimates of strikes and mortality. The possibility of using modeling to better determine true rates of ship collisions was also enquired and it was suggested to liaise with the Scientific Committee of the International Whaling Commission, which has also shown an interest in developing appropriate models. The workshop discussed whether mitigation and management measures were necessary, and proposed and prioritized measures that might effectively be employed to address the issue. Strong similarities, in terms of ship collision problems and long-term management philosophy, were observed between the Stellwagen Bank National Marine Sanctuary (SBNMS) and the Pelagos Sanctuary. It was therefore discussed and proposed to adopt similar management and research strategies in the two areas, which could lead to an effective reduction of the risk of vessel strikes to large whales.

4. PANIGADA, S., PODESTÀ, M., GRECO, S. AND ROSSO, M. Update on ship strikes in the Italian waters between 2002 and 2005. +

Aim of this paper is to present an update of ship strike events reported in the waters around the Italian coasts, by presenting data both from stranded animals and photoidentified free ranging individuals. Since 1986 the Italian Stranding Network (Centro Studi Cetacei) has been collecting data on cetaceans stranded, accidentally caught, and possibly killed by vessel collisions for the whole Italian coasts and its nearby seas. Data were managed by the Natural History Museum of Milan, and an annual report is published yearly in the scientific journal "Atti della Società Italiana di Scienze Naturali" with a complete list of the information concerning each event. The Mediterranean Marine Mammals Tissue Bank based at the University of Padua collects and stores samples from these stranded animals. Data on live whales presenting evidence of collisions were gathered by contacting research institutes involved in photo-identification projects. Animals with large wounds or propeller scars were considered as victims of a boat collision. Since data from 1986 to 2001 have been analysed and presented by Laist *et al.* (2001) and Panigada and colleagues (in press), the focus of this paper was limited to the period between 2002 and 2005. An analysis of this data set showed that over the study period only fin whales, either stranded or observed at sea, presented evidence of a ship strike. Out of a total of 10 fin whale strandings and reported carcasses, 4 were described as being killed by a collision event. Three whales arrived in port on the bow of a ship and one whale stranded along the coast. All the fin whales fatally struck were reported from the Pelagos Sanctuary, a MPA characterized by high levels of naval traffic and whale abundance. Several photo-identified whales presented wounds positively attributed to a ship strike. No information on the year or the location of the collision was available in any case, as no animal was seen before and after the collision. Twelve animals were sighted and photo-identified in the Ligurian Sea, four of them presented propeller scars on the body, five individuals were missing half of the fluke, while the other three were missing their dorsal fin. Two more individuals, both presenting propeller scars, were observed in February 2004 in the waters surrounding the Island of Lampedusa, Sicily Channel. The data provided here represent an update on human induced mortality events on large whales in the Mediterranean Sea, plus some insights on whales that survived after a ship strike. Given the paucity of data and the high likelihood of underreporting fatal ship strikes, we strongly suggest that appropriate mitigation measures are applied as well as a continuous monitoring effort to precisely estimate the effective magnitude of the issue.

5. DE STEPHANIS, R. AND URQUIOLA, E. Collisions between ships and cetaceans in Spain. +

Collisions between ships and marine mammals have been reported all over the world, and can be one of the major threats for several species. In Spain, two places have been located where collisions are taking place, the Strait of Gibraltar and the Canary Islands. In the Strait of Gibraltar, due to the high maritime traffic, with more than 90.000 ships crossing the Strait in the line north-South, or East-West, collisions have been reported with sperm whales and fin whales. At the end of 2007, a new commercial harbour will start to work in the north of Morocco, just in the middle of the Strait. The ferries, and fast ferries route will change and will cross the main feeding grounds for sperm whales in the Strait. Due to this new harbour the presence of sperm whales could be affected. In the Canary Islands, this problem started in the 1995, with the apparition of jet foils linking the islands. In the 1999, big fast ferries started to operate, replacing the jet foils in some Islands. Collisions with sperm whales, pigmy killer whale, and common beaked whale, have been reported since then. The data of collisions of the two areas, and their relation with the maritime traffic routes will be shown. Mitigation measures raised will be also presented.

6. VAN WAEREBEEK, K., BAKER, A.N., FÉLIX, F., GEDAMKE, J., IÑIGUEZ, M., SANINO, P.G., SECCHI, E., SUTARIA, D., VAN HELDEN, A. AND WANG, Y. Vessel collisions with small cetaceans worldwide and with large whales in the Southern Hemisphere. +

We compiled and reviewed 248 cases of reported vessel collisions with small cetaceans worldwide and with large cetaceans in the Southern Hemisphere. Difficulties were encountered with the comparison of highly variable data in terms of quality (evidence), sources, detail and degree of authentication. It is recommended that wide agreement be reached on a minimum dataset template. We propose 25 standardized parameters, including an essential 'probability tag' (confirmed, probable, possible and indeterminate) that categorizes likelihood of vessel strike as evaluated by the original observer(s). Since the time-consuming process of fact-checking and standardizing is ongoing, any elaborate quantitative analysis is premature. Among

baleen whales in the Southern Hemisphere, ship collisions have definitely accounted for deaths of southern right, blue, sei, fin, Bryde's and humpback whales. In South Africa, an estimated 20% of mortality in *Eubalaena australis* is due to vessel strikes (Best *et al.*, 2001). Accumulating evidence suggests the problem to be severe also in Argentina, Brazil and Uruguay, but small samples impede estimation of incidence. Odontocetes regularly affected include sperm whale, killer whale and common bottlenose dolphin. At least one or a few vessel strikes are documented for 19 species of small cetaceans (several for the first time): *Kogia breviceps*, *Orcinus orca*, *Globicephala melas*, *G. macrorhynchus*, *Tursiops truncatus*, *Sousa chinensis*, *Orcaella brevirostris*, *Cephalorhynchus hectori*, *C. commersonii*, *Lagenorhynchus australis*, *Stenella frontalis*, *Neophocaena phocaenoides*, *Phocoena spinipinnis*, *Phocoena phocoena*, *Lipotes vexillifer*, *Platanista gangetica*, *Ziphius cavirostris*, *Berardius arnuxii* and *Mesoplodon grayi*. Three species with suspected involvement in accidents include *Sousa plumbea*, *Mesoplodon hectori* and *M. bowdoini*. For some 11 small cetacean species the effect of collisions on populations is thought to be insignificant. Among estuarine species, at least two populations of each *S. chinensis* (Xiamen and Hong Kong/Pearl River) and *O. brevirostris* (Mahakam River and Chilika Lagoon) are significantly impacted. Mahakam population mortality is definitely not sustainable (2.9% minimum annual mortality). For *L. vexillifer* of the Yangtze river and *P. gangetica*, because of extremely low population numbers, even a very few mortalities may reduce likelihood of future survival. In Hong Kong's *N. phocaenoides*, 9.4% of carcasses showed blunt traumatic injury consistent with boat collisions. Two calves *C. hectori* were killed by boats near Banks Peninsula in 1999, a major concern considering its endangered status. Around 2% of *T. truncatus* in the Gulf of Guayaquil showed scars and mutilations of dorsal fins, caused at least partly by propellers. Boat based dolphin-watching, such as in Chile and Costa Rica may adversely affect local *T. truncatus* populations. Overall, considering the high incidence of injuries and mortality caused by propellers, a much wider use of propeller guards is advised.

7. LAMBERTSEN, R.H. Extraordinary susceptibility of baleen whales to marine debris and commercial fishing gear.

SC/58/BRG – Bowhead, right and gray whales

1. BROWNELL, R.L. Fishing gear entanglement of western gray whales: threat to survival.

2. WELLER, D.W., BRADFORD, A.L., TSIDULKO, G.A., IVASHCHENKO, Y.V., LANG, A.R., KIM, H.Y., BURDIN, A.M. AND BROWNELL, R.L., Jr. A catalog of photo-identified western gray whales from Sakhalin Island, Russia.

This is a CD.

SC/58/BRG3. BURDIN, A.M., BRADFORD, A.L., LANG, A.R., TSIDULKO, G.A., KIM, H.W. AND BROWNELL, R.L., Jr. Status of western gray whales of Sakhalin Island, Russia, in 2005.

4. POSTMA, L.D., DUECK, L.P., HEIDE-JØRGENSEN, M.P. AND COSENS, S.E. Molecular genetic support of a single population of bowhead whales (*Balaena mysticetus*) in eastern Canadian Arctic and western Greenland waters. +

Molecular genetic relationships among bowhead whales (*Balaena mysticetus*) were examined and tested for population sub-structuring of samples collected in the waters of the Eastern Canadian Arctic and Western Greenland. An analysis of 15 nuclear DNA microsatellite loci was completed for 286 individual bowheads sampled at Pelly Bay, Igloodik, Repulse Bay and Pangnirtung in Nunavut, Canada and from Disko Bay in western Greenland. An additional sample of whales from the Beaufort Sea representing the putative Bering-Chukchi-Beaufort (B-C-B) Sea stock/population was also included in the analysis. A Bayesian clustering (assignment) procedure was used to interpret the genetic profiles obtained from the samples in order to identify the inferred population structure detected from the observed genotypes. The analysis consistently revealed a lack of identifiable structure for these samples and the clustering analysis supports the results obtained from satellite tracking and aerial survey studies that indicate a single population of bowheads in the Eastern Canadian Arctic and Western Greenland. However, the small sample of whales from the Beaufort Sea was not clearly distinguished from the other samples in the analysis. Additional collaborative work is currently ongoing to increase the number of samples from the B-C-B population for comparison to the Eastern Canadian samples and to increase the number of loci examined in order to increase the power of the analysis.

5. DUECK, L.P., HEIDE-JØRGENSEN, M.P., JENSEN, M.V. AND POSTMA, L.D. Update on investigations of bowhead whales (*Balaena mysticetus*) movements in the eastern Canadian Arctic, 2003-2005, based on satellite-linked telemetry. +

Using satellite-linked telemetry, studies of bowhead whale movements in Canada were conducted in northern Foxe Basin from 2001 to 2003 and in Cumberland Sound in 2004 and 2005. Four whales were tagged in 2001, but all provided data for <1 wk. Over the next four years, 28 bowhead whales were tagged in northern Foxe Basin (n=16) and Cumberland Sound (n=12), of which 9 provided no data, 6 tags transmitted for periods of up to one month, 8 for one to two months, 3 for two to three months, one for 3.5 months and one for about seven months. Of 13 tags deployed in northern Foxe Basin that provided data for =18 days, eight moved through Fury and Hecla Strait and ranged throughout Gulf of Boothia and Prince Regent Inlet. The remaining five whales made mostly local movements. Of 4 whales tagged in Cumberland Sound that provided data for =26 days, all moved out of Cumberland Sound. Three of these whales traveled to Prince Regent Inlet, one of which made a nearly complete circumnavigation of Baffin Island. The latter took up winter residency in Hudson Strait. Six females accompanied by calves were among those whales tagged in Foxe Basin, and two moved into Prince Regent Inlet. Both adult males and juveniles were among those tagged in Cumberland Sound and that moved to Prince Regent Inlet. Combined with tracking results of Greenland whales, the findings indicate that bowhead whales are wide ranging and whales from both Foxe Basin and Baffin Bay regions share common ranges in summer as well as winter. Whales tagged in all localities exhibited varying travel routes. Common use of wintering ranges suggests that there is potential for significant genetic exchange between the various components of the eastern Arctic population.

6. DUECK, L.P., HEIDE-JØRGENSEN, M.P., JENSEN, M.V. AND POSTMA, L.D. Diving characteristics and sightability estimates of Canadian eastern Arctic bowhead whales, *Balaena mysticetus*, based on satellite-linked telemetry. +

Satellite-linked dive-recording instruments were deployed on four eastern Arctic bowhead whales. Two of the tagged animals were sexually mature females accompanied by calves. The other two animals were inferred to be an adult male and a juvenile female. Dive measurement data was received between July 5 and August 11, 2003. Tags reported data for 17-34 days for a total of 96 tag-days. Approximately 17,500 dives =8 m in depth were recorded. Dive rate ranged from 2.8 dives/hr to 30.7 dives/hr, and both dive rate and variance increased with day of-year. All four whales dove to depths =100 m. The maximum recorded dive depth was 400 m. Most dives (59%) were to depths =12 m; only 4.2% were to depths >50 m. Mean dive

duration ranged from 2.6 min to 8.1 min (mean = 5.0 min., S.E. = 1.1 min, n = 4). Whales spent most of their dive time (63-78% of time-at-depth) at dive depths = 12 m (mean = 71%, S.E. = 3%, n = 4). Overall surface time (= 4 m depth) for individuals ranged from 19% to 35% (mean = 28%, S.E. = 4%, n = 4). Differences between whales were evident for surface time and certain dive characteristics; females accompanied by calves had the lowest mean dive duration and spent more time at the surface than the other whales. No differences in surface time or dive characteristics were observed for time-of-day. Overall sightability estimates, based on pooled surface time (above 4 m depth) and partitioned by week, were 40% prior to breakup of landfast ice and ranged from 21% to 29% for subsequent weeks in which at least three tags were active. Adjustments to sightability estimates for application to aerial surveys of bowhead whales in the eastern Arctic are discussed.

7. COSENS, S.E., CLEATOR, H. AND RICHARD, P. Results of aerial surveys of bowhead whales (*Balaena mysticetus*) in the Eastern Canadian Arctic in 2002, 2003 and 2004. +

In 2002, a three- year program was begun to fly line transect surveys of bowhead whales summering in the Canadian eastern Arctic. The goals of the survey were to estimate numbers in both the putative Davis Strait-Baffin Bay (DS-BB) and Hudson Bay-Foxe Basin (HB-FB) stocks and to develop a better understanding of the summering distribution of these whales. In 2002, bowheads thought to belong to the DS-BB stock, were surveyed in Eclipse Sound, Prince Regent Inlet and Gulf of Boothia. In 2003, surveys were flown in southern Gulf of Boothia, Foxe Basin and north-western Hudson Bay to estimate numbers in the putative HB-FB stock. A second 2003 survey estimated numbers of DS-BB whales summering along the east coast of Baffin Island. In 2004, Eclipse Sound and Admiralty Inlet were re surveyed and parts of Barrow Strait were surveyed. Surface counts of bowheads were analyzed in DISTANCE and adjusted for whales not seen because they were diving. Adjustment factors for diving animals were derived using data collected from whales monitored with satellite-linked tags. An estimated 7,309 (95% CI = 3,161-16,900) bowheads occupied Eclipse Sound, Prince Regent Inlet and Gulf of Boothia in 2002. In 2003, 1,828 (95% CI = 940-3,554) bowheads were estimated in Admiralty Inlet and along the east coast of Baffin Island and an estimated 981 (95% CI = 319-3,018) whales occupied the southern Gulf of Boothia, Foxe Basin and north-western Hudson Bay. Few whales were seen in the areas covered during the 2004 survey; not enough to produce an estimate. Recent results of satellite tracking studies and genetic analyses are consistent with a single population of bowheads in the eastern Canadian Arctic and west Greenland waters. As a result of this and to limit the possibility of counting individuals more than once, surveys results were not combined between years. The best partial estimate from the combined bowhead population is 7,309 (95% CI = 3,161-16,900). This is considered a partial estimate because it covered the Prince Regent Inlet-Gulf of Boothia-Eclipse Sound (PRI-GoB-ES) survey area, which is only part of the known summer range.

8. STAFFORD, K.M., MOORE, S.E. AND MUNGER, L.M. Summary of bowhead whale calls recorded on autonomous recorders in the Beaufort Sea, 2003-04. +

Here we augment our provisional report on recordings of bowhead whale calls from an autonomous instrument deployed in the western Beaufort Sea (SC57BRG3) and provide a synoptic comparison of sound profiles from known and unknown sources. We focused our analyses on data from the recorder containing the longest data record. Bowhead calls were recorded only during the first few weeks after deployment on 3 October 2003 and then not again until 12 April 2004 after which calls were recorded until the instrument failed on 12 May 2004. Ambient noise levels in the vicinity of the hydrophone, based on spectra derived from 30-minute samples of whale calls, ship's passage and a range of wind and ice conditions, varied by as much as 20 dB. Notably, as reported last year, gray whale calls dominated the spectra, especially in late autumn 2004.

9. LEDUC, R., MORIN, P., GEORGE, C., NOONGWOOK, G., HANCOCK, B., ROBERTSON, K. AND TAYLOR, B. Mitochondrial sequence variation in the Bering/Chukchi/Beaufort Seas bowhead whale. +

Sequences of the mitochondrial control region were used to test for spatial, temporal and cohort structure in bowhead whales from the North Pacific. ?? and Fst tests were used to test spatial comparisons (North Slope vs. S. Lawrence Island (SLI), North Slope vs. Savoonga and North Slope vs. Gambell), temporal comparisons (fall vs. spring migrations for the North Slope and for Barrow only), and age groups (old vs. young). All tests yielded non-significant results.

10. CLARK, C.W., CORTOPASSI, K., PONIRAKIS, D. AND FOWLER, M.C. Seasonal variation in acoustic characteristics of bowhead whales (*Balaena mysticetus*) sounds during the spring 2001 migration off Pt. Barrow, Alaska.

This report is based on an analysis of over 90,000 bowhead sounds collected during 1044h of acoustic array recording effort during the 2001 bowhead census off Point Barrow, Alaska. These detections were reduced to reliable locations and call tracks. A feature vector of call characteristics was automatically extracted for each located call. Call vectors were analyzed by several statistical techniques to evaluate whether or not there was structure in call characteristics over the course of the migration, and to test for the significance of diurnal, environmental and seasonal factors on call characteristics where such structure might serve as an indication of structure in the composition of animals in the migration. Although over the many years of acoustic survey the subjective impressions have been that call types change throughout the migration season, the working hypothesis is that there is no seasonal structure in call characteristics. Analysis revealed there was some structure in call characteristics throughout the season, and we discuss the interpretation of these results.

11. CLAPHAM, P. Update on research and management activities for North Atlantic and North Pacific right whales.

12. BRADFORD, A.L., WELLER, D.W., BURDIN, A.M., IVASHCHENKO, Y.V. AND BROWNELL, R.L. Anthropogenic scarring of western gray whales (*Eschrichtius robustus*).

13. RIPLEY, B.J., MARTIEN, K. AND TAYLOR, B.L. A simulation approach to understanding non-equilibrium dynamics in a recovering long-lived species: the bowhead whale.

14. LUBETKIN, S.C. AND ZEH, J. Deriving age-length relationships for bowhead whales (*Balaena mysticetus*) using a synthesis of age estimation techniques.

15. MELNIKOV, V. AND ZEH, J. Chukotka Peninsula counts and estimates of the number of migrating bowhead whales. +

In May and June 1999-2001, shore-based counts of migrating bowhead whales were conducted in the Cape Dezhnev area of the Chukotka Peninsula. It is unknown if the same whales migrate along the Chukotka coast each spring, nor is it known if they form a sub-population. The 1999 count was a feasibility study, and the counts from Cape Pe'ek in 2000 and 2001 were designed to permit estimation of the number of whales migrating past Cape Dezhnev. These surveys were similar to those of bowhead whales near Barrow, AK and of gray whales near Monterey, CA except that no experiments

designed for estimating detection probabilities P were conducted. The number of migrating bowheads was estimated using three alternatives for P : (1) $P = 1$ (all whales passing during watch with acceptable visibility conditions were seen); (2) $P = P_b$, bowhead detection probabilities estimated for the surveys near Barrow (except that $>10\text{km}$ range from Cape Pe'ek was treated as equivalent to offshore distance $>2\text{km}$ near Barrow because observation perch height was so much greater at Cape Pe'ek) and (3) P_g as analogous as possible to detection probabilities estimated for the gray whale surveys near Monterey. Whales/sighting were estimated as (number recorded)/ P . Methods of estimating the number of migrating whales from the Cape Pe'ek data and the assumptions on which they were based were as similar as possible to those of the surveys near Barrow. The migration period at Cape Pe'ek was assumed to extend from the first day a bowhead was seen through the last day a bowhead was seen in each year. Whales were assumed to migrate continuously throughout this period, regardless of weather, time of day and whether or not observers were counting them. Days were assumed to be "watched" if observers counted for more than 2h with fair to excellent visibility and "unwatched" otherwise during this period. The day estimate for a watched day is $(N + C/2) \times 1440 / (\text{watched minutes})$. N and C are the total whales/sighting summed over sightings scored as not previously seen (N) and uncertain whether previously seen (C), respectively. The season total estimate for each year is the sum of the day estimates over all the days in the migration period, with a weighted mean estimate used for the unwatched days. The weighted mean estimate, based on the watched days, was computed on a square root scale to give day estimates appropriate weight, considering the minutes of watch and the rate and variability of whale passage each day. A jackknife on watched days provided the SE for the season total estimate. The 2000 migration period was 14 May - 13 June with 18 (58%) watched days; 155 N whales and no C whales were seen. The 2001 migration period was 23 May - 15 June with 14 (58%) watched days; 148 N whales and 26 C whales were seen. Weighted geometric means of the 2000 and 2001 estimates of the number of migrating bowheads for the three alternatives for P with their 95% confidence intervals are: (1) 426 (301, 603); (2) 841 (601, 1176) and (3) 774 (558, 1073). Given observed migration speeds of bowheads in 2001, it is unlikely that any of the 94 N and 18 C whales seen from Cape Pe'ek in June of 2001 were counted by the survey near Barrow that year.

16. MATE, B.R. AND URBÁN-RAMIREZ, J. The spring northward migration and summer feeding of mother gray whales in the eastern North Pacific Ocean, Bering Sea and Chukchi Sea.

During March 2005, 17 adult gray whales were tagged one month after the peak of calving in Laguna Ojo de Liebre, Baja California Sur, Mexico ($21^{\circ}51'N \times 114^{\circ}16'W$). Sixteen whales were mothers with calves and one was a single adult. Implantable Argos (Telonics ST-16) satellite-monitored radio tags were used with color-coded antennas for subsequent re-identification. Tags transmitted data four 1-hr periods each day for 90 days; then four 1-hr periods every other day. Data were received from tags for 6-321 days ($X = 99$ d) and provided tracks of whales for a total of 86,059 km ($X = 5,062$ km) with five whales each traveling between 8,944 and 17,215 km (5,555-10,690 miles). Migration from Mexico to Alaska was near-shore with locations an average of just 2.3km from shore in water 22m deep and at a speed of 4.3 km/h. The speed north of Oregon was significantly faster than to the south probably due to improved calf development. These are the first multi-day migration routes and rates of speed for mother gray whales or individual gray whales north of San Francisco. Historically, gray whales have fed extensively over the shallow eastern Bering Sea shelf (primarily U.S. waters) with only an estimated 10% to 15% of the population traveling into the Chukchi and Beaufort Seas. This pattern did not materialize. Although one whale spent extensive time along the Russian coast from SW of the Gulf of Anadyr to the Bering Straits, all six whales tracked >100 days ($X = 175\text{d}$) spent most of their time in the Chukchi Sea (and primarily in Russian waters), providing new insights into gray whale summer foraging ranges and strategies. Two whales were tracked in early to mid June along the primary lead (open water path in ice) in the eastern Chukchi from Bering Straits toward Point Barrow. Three of the six whales used the area between Pt. Barrow and Icy Cape simultaneously in July. One of these whales traveled as far north as $72^{\circ}N$ as it traversed the Chukchi west to Wrangell Island, where it spent the month of August NW of the island. The most favored area during the feeding season was NNW of Bering Straits in the Chukchi, where three whales spent August through mid-November in roughly the same area before simultaneously heading south as the near-shore ice built up quickly in the Chukchi, suggesting this may be the environmental cue stimulating the south-bound migration. Such extensive use of the high latitude regions of the Chukchi Sea appears to be a recent phenomenon. The new wide-ranging movements documented by this study during the feeding season likely reflect changes in available food for gray whales in their traditional feeding areas. This is likely the result of both top-down predation pressure from the recovered eastern gray whale population's increased foraging requirements and bottom-up pressure as the growth of benthic amphipod species traditionally preyed upon by gray whales has been stifled by a recent Bering Sea regime shift. Two tagged whales were tracked south of the Aleutians and the tag on one of these was last located off Point Conception on 9 February 2006 with a southern migration speed of 5.1 km/h. The relatively late initiation of their south-bound migration and arrival in southern waters suggests that mothers of the previous year may linger longer on the feeding grounds to restore lost energy reserves from calf creation and suckling. Thus successful breeding on alternate years from calving may also occur "late" in the reproductive season, when most "single" whales have already departed the lagoons and are heading north. Mating behavior is observed from January through April, including along the northward migration, but calving is concentrated in a two month period. Thus, delayed implantation may be the mechanism by which gray whales achieve a relatively short and synchronous calving season. Seven tags operated for < 30 days. Most of these stopped in the lagoon and were likely lost due to the intimate contact between mothers and their calves. However, one of those whales (the non-mother) died and another lost its tag during entanglement and subsequent escape from a fisherman's net. A necropsy of the single whale determined that it had a distended uterus, indicative of an earlier birth that season and there were no indications (signs of infection in the tag area) that the death was tag-related. A third tag stopped providing useful data 202 days after tagging when it was killed during the Russian harvest of gray whales off the Chukotka Peninsula. The whale had mild swelling within 2-4cm of the tag. All three tags were recovered in excellent operational condition and showed no signs of corrosion. Despite considerable effort, re-sightings along the northern migration route were limited by weather, the timing of good locations in proximity to ports and other logistics. One mother calf pair was re-sighted off Oregon 41 days after tagging and showed no signs of adverse tag effects. Overall, tag performance during this experiment was deemed excellent and the results provide many new insights into gray whale migration, foraging strategies and distribution.

17. SPIRIDONOV, V., TARASYAN, K. AND DYACHENKO, S. Observations on western Pacific gray whales in the feeding grounds of North East Sakhalin during the installation of the concrete gravity base structure for the Piltun-Astokh B platform in July-September 2006.

18. GIVENS, G. AND OZAKSOY, I. Transience of a temporal lag correlation feature in bowhead microsatellites.

19. GIVENS, G.H., HUEBINGER, R.M., BICKHAM, J.W., GEORGE, J.C. AND SUYDAM, R. Re-examination of stock structure in bowhead whales from the western Arctic: preliminary analyses based on new microsatellites.

20. KOSKI, W.R., RUGH, D.J., ZEH, J., GEORGE, J.C., SUYDAM, R., DAVIS, A.R. AND MOCKLIN, J. An update on

analyses of BCB bowhead whale photographs obtained in 2003-2005. +

Aerial photographic surveys were conducted near Point Barrow, Alaska, from 12 April to 6 June in 2003, from 18 April to 7 June in 2004, and from 6-9 September 2005, and in the Bering Sea, Alaska, from 9 April to 2 May 2005. Approximately 1,157, 1,443, 105, and 454 photographs containing 1,606, 1,974, 114 and 965 images, respectively, were obtained. The 2003 survey had the temporally most complete photographic coverage of whales passing Barrow during spring of any survey to date, and the 2004 survey covered the main migration well although poor weather resulted in poor coverage of the mother/calf migration late in the season. The photographs from these studies will permit calculation of a population estimate for comparison with the estimate from ice based counts (George *et al.*, 2004) and better precision in the calculation of bowhead whale life-history parameters. The 2005 spring survey photographed bowheads during the later part of the bowhead migration, which includes a higher proportion of medium- and large-sized whales that are well marked. These photographs will be compared to 1981-2003 photographs to determine whether the recapture rate for Bering Sea bowheads differs from the rate at Barrow in 2004. Sizes of recaptured whales and their timing in those two areas will also be examined. A power analysis indicates that we will not be able to reliably detect the existence of a second stock that makes up less than 30% of the Bering Sea photographs. A small set of photographs was obtained near Barrow in early September 2005 which is before the main migration from the Beaufort Sea reaches Barrow.

21. SUYDAM, R.S., GEORGE, J.C., HANNS, C. AND SHEFFIELD, G. Subsistence harvest of bowhead whales (*Balaena mysticetus*) by Alaskan Eskimos during 2005. +

In 2005, 68 bowhead whales (*Balaena mysticetus*) were struck during the Alaskan subsistence hunt resulting in 55 animals landed. The efficiency (# landed / # struck) of the hunt was 81%, which is similar to the average efficiency over the past 10 years (1995-2004: mean = 79%, standard deviation = 8%). Twenty-five of the landed whales were males, 28 were females and the sex of two animals was not determined. Of the females, eight were presumably mature (>13.4m in length). Four were pregnant; although only sex and length were recorded for three of the fetuses. The three fetuses were all females and their lengths were 273 cm, 277 cm, and 450 cm. A fifth female may also have been pregnant (based on the presence of a large corpus luteum on one of the ovaries), although we were not able to examine her uterus for confirmation. A hunting captain examined a sixth mature female that was not pregnant. The other two sexually mature females were not examined closely.

22. KNOCH, M.J., SUYDAM, R.S. AND GEORGE, J.C. Inference into stock separation of Bering-Chukchi-Beaufort Seas bowhead whales (*Balaena mysticetus*) from stable isotopes in baleen.

23. GEORGE, J.C. AND SUYDAM, R. Length estimates of bowhead whale calves.

24. GEORGE, J.C., MOORE, S. AND SUYDAM, R. Progress report on bowhead whale stock structure studies.

25. LAMBERTSEN, R.H. Susceptibility of the great polar or bowhead whale to global warming. +

The great polar or bowhead whale (*Balaena mysticetus*) is commonly believed to be pagophilic, or "iceloving." Given knowledge that the extent of ice cover in its Arctic habitat is decreasing, there is a need for improved knowledge of the susceptibility of this species to global warming. Here this question is approached by considering those evolutionary feedbacks which likely account for the divergent morphophysiological characteristics of balaenids and balaenopterids. Acknowledging first the very high concentrations of fluoride in krill, it is pointed out that the most plausible hypothesis explaining the evolutionary emergence of baleen whales is cladogenesis driven by toxic disease. Fluoride toxicosis is known to affect preferentially the enamel organ of tooth buds, which organ is essential for development of a durable dentition. When one then assumes a primordial mysticete population characterized by variation in individual densities to either side of that of seawater, a plausible and likely mechanism of disruptive selection is revealed. This in theory would have been linked to different levels of activity required for respiration. Natural selection for feeding power then predicts two radically different outcomes that conform to the distinctive morphophysiologicals of balaenids and balaenopterids. The presumptive balaenopterid evolutionary path involves maximization of feeding power through the attainment of high individual kinetic energies. The presumptive balaenid evolutionary path in contrast involves maximization of feeding power at low swimming velocities, and hence comparatively low individual kinetic energies. This difference notably explains the ability of the bowhead to flourish in shallow Arctic seas as a reflection of a feeding strategy not associated with a high probability of lethal collisions with solid substrate. It also explains the larger average body size of Southern Hemisphere balaenopterid races or variants as a manifestation of the greater probability of lethal collisions with solid substrate in the Northern Hemisphere. The paradoxically low pre-exploitation population size of the blue whale is then similarly explained by a comparatively high natural mortality rate causally related to extremely high individual kinetic energies during feeding, extremely large turning radii, and an associated higher probability of lethal collisions with solid substrate. Ubiquitous bacterial pathogens would be involved secondarily. Coupled with other lines of evidence, the empirical support for this novel hypothesis rejects theories to the effect that the interhemispheric size dimorphism in Earth's largest whales is attributable to slightly lower ocean temperatures in the Southern Hemispheres. Further, in light of the rather shallow habitat of the bowhead, the same mechanism of mortality likely accounts in part for the bizarre morphology of that species. In the bowhead the propulsive action of the tail is constrained both by an extremely thick blubber layer and the fact that the body and tail themselves are foreshortened relative to the length of the head. It also is clear from measures of heat conductance through blubber that the thickness of its blubber greatly exceeds that required for thermal homeostasis. On these bases it is most reasonable to conclude that the bowhead whale is not in fact pagophilic, but rather thermophobic. It follows that amongst the Cetacea the bowhead probably should be viewed as comparatively extremely susceptible to global warming. One ecological threat to the bowhead to be anticipated with reduction in the extent of Arctic ice is a greater frequency of incursions into the Beaufort Sea by the humpback whale (*Megaptera novaeangliae*). Unlike other balaenopterids, the humpback whale is anatomically specialized for feeding in shallow water and carries weapons in the form of patches of barnacles on its chin and flippers. It also is well equipped to feed on euphausiids that comprise a component of the diet of the bowhead.

E – Environmental concerns

1. STACHOWITSCH, M., PARSONS, E.C.M. AND ROSE, N.A. State of the Cetacean Environment Report (SOCER) 2006.

The State of the Cetacean Environment Report (SOCER) is the response to several resolutions from the International Whaling Commission (i.e. Resolutions 1997-7 and 1998-5) which directed the IWC Scientific Committee to provide regular updates on environmental matters that affect cetaceans. Resolution 2000-7 welcomed the submission of the first SOCER at the 52nd Annual Meeting in Adelaide, Australia, and "request[ed] the

annual submission of this report to the Commission". The ultimate objective is to provide IWC Commissioners and other interested parties with a non-technical periodic summary of the positive and negative events, developments and conditions in the marine environment that are relevant to cetaceans. Such developments might range from unusual mortalities to new legislation protecting marine habitats. Previous SOCERs have focused on the Atlantic Ocean, the Mediterranean Sea, the Pacific Ocean and the Arctic and Southern Ocean (polar) regions. The current edition of the SOCER focuses on the Indian Ocean summarising key papers and articles that have been published in recent years. In addition the paper summaries key publications documenting events and research of global concern published over the past year, since the 2005 meeting of the International Whaling Commission.

2. HATCH, L.T., GONTZ, A.M., CLARK, C.W. AND WILEY, D. The Gerry E. Studds Stellwagen Bank National Marine Sanctuary as a regional case study for integrating protected species and protected area management tools to study and mitigate impacts of anthropogenic noise sources on marine mammals. +

Energy development in US federal waters is big business, and has become an important ingredient in the United States' (US) ocean policy mix. Despite the limited offshore geographic area for which leasing is currently authorized, the amount of oil and gas production from the Outer Continental Shelf (OCS) is significant. In its recently released final report, the US Commission on Ocean Policy recommended that the Minerals Management Service should conduct long-term environmental research and monitoring to better understand cumulative, low-level, and chronic impacts of OCS oil and gas activities on the marine environment (US Commission on Ocean Policy, 2004). In this paper we present the Gerry E. Studds Stellwagen Bank National Marine Sanctuary (SBNMS) as a case study in which we are assessing regulatory needs surrounding seismic surveying and other anthropogenic sound sources on two fronts: developing policy and gathering scientific information. Here, we examine the status of current US policy used to regulate anthropogenic sound within US National Marine Sanctuaries and ask a series of questions regarding the application of the US Marine Mammal Protection Act. We examine the relationship between current management tools focused on marine mammal species and marine protected areas, and highlight the role that spatially and temporally explicit regulatory models could play in integrating these tools. SBNMS is introduced as an urbanized marine environment, a feeding site for numerous protected marine mammal species and a pending site for increased use of seismic surveying technologies associated with energy inventories and liquid natural gas terminal development in the Gulf of Maine. A collaborative effort to monitor SBNMS's acoustic environment throughout the year using an array of autonomous recording units is described, and the utilities of these acoustic data for characterizing whale demographics, whale locations relative to ship traffic and whale-watching vessels and the Sanctuary's annual "noise budget" are detailed. Finally, the experimental set-up for a preliminary study of the acoustic signatures generated by two commonly-used but poorly-characterized seismic surveying technologies (boomers and mini-sparkers) is introduced to generate discussion by members of the International Whaling Commission's Scientific Committee (IWC's SC) who are participating in a pre-meeting to "Review the Potential Impacts of Seismic Surveys on Cetaceans". Although this paper discusses US policy at some length, it does so not to imply that the US approach warrants this forum's particular attention, but instead to provide the IWC's SC with reference points for discussing how to design and/or prioritize future scientific research efforts to best address common domestic and international regulatory questions surrounding the potential impacts of seismic surveys on cetaceans.

3. KASCHNER, K., CHRISTENSEN, L.B., WATSON, R., BEBLOW, J. AND MARTELL, S. Mapping top consumers in marine ecosystems past and present: comparative consumption rates of great whales and fisheries.

We attempted to map the effects of changes in great whale species composition in terms of maximum food consumption rates to assess their role globally as top consumers in marine ecosystems over the past century. We modeled trends in abundance over the past century for 14 marine mammal species, including all mysticetes (except for the Bryde's whale species complex and the pygmy right whale), the sperm whale, crabeater seal and Antarctic fur seal, based on available catch data and knowledge about current species abundance using a Bayesian stock reduction analysis approach. For each species, we then estimated mean annual food consumption (specified by food types) for different decades (1910s, 1950s, 1970s and 1990s) using published mean sex-specific body weights, diet compositions, and feeding rates. By linking food consumption to species distributions produced by a relative environmental suitability model within a global grid of 0.5 degree cell dimensions, we calculated spatially-explicit food intake per km². Using geographically disaggregated fisheries catches for the same time periods, we then compared top consumption rates estimated for any species including humans in each grid cell and mapped the identified top consumer species. We also assessed maximum fisheries catch rates relative to the top food consumption rate of any other species. Our results suggest that humans have increasingly replaced the large whales as top consumers in marine ecosystems in many areas of the world over the course of the past 50 years, except for the Antarctic where crabeater seals may have taken over that role. Moreover, areas with extremely high fisheries catch rates, particularly of demersal fishes and small pelagics, have been spreading rapidly over the same time period. The developed spatially-explicit, multi-species analysis approach may help in the assessment of the past and current role that individual species play in marine ecosystems.

4. WELLER, D.W., RICHARDS, S.H., BRADFORD, A.L., BURDIN, A.M. AND BROWNELL, R.L., Jr. Influence of 1997 seismic surveys on the behaviour of western gray whales off Sakhalin Island, Russia.

5. WELLER, D.W., TSIDULKO, G.A., IVASHCHENKO, Y.V., BURDIN, A.M. AND BROWNELL, R.L., Jr. A re-evaluation of the influence of 2001 seismic surveys on western gray whales off Sakhalin Island, Russia.

6. MOORE, S.E. AND ANGLISS, R.P. Overview of planned seismic surveys offshore northern Alaska July-October 2006. +

7. MOORE, S.E. AND KRAHN, M.M. Overview of Arctic research and assessment activities: cetacean-relevant updates on ACIA, PAME, IPY, ICARPII and recent publications. +

8. WILSON, J., ROTTERMAN, L. AND EPPERSON, D. Minerals Management Service overview of seismic survey mitigation and monitoring on the US outer continental shelf. +

The Minerals Management Service administers about 7,500 active leases on 40 million acres of the Outer Continental Shelf (OCS). Under statutory authority of the OCS Lands Act, we regulate oil and gas exploration and development related seismic survey activity on the U.S. OCS and have been actively involved in research and environmental analysis of those activities for over 20 years. The MMS protected species program involves complying with the Endangered Species Act (ESA) and the Marine Mammal Protection Act (MMPA); analyzing impacts; designing mitigation, monitoring guidelines; providing information necessary for promulgating regulations; and identifying, funding, and participating in research necessary for the protection and enhancement of protected species and their habitat. MMS implements mitigation and monitoring measures to avoid or reduce the

potential impacts of noise through a variety of mechanisms which include our regulations (30 CFR Part 250 - Oil and Gas and Sulphur Operations in the OCS) that implement provisions of the OCS Lands Act (U.S. Code Title 43, Chapter 29 Subchapter III), lease stipulations, and notices to lessees (to clarify requirements addressed in our regulations). MMS has focused two programmatic environmental analyses (under the National Environmental Policy Act-NEPA) on seismic surveys, one for the Gulf of Mexico and the other for the Alaskan Beaufort and Chukchi Seas. The MMS approach to mitigation and monitoring is based on the best scientific information available rather than requiring scientific certainty. We assess the available data and apply our technical expertise to make judgments based on scientific data in a manner consistent with the conservation purposes of laws such as the Endangered Species Act (ESA) and the Marine Mammal Protection Act (MMPA).

9. CLARK, C.W. Estimating the temporal and spatial scales of noise exposures from seismic surveys on baleen whales.

This report is based on an analysis of acoustic recordings collected throughout the North Atlantic Ocean and containing the low-frequency sounds from seismic surveys. The report will describe the spatial and temporal scales over which these sounds occur. It will also describe the acoustic behaviors of various baleen whale species under different exposure conditions.

10. BASS, C.L., ISAAC, S.J. AND SIMMONDS, M.P. An overview of the potential consequences for cetaceans of oceanic acidification. +

There has been a recent increase in research dedicated to understanding the complex effects of ocean acidification on marine ecosystems and organisms. Whilst study in this area is very much in its infancy, there is a clear message from a range of scientists and research institutions that this could have serious implications for cetaceans, with high latitude species likely to experience changes in their food web structure within this century. This paper provides a summary of the key peer-reviewed literature on ocean acidification with reference to consequences for cetaceans, their food webs or habitats. Drawing on assertions made in these papers, it is our contention that the potential impacts of ocean acidification on cetaceans merit future in-depth consideration from the Scientific Committee of the IWC and may have implications for the management of whale populations.

11. JOPLING, B., DOLMAN, S.J. AND SIMMONDS, M.P. The extent of seismic exploration worldwide, 1994-2004. +

The aim of this paper is to investigate the extent of seismic exploration on a global scale and how this is changing. This is explored by splitting the available data from 1994 to 2004 into 8 regions. The data are difficult to interpret because of their varying quality. We conclude that future reporting should be standardised, mandatory and transparent throughout the industry to aid our understanding of the extent of seismic surveys globally and therefore the potential impact on marine fauna.

12. WEIR, C.R., DOLMAN, S.J. AND SIMMONDS, M.P. Marine mammal mitigation during seismic surveys and recommendations for worldwide standard mitigation guidance. +

There is considerable worldwide variation in the mitigation measures implemented to protect marine mammals during geophysical seismic surveys. The criteria used for determining mitigation measures, and the similarities and differences in regional guidelines, are discussed. Suggestions are made towards developing a worldwide standard for marine mammal mitigation during seismic surveys.

13. KRAHN, M.M., PITMAN, R.L., BURROWS, D.G., HERMAN, D.P. AND PEARCE, R.W. Assessing the feeding ecology of Antarctic Type C killer whales using chemical tracers.

Top predators in the marine environment integrate chemical tracers acquired from their prey to reflect the prey species consumed. These chemical tracers-stable isotopes ratios of carbon and nitrogen, fatty acids and persistent organic pollutants (POPs)-were determined in blubber biopsy samples from Type C killer whales (*Orcinus orca*) from Antarctica. Type C whales were shown to have fatty acid, stable isotope and POP profiles that were very different from those of the eastern Tropical Pacific and eastern North Pacific killer whale populations studied to date. For example, stable isotope results showed that these whales occupy a lower trophic position than found for the other populations. In addition, Type C whales exhibited POP concentrations that were much lower than those in the other killer whale populations, as well as POP patterns and ratios that were distinct from those of the other populations. Furthermore, these results for Type C killer whale were also compared to those from a small number of Antarctic marine fish species postulated to comprise a sizeable portion of their diet. The chemical tracers from Antarctic fish were consistent with the fish diet observed in the field for Type C whales.

14. MORI, M. AND BUTTERWORTH, D.S. Further progress on modeling the krill-predator dynamics of the Antarctic ecosystem.

15. URBÁN, J., BRUCE, M., JAUME-SCHINKEL, S., DIAZ, C., TERSHY, B., ACEVEDO-GUTIERREZ, A. AND CROLL, D. Determination and characterisation of fin whale habitat in the Gulf of California.

An estimated 500-600 fin whales (*Balaenoptera physalus*) inhabit the Gulf of California, Mexico. They are found in the southern Gulf during winter and spring and show marked declines in abundance during the summer, when other baleen whales are known to migrate to high latitude feeding areas and when krill, their primary prey, are least abundant. These observations have led to the hypothesis that fin whales migrate out of the Gulf. Yet, recent genetic evidence suggests that these whales might be residents. If this is the case, it is unknown which region of the Gulf they use during the summer. To answer this question, we tagged 11 individuals in the southern Gulf of California during 22-31 March, 2001, and related their movements to remotely-sensed chlorophyll values from Gulf Sea-Wifs. Argos satellite tags were attached with a 68-kg Barnett compound crossbow from a 7 m boat; they remained attached to the whales 54.3±50.1 days (end of spring and beginning of summer). All tagged whales stayed inside the Gulf and traveled 36.8±22.7 km per day. Three whales remained tagged for 142.3±50.1 days, spending the summer in the mid-riff islands, the northern Gulf. Chlorophyll values in the Gulf were highest in the mid-riff islands at the end of spring and throughout the summer, and the movements of the tagged whales to the most productive area of the Gulf coincided with a diet shift from krill to sardines. During winter and spring of 2005, chlorophyll values were atypically low in the southern Gulf and highest in the mid-riff islands, and fin whales were not observed in the southern Gulf but in the midriff islands, feeding on krill. Results indicate that fin whales are residents of the Gulf and effective at finding and exploiting its most productive regions by moving long distances and shifting their diet.

16. WINSOR, M.H. AND MATE, B.R. Seismic survey activity and the proximity of satellite-tagged sperm whales.

Researchers from Oregon State University's Marine Mammal Program tagged sperm whales [*Physeter macrocephalus*] in the Gulf of Mexico with satellite-monitored radio tags in June and July 2002, July 2003 and June 2004 and 2005. High-quality locations (N=1507) from 56 whales were correlated with the central hotspot locations from active seismic vessels to determine whether whales were avoiding the vessels. Only locations within 25km of the active vessel were considered in this study (n=30 from 12 animals). It was assumed that non-randomly distributed distances

between whales and vessels could be possible evidence of a behavioral response to an active vessel. Distances were tabulated into 5km classes and a chi-square test was used to compare the observed frequencies with area-normalized expected frequencies. There was no evidence ($p=0.38$) that the data were non-randomly distributed. Because there were no whale locations less than 5km of a vessel, a Monte Carlo test was performed to determine if this pattern was unusual. Using 1,000 sets of 30 randomly created locations within a 25km radius of a central point, 27% of the simulated data sets had no locations less than 5km from the center providing further evidence that the data are randomly distributed. However, due to the small data set size, it was important to consider the power of the tests to determine a random distribution. Results from Monte Carlo simulations varying sample sizes indicate that a data set size between 75-100 locations is necessary to determine a significant ($p<0.05$) value for 0 locations within 5km. Distances between whales and active vessels appear to be randomly distributed with no evidence of avoidance from 5km and further. Preliminary results, however, cannot refute avoidance at distances less than 5km because of lack of sufficient sample size.

17. PAVAN, G., FOSSATI, C., MANGHI, M., PRIANO, M. AND PODESTÁ, M. The impact of man-made noise on marine mammals and mitigation procedures - the Italian situation. +

In response to harmful interactions and to the increasing international concern about the impact of anthropogenic noise on marine life, and on marine mammals in particular, it is widely requested to enforce suitable permit systems and mitigation procedures in the European waters. Missing specific prescriptions, in Italian and Mediterranean seas the EU Habitat Directive is the main framework for developing such measures and for complying with the recommendations expressed by several European and International organizations (ACCOBAMS Recommendation 2.7 and ACCOBAMS Resolution 2.16, the recommendations of the 2004 IWC meeting, and the latest Motion B6-0089/04 of the European Parliament). This paper introduces the issues of acoustic pollution, the basic concepts for the development of a mitigation policy, and reviews the situation in Italian waters.

18. PAVAN, G., FASSATI, C., PRIANO, M. AND MANGHI, M. Recording Cuvier's beaked whales (*Ziphius cavirostris*) with a wideband towed array. +

In late September 2005 CIBRA was in charge of the bioacoustic part of a wide NURC (NATO Undersea Research Center, La Spezia, IT) research campaign (Ziphius '05) in the Ligurian Sea to study Cuvier's beaked whales, characterize their habitat, and possibly remotely record their acoustic signals. Up to five different platforms worked at the same time, with different tasks. The CIBRA team, onboard the Krill, a 12 meters long catamaran, surveyed the area off the Western Ligurian coast with the advanced Passive Acoustic Monitoring (PAM) equipment based on a high quality towed array connected to a wideband low-noise front-end to allow digital recording with nearly 90 kHz bandwidth. On September 25th, the Krill quietly approached the location where three Cuvier's beaked whales were sighted by another vessel. Close to the location of the last sighting, the team saw the blows of two animals, immediately before their dive. No other animals of any species were observed before and after this sighting. The catamaran was stopped, the engines turned off and the array sank to more than 40 meters depth. A few minutes after the animals started their dive, high frequencies click trains on the real-time spectrogram display were noticed (SeaProUltra, two channels, 96 kHz bandwidth); the 96kHz spectrogram display showed click series with features matching the description given by Johnson *et al.* 2005 (based on WHOI's D-TAG recording). Frequency center, bandwidth, waveform, repetition intervals and amplitude variations related with head scanning movements indicate that the recording captured the emissions of two diving *Ziphius cavirostris*. This was the first recording of *Ziphius cavirostris* clicks ever made with a sub-surface towed array that exactly match D-TAG data. The result is relevant for setting up affordable and easy to use equipment to be used for mitigation operations in areas where the presence of Cuvier's beaked whales must be estimated and monitored.

19. PAVAN, G., COSENTINO, G., MUSUMECI, M. AND SPEZIALE, F. Continuous real-time monitoring with a deep underwater acoustic station. Noise spectra and biological sounds from the NEMO Test Site. +

20. PAVAN, G., MANGHI, M., FOSSATI, C. AND PRIANO, M. Passive Acoustic Monitoring (PAM) tools for the implementation of mitigation policies.

In response to the increasing international concern about the impact of anthropogenic noise sources on marine life, and on marine mammals in particular, regulatory processes and mitigation procedures are being progressively adopted by the Navies to reduce the impact of sonars, and by the oil industry and scientific institutions to reduce the impact of seismic surveys. Mitigation procedures have been designed and implemented mostly to reduce the risks associated with the acute exposure to high power sound sources. Despite the fact that no risk mitigation measure can completely eliminate the risks associated with high power sound sources, such as sonars and airguns, thoughtful and prudent planning along with mitigation actions based on dedicated tools can significantly reduce these risks. Passive acoustics is one of the tools to be used for (a) expanding knowledge about marine mammals' distribution (i.e. with surveys), (b) evaluating the effects of sound exposure on animals' behaviour, (c) in situ monitoring to detect any animal within or approaching the possibly dangerous sound exposure area, (d) monitoring underwater noise levels. Passive acoustics has the potential for detecting diving animals, if they produce sounds, and also for accurately establishing direction and distance of the "contact", but in most of the current implementations the accurate localization is very difficult as repeated contacts with the same source are normally required for a reliable triangulation. In the real world, the triangulation of sources that move fast in three dimensions and don't vocalize regularly is very difficult and can't provide the effectiveness required by the most severe mitigation rules. It is thus required to further invest in developing new techniques and tools to give PAM a more advanced and effective role.

21. CAÑADAS, A., FORTUNA, C. AND HAMMOND, P.S. Modelling techniques to investigate the impact of changes in habitat on cetacean distribution and abundance.

The use of spatial habitat modelling applied to data from long-term monitoring studies to investigate the possible effects of anthropogenic stressors on cetacean distribution and abundance is a recent development with the potential to provide valuable information for conservation and management. Such stressors include locally intense maritime traffic and overfishing that may exclude certain species from areas that may otherwise be important to them. In this context, spatial habitat modelling may also help us to understand whether fluctuations in cetacean distribution and abundance over time are a result of natural or human-related factors. Three examples of spatial analysis applied to long-term cetacean population studies are given in this paper to illustrate these points: a study of common dolphins in South-east Spain over 14 years, in which a reduction in density and shift in distribution seems to be related to a local increase in fish farms; a study of bottlenose dolphins in South Spain also over 14 years, where natural fluctuations occur in density but not in distribution, apparently unrelated to any human-related stressor; a study of bottlenose dolphins in Croatia over 9 years, where a shift in distribution and a reduction in density has been linked to recreational boat traffic.

22. DOLMAN, S.J. AND SIMMONDS, M.P. An updated note on the vulnerability of cetaceans to acoustic disturbance. +

This short review of negative impacts of intense marine noise pollution provides an update to an earlier submission to the IWC Scientific Committee (Simmonds and Dolman, 2000) and provides a summary of some important recent developments.

23. FOSSI, M.C. AND MARSILI, L. New-tool to investigate toxicological hazard due to endocrine disrupters in Mediterranean cetaceans. +

Mediterranean cetaceans, particularly odontocetes, accumulate high concentrations of organochlorine contaminants (OCs) and are therefore exposed to high toxicological risk. Some OCs are known to be endocrine disrupting compounds (EDCs). The hypothesis that Mediterranean cetaceans (*Stenella coeruleoalba*, *Delphinus delphis*, *Tursiops truncatus* and *Balaenoptera physalus*) are subject to toxicological risk due to organochlorines and emerging contaminants, such as polybrominated diphenyl ethers (PBDEs) with endocrine disrupting capacity, was investigated using non-lethal “diagnostic” and “prognostic” methods. CYP1A1 activity induction (Benzo(a)pyrene monooxygenase) in skin biopsies was used as a “diagnostic” indicator of exposure to organochlorines in odontocetes and mysticetes and in different populations of *Stenella coeruleoalba*. Marked differences in levels of OCs and CYP1A1 activity were found between fin whales and odontocetes. Organochlorine levels and CYP1A1 activity were significantly higher in the *Stenella coeruleoalba* population of the Mediterranean Whale Sanctuary than in those of two other study areas, suggesting that cetaceans are exposed to high risk in this protected area. Several questions remain still unanswered in ecotoxicological studies of Mediterranean cetaceans. The need for new biomarkers for EDCs and for a “cell model” to explore the different susceptibilities to several classes of EDCs, including emerging contaminants, led us to culture fibroblasts of different cetacean species as a non-lethal new investigation tool (“dolphins in test tubes”). As a new “prognostic” tool we explored interspecies and gender susceptibility to OC-EDCs and PBDEs using qualitative and semi-quantitative evaluation of target proteins, such as CYP1A1 and CYP 2B in cultured cetacean (*Stenella coeruleoalba*, *Tursiops truncatus* and *Balaenoptera physalus*) fibroblasts, by western blot, immunofluorescence technique and PCR real time. The information obtained in this pilot experiment will be the basis for further applications and validation of these methodologies to explore different species and gender susceptibility of marine mammals to different mixtures of endocrine disrupting xenobiotics including emerging contaminants.

24. WOSHNER, V., KNOTT, K., WELLS, R., WILLETTO, C., SWOR, R. AND O’HARA, T. Mercury and selenium in blood of bottlenose dolphins (*Tursiops truncatus*): interaction and reference to life history parameters. +

Mercury (Hg) contamination of freshwater and marine ecosystems is a grave environmental concern, particularly in the southeastern United States. Mercury biomagnification may increase risk of toxicosis to upper level trophic organisms. Because Se antagonizes Hg in laboratory studies, the coincident increase of Se and Hg in certain tissues of marine mammals (principally Odontoceti) implicates a protective role for Se against Hg toxicity. Unlike Hg, which has no known function in mammals, Se is an essential element, and as such, its levels are homeostatically regulated within a narrow range. As a component of the amino acid selenocysteine, Se is a constituent of numerous proteins, including the glutathione peroxidases (GSH-Px), which possess potent antioxidant properties, especially with respect to various hydroperoxides. Initial data from free-range bottlenose dolphins (*Tursiops truncatus*) inhabiting Sarasota Bay, FL, USA, indicated whole blood mean total Hg (THg) concentrations in excess of 500 µg/L (ppb ww). This concentration is approximately 10 times the 58 µg/L benchmark dose level for human cord blood (USEPA), and 100 times the level at which adverse neurodevelopmental effects can occur (5.8 µg/L in human cord blood) (Trasande *et al.*, 2005). Objectives of this study are: 1) to monitor and to explore relationships between levels of Hg, Se, and GSH-Px in biopsies of blood and epidermis from Sarasota Bay *Tursiops*, and, 2) to relate tissue Hg and Se concentrations to specific environmental, hematological, or morphometric parameters, including season, age, and trophic level as assessed by stable isotope signatures of C and N. Among 46 dolphins sampled during 2004 and 2005, ages ranged from 1.5 to 25.5 years (mean=10.25; SD=7.78; n=39). Mean blood THg was 554.03±377.80 µg/L (n=36), with virtually all Hg present as monomethyl mercury (MeHg). Mean blood Se measured 0.77±0.17 µg/ml (n=36), just over half the concentration in serum. Blood GSH-Px activity correlated linearly with Se in whole blood (P=0.03; F=5.06; R²=0.13), but not with serum Se (P=0.12; F=2.54; R²=0.07) nor with blood THg (P=0.36; F=0.86; R²=0.02). Blood Se correlated only marginally with serum Se or with blood THg. However blood THg concentrations were related linearly to serum Se (P=0.01; F=7.41; R²=0.18) as well as serum albumen (P=0.02; F=5.56; R²=0.14). Each of the following variables increased linearly as a function of Age: THg (P<0.001); MeHg (P<0.001); blood Se (P=0.007); serum Se (P=0.006); and GSH-Px (P=0.04). Preliminary data suggest that relationships among Hg, Se, GSH-Px, and other blood proteins are complex, and alter mutually in conjunction with age and trophic level. Literature cited: Trasande, L. *et al.* 2005. Public health and economic consequences of methyl mercury toxicity to the developing brain. *Environ. Health Perspect.* 113:590-596.

25. WEILGART, L. Managing noise through Marine Protected Areas around global hot spots. +

Anthropogenic noise sources may interact cumulatively or synergistically with other noise sources or with other threats facing cetaceans, though such impacts will be hard to determine, especially as noise could cause effects over thousands of kilometers. Marine Protected Areas (MPAs) are one of the most effective means to protect cetaceans and their habitat from such impacts. Models of cetacean distribution can identify cetacean “hot spots” globally, which can be used to determine the location of suitable MPAs, both in coastal areas and on the high seas. A case study of the Gully MPA off Nova Scotia is discussed and its policy toward seismic surveys. MPAs must be large enough to safeguard essential habitat and migration corridors and to accommodate highly mobile species. Management schemes should ideally encompass whole ocean basins, and a global network of marine reserves ensuring connectivity between them is needed. MPAs must be well-managed with strict, enforced regulations extending toward the entire ecosystem if they are to achieve their purpose. Alternatives to MPAs such as diverting shipping lanes and area/time closures for noise sources or other threats may be appropriate, though may not adequately safeguard the ecosystem.

26. CCAMLR SCIENTIFIC COMMITTEE WORKSHOP STEERING COMMITTEE Invitation to the SC-IWC to jointly organise with SC-CAMLR a workshop to review the state and characteristics of information required for ecosystem models being developed to provide management advice on krill predators in the Antarctic marine ecosystem.

At its 2005 meeting, the Scientific Committee of CCAMLR endorsed holding a workshop in 2008 to i) consider the types of information needed for models on the Antarctic marine ecosystem that could be developed for providing management advice; ii) consider how the information might be used in modelling the Antarctic marine ecosystem, the quality of information and key gaps needing to be resolved before such information might be used in the development of those models; and iii) consider metadata, rather than reviewing individual datasets and undertaking analyses to summarise the data, where the metadata would comprise information on the estimates of abundance, population trends and parameters, their data sources and methods used to estimate them. The SC-CAMLR agreed to invite the SC-IWC to assist in organising this workshop as it would be beneficial to the work of both CCAMLR and the IWC. This paper will provide the background to this invitation and a suggested plan for work leading up to the workshop.

27. NICOL, S., GEDAMKE, J., THIELE, D., BINDOFF, N. AND WILLIAMS, G. Ecosystem research in the waters off East

Antarctica (30-80°E) during the Austral summer of 2006.

28. BORRELL, A., AGUILAR, A., ZELJKOVIC, A., BROUWER, H., BESSELINK, T. AND REIJNDERS, P.J.H. Post-mortem stability of blubber DLCs, PCB and tDDT in by-caught harbour porpoises (*Phocoena phocoena*). +

In order to try to assess the reliability of samples collected from animals after they died, this paper investigates the effect of post-mortem time (0-48 hours) on dioxin-like compounds or DLCs (such as 2,3,7,8-substituted dioxins and benzofurans as well as nonsubstituted and mono-ortho-substituted PCBs), tPCB (total polychlorinated biphenyls) and tDDT (dichloro diphenyl trichloro ethane and family) in the blubber of harbour porpoises that were left after death under natural conditions. Neither significant differences nor time trends were detected in the concentration of DLCs over the study period, indicating that degradation agents (ultraviolet rays, oxygen exposure and temperature) did not affect them. tDDT and PCBs were calculated at two points in time (INSERT) and again no trends were observed. Blubber can thus be regarded as a reliable tissue for the assessment of the organochlorine compounds (DLCs, PCB, DDT and others) of unpreserved specimens kept up to at least 48 hours in conditions similar to those of the study.

29. JARMAN, S., WISEMAN, N., BAKER, C.S. AND GALES, N.J. Incidence of prey DNA types in Bryde's whale scats. +

The diet of whales is an important aspect of their ecology and also a very difficult one to study. We have previously demonstrated that DNA can be used to study the diet of blue whales (*Balaenoptera musculus*) and fin whales (*Balaenoptera physalus*) through identification of prey item DNA found in whale faeces. We apply similar DNA based methods here to samples of faeces from ten Bryde's whales (*Balaenoptera edeni*) to determine the presence or absence of important prey groups. DNA from rayfinned fish was present in all samples tested (n=10). Krill and amphipod DNA were present in 7/10 samples and copepod DNA was present in 3/10 samples. This study is an example of using DNA based prey detection as a rapid, cheap and noninvasive way of studying whale diet.

30. GOOLD, J.C. AND COATES, R.F.W. Near source, high frequency air-gun signatures. +

High frequency signatures of individual 60 cubic inch and 250 cubic inch air-guns were recorded at 10m from source during dedicated air-gun field trials. The high frequency recordings were made with a sample rate of 300 kHz and had a flat response from 20 kHz - 100 kHz. Recordings were low cut filtered at 20dB per decade below 20 kHz. Waveform traces were inspected and maximum pulse power was evaluated. These two air-guns were found to have substantial high frequency energy output up to 150 kHz. Maximum pulse power occurred close to the pulse onset, and ranged from approximately 170 dB re 1µPa.

31. MARSILI, L., FOSSI, M.C. AND BUCALOSSI, D. Trend of organochlorine contaminants in free-ranging and stranded cetaceans along the Italian coasts in the period 1987-2005.

The temporal trend of organochlorine (HCB, DDTs and PCBs) contamination along the Italian coasts in the period 1987-2005 was evaluated in Mediterranean cetaceans (*Stenella coeruleoalba*, *Tursiops truncatus*, *Delphinus delphis*, *Balaenoptera physalus*, *Ziphius cavirostris* and *Grampus griseus*). Tissues and organs of stranded cetaceans and subcutaneous blubber of free-ranging cetaceans were analysed for organochlorine contaminants (OCs). Despite prohibition of DDT since the late 1970s-early 1980s and regulation of the use of HCB and PCBs, these xenobiotics are still present in marine mammals. Levels in Mediterranean cetaceans are much higher than in the same species sampled in the other parts of the world. In this study we found a slight decrease in organochlorine levels in these mammals in the last few years, with differences between and within species in relation to area and year of sampling. OC levels were also compared in relation to tissue and sex. Differences in accumulation encountered in the different species were related principally to different feeding habitats. Remarkable differences between males and females of each species confirm that females undergo detoxification by passing much of their total burden of OCs to their young during gestation and lactation. Though these results suggest that the bans on DDTs and PCBs may be having some effect, emerging contaminants such as polybrominated diphenyl ethers (PBDEs), used as flame retardants, seem to be increasing in the Mediterranean environment. A major problem in their management depends on lack of information of their toxicological properties and effects on biota. Most toxicological studies have used rats as mammals models and certain aquatic organisms, but almost no data exists for wildlife and especially marine mammals.

32. FRIEDLAENDER, A.S., LAWSON, G.L. AND HALPIN, P.N. Evidence of resource partitioning and niche separation between humpback and minke whales in Antarctica: implications for inter-specific competition. +

Closely related sympatric species must differ in their ecological requirements or niches (e.g. diets) to avoid inter-specific competition. Body size and energetic models suggest smaller whales should target shallower, smaller, denser, prey aggregations than larger whales. The large sympatric pre-whaling Antarctic cetacean community suggests resource partitioning or non-limiting resources. We use Mantel's tests to elucidate physical and biological environmental variables affecting minke and humpback whale distribution patterns. We find distribution of both species most related to prey distribution, and species-specific differences in physical features which may aggregate prey or help determine ice free areas during winter. CART models including concurrent measurements of acoustically inferred prey aggregations show smaller minke whales consistently associating with significantly deeper krill aggregations across a range of spatial scales. Furthermore, we find evidence of minke whales targeting patches with larger individual krill and smaller aggregation area than humpback whales. These results indicate possible resource partitioning and niche separation mediated by food preferences and the biomechanics of body size, suggesting inter-specific competition is unlikely. Given accelerating rates of climate change around the Antarctic Peninsula, and the ecological importance of baleen whales still recovering from exploitation, our results can benefit organizations managing and conserving Antarctic cetaceans and ecosystems.

33. GENTRY, R.L. A new research programme on the effects of industry sounds on marine animals. +

34. MILLER, D.G.M. Joint CCAMLR-IWC Workshop. +

35. BAIN, D.E. AND WILLIAMS, R. Long-range effects of airgun noise on marine mammals: responses as a function of received sound level and distance. +

Effects of noise from seismic surveys on marine mammals need to be understood so that they can be appropriately mitigated. This study examined effects of large airgun arrays (79-110 l) on a variety of marine mammal species in the waters of British Columbia and Washington at long distances (1 to > 70 km). Received noise levels near marine mammals were measured to overcome difficulties in modeling long-range propagation in complex near-shore waters. Although airguns concentrate energy at low frequencies, noise was detectable to at least 100 kHz, providing a mechanism to affect marine mammals with good high-frequency hearing. Apparent behavioral responses varied by species. Species with similar hearing capabilities exhibited markedly different responses to airgun noise, and a high frequency specialist, the harbor porpoise, appeared to be the species affected by the lowest

level of noise (< 145 db re $1 \mu\text{Pa}$ RMS at a distance > 70 km). The long distances at which behavioral changes were observed indicate that long ramp-up times (> 1 -5 hours depending on species) are likely to be needed to prevent strong behavioral changes. While infrared imaging and passive acoustic monitoring can complement visual detection, technical constraints limit their usefulness. Scheduling surveys around seasonal distribution of species of concern, limiting periods of exposure, and routing airguns to ensure that marine mammals are not driven ashore may be as important as monitoring safety zones in preventing injuries and death.

36. LEPAGE, K., MALME, C., MLAWSKI, R. AND KRUMHANS, P. Exxon SYU sound propagation study, November 1995. BBN Report No. 8120. +

37. LEPAGE, K., MALME, C., MLAWSKI, R. AND KRUMHANS, P. Mississippi Canyon sound propagation study, February 1996. BBN Report No. 8139. +

38. REIJNDERS, P., WELLS, R., AGUILAR, A., BJØRGE, A., DONOVAN, G., O'HARA, T., ROWLES, T. AND SIEBERT, U. Final report on POLLUTION 2000+: Phase 1.

39. HALL, A.J., STOTT, J., BLANCHARD, M., ROWLES, T.K., BORRELL, A., AGUILAR, A., REIJNDERS, P.J.H. AND WELLS, R.S. The relationship between immune measures and blubber organochlorine concentrations in bottlenose dolphins (*Tursiops truncatus*) from Sarasota Bay, Florida.

SC/58/IA – In-depth assessment

1. ENSOR, P., KOMIYA, H., OLSON, P., SEKIGUCHI, K. AND STAFFORD, K. 2005-2006 International Whaling Commission-Southern Ocean Whale and Ecosystem Research (IWC-SOWER) Cruise. +

We conducted the 28th annual IWC-SOWER (formerly IDCR) Cruise in the western part of Antarctic Area III (000° - 020° E) aboard the Japanese Research Vessel Shonan Maru No.2. The cruise departed Cape Town, South Africa on 22 December 2005 and returned to Cape Town on 22 February 2006. The cruise had two primary research components: a feasibility study for fin whale research in latitudes north of 60° S; and survey experiments designed to improve and interpret estimates of minke whale abundance from previous cruises. After departing Cape Town, the ship first transited south to the study area for fin whales, located between latitudes 55° S and 61° S. From 27 December to 16 January a visual survey for fin whales was conducted using Adaptive Line Transect Sampling (ALTS) as the primary method. A total of 863.9 nmiles of trackline were covered in primary searching effort including 729.9 nmiles of ALTS. Ten ALTS cycles were triggered during the survey. Biopsy sampling was conducted on four groups of fin whales resulting in 30 samples collected from 26 whales. 25 of the 26 biopsied whales were photographed. Acoustic monitoring for fin whales was also undertaken using sonobuoys. 75 sonobuoys were deployed but fin whale calls were only recorded on eight of these. Fin whales and humpback whales were the most frequently sighted species in the fin whale research area, totaling 31 groups/274 individual fin whales and 149 groups/377 individual humpback whales. Minke whale research was carried out from 18 January to 13 February in the vicinity of the ice edge. The focus of this research component was to evaluate BT mode (Buckland and Turnock, 1992) survey methodology using 25X mounted binoculars. 1,730 nmiles of trackline were surveyed during the minke whale research, including 1,305 in BT mode. 38 sightings of minke whales out of a total of 309 sightings were first detected and tracked by the 25X binoculars; of these 23 were subsequently detected by the primary platform. The number of re-sightings during tracking before detection or the whale(s) passed the ship's beam ranged from 0 to 101. Minke whales were the most frequently sighted species in this research area, totaling 361 groups/940 animals. During the cruise, additional research was conducted on blue whales and humpback whales. 33 groups of 63 blue whales were sighted (61 individuals were identified as true blue whales). Of these, biopsies were collected from 36 whales and photo-id images collected from 52 whales. Sounds attributed to blue whales were recorded in the vicinity of 29 sightings. During the cruise, biopsies were collected from 71 humpback whales and photo-id images from 115. Other notable sightings during the cruise included two sightings of southern right whales (1 group/1 individual, 1 group/2 individuals). All three whales were photographed and the group of two were biopsied. Ten groups/75 individual killer whales were sighted including two groups determined to be Type A, two groups Type B, and one group Type C. Biopsy samples and photographs were collected from all three types. The Estimated Angle and Distance Training Exercise and Experiment was completed as in previous years.

2. PUNT, A.E. AND POLACHECK, T. Further statistical catch-at-age analyses for Southern Hemisphere minke whales.

3. POLACHECK, T. AND PUNT, A.E. Minke whale growth models for use in statistical catch-at-age models.

4. BRANCH, T.A. Possible reasons for the appreciable decrease in abundance estimates for Antarctic minke whales from the IDCR/SOWER surveys between the second and third circumpolar sets. +

5. HUGHES, M.S. AND BURT, M.L. Minke whale abundance estimation from the 2004/2005 IWC SOWER Antarctic cruise in Area III. +

Estimates of minke whale abundance in the part of Area III surveyed in 2004/2005 were obtained using standard IWC methods. A variety of pooling options to estimate the effective strip half-width (W_s) and mean school size were considered but small numbers of sightings meant that all sightings had to be pooled to estimate a single W_s for each mode and a single mean school size. The combined closing and IO mode estimate of minke whale abundance in the survey area is 8,347 whales ($cv=24.5\%$) with a 95% confidence interval (5,200; 13,400). We also estimated whale abundance when sightings classified as 'like minke' were included. Comparisons with previous surveys conducted in Area III were difficult because of the different survey regions, however, some density estimates from these surveys are presented.

6. HAKAMADA, T. Examination of the effect of ship on abundance estimate for Antarctic minke whales.

7. HAKAMADA, T., MATSUOKA, K. AND NISHIWAKI, S. Abundance trend of Antarctic minke whales in Areas IV and V based on JARPA data. +

Abundance trends for Antarctic minke whales (*Balaenoptera bonaerensis*) in Areas IV and V based on JARPA (1989/90-2003/04 in Area IV and 1990/91-2004/05 in Area V) were estimated. Those were estimated to be 1.2% and -1.3% in Areas IV and V, respectively. As their 95% confidential intervals are (-2.8%, 3.9%) and (-4.3%, 1.1%) in Areas IV and V, respectively, there is no significant trend in Areas IV and V from JARPA abundance data. However, the change in Area V may be negatively biased because of possible underestimate of abundance in 2004/05. Change in abundance

estimates is different between IWC- IDCR/SOWER and JARPA in Areas IV and V. JARPA surveyed in Areas IV and V every two years for 16 years, respectively whereas IDCR/SOWER surveyed three times in these Areas in 26 years. It is suggested that JARPA provide more reliable trend of abundance estimate.

8. MORI, M. Application of ADAPT-VPA to various stock hypotheses on Antarctic minke whales distributed through IWC Management Areas III to VIW.

9. OKAMURA, H. AND KITAKADO, T. A modification of the hazard probability model.

10. OKAMURA, H. AND KITAKADO, T. Abundance estimates from IDCR/SOWER data using the hazard probability model.

11. SHIMADA, H. AND KATO, A. Preliminary results of a sighting survey of Antarctic minke whale within pack ice by ice breaker and helicopter.

12. SHIMADA, H. AND MURASE, H. Relationship between minke whale abundance and pack ice extent.

13. CAÑADAS, A., DE STEPHANIS, R., PEREZ, S., GARCÍA, S. AND HAMMOND, P. Methods for estimating cetacean abundance: model-based line transect and mark-recapture compared. +

Effective conservation of wild populations requires an understanding of their ecology, including the fundamental need for information on their abundance. The two most widespread methods for estimating cetacean abundance are line transect sampling and mark-recapture using photo-identification data. For line transect studies in which equal coverage probability cannot be achieved, model-based line transect methods (line transect combined with spatial analysis) can be used. These methods make different assumptions and each may therefore be more suitable for different scenarios. Mark-recapture is likely to be more useful for relatively closed populations (with good natural markings) in small areas, while line transect sampling is more suitable for larger areas containing open populations. In this paper, we present abundance estimates for bottlenose dolphins off southern Spain using both methods. Abundance was estimated using mark-recapture in the Strait of Gibraltar where there appears to be a relatively small local population, and with model-based line transect methods in the Alborán Sea, where there is evidence of an open population inhabiting a larger area. Estimation of abundance of this species in the Alborán Sea was also attempted using mark-recapture, illustrating the difficulties of applying this method to an open population with an extensive range, and providing a useful comparison of the two methods.

14. BRANCH, T.A. Analysis of simulated Antarctic minke surveys using the ‘standard’ method and the ‘direct duplicate’ method. +

Four new scenarios (sc33-sc36) of simulated survey data are analysed using the “standard” distance sampling method and the direct duplicate method of Palka (1995). The new scenarios were “blind” in that true simulated densities and the factors included were not revealed. Estimated densities were 0.029, 0.021, 0.082, and 0.063 whales per km² for the four scenarios using the “standard” method, and 0.029, 0.020, 0.081, and 0.062 whales per km² for the direct duplicate method. Some negative bias in estimates is expected from the standard method due to whales on the trackline being missed by the surveys. If true, the direct duplicate method then failed to correct for this bias for these scenarios, as resulting estimates were very similar to those obtained from the “standard” method.

15. BRAVINGTON, M., PEEL, D. AND HEDLEY, S. More abundance estimates for Antarctic minke whales, with new statistical methods.

We present some more abundance estimates for Antarctic minke whales, using the SOWER/IDCR data from the CPII and CPIII cruises. The estimates are based on new statistical methods, using spatial models for school-size-distribution and school-density. Distance sampling aspects are handled via point-independence (Laake & Borchers, 2004, “Advanced Distance Sampling”). We also apply the new methods to simulated datasets.

16. THOMAS, L., SANDILANDS, D. AND WILLIAMS, R. Designing line transect surveys for complex survey regions. Line transect surveys are widely used to estimate the density and/or size of cetacean populations. +

Good survey design is essential for obtaining reliable results using standard (design based) analysis methods. Even for more complex (model based) analysis methods, a good survey design is very helpful. By ‘good’ we mean a design (a) that employs randomization in laying out transects; (b) that is stratified if density is known to vary on a large scale; (c) where each location within a stratum has an equal probability of being surveyed (equal coverage probability); (d) that produces at least 10-20 transects per stratum; (e) that, given the previous points, gives maximum efficiency per unit effort - for example by minimizing time spent travelling between survey lines (off-effort time). We discuss strategies for creating good designs given the constraints inherent in many shipboard surveys of cetaceans: severely limited ship time and complex topography. We advocate the use of computer software, such as the program Distance, to create designs and compare their properties using simulation. We provide a link between the concepts and their implementation through a concrete example of survey design: a multi-species survey of cetaceans in coastal British Columbia. The design uses an equally spaced zig-zag configuration of transects in more open strata combined with sub-stratification to minimize off-effort time. In the highly convex inshore stratum we develop a systematic cluster sampling algorithm, and within the selected clusters use a systematic parallel line layout to ensure equal coverage probability in the long, narrow fjords. To aid those wishing to learn automated design methods, we provide Distance project files in an online appendix.

17. MATSUOKA Trends in sightings parameters of Antarctic minke whales based on IDCR-SOWER data between CPII and CPIII.

18. BRANCH, T.A. Abundance estimates for Antarctic minke whales from three completed sets of circumpolar surveys.

SC/58/NPM – Western North Pacific common minke whales

1. PASTENE, L.A. Summary of the activities of the intersessional Working Group on preparation for the in-depth assessment of North Pacific common minke whale, focused on the J-stock.

2. KANDA, N., PARK, J.Y., SOHN, H., KIM, Z.G., GOTO, M. AND PASTENE, L.A. Preliminary microsatellite analysis of by-caught J-stock minke whales from Japan and Korea. +

We analyzed samples of minke whales from Japan (Sub-area 6 (SA6)) and Korea (SA5 and SA6) using nine microsatellite loci in order to describe their genetic population structure. The samples were bycaught in set net fisheries conducted along the Japanese coast in SA6 (N = 202) from 2001 to 2004 and in coastal fishing gears along the Korean peninsula (N = 278) in SA6 and SA5 from 1999 to 2004. The genotypes of the individuals were first standardized using reference samples in order to avoid scoring differences between the two laboratories. We then examined if there was any evidence of genetic differences among the samples collected on different years within Japanese and Korean samples, respectively, among the samples from different areas of Korea, and finally between the samples from Japan and Korea. No evidence of statistically significant temporal heterogeneity was detected in the Japanese samples (JBC). However, the Korean sample collected from SA6 in 1999 (99KBC-6) was different from both the JBC and the rest of the Korean samples (KBC), although we were not able to completely reject the possibility of a chance effect for this heterogeneity. Finally, no evidence of statistically significant heterogeneity was detected within the KBC as well as between the JBC and KBC. A Bayesian clustering method did not show evidence of multiple stocks in our samples. Although we observed the heterogeneity of the 99KBC-6, no strong evidence of the existence of an additional stock in SA5 and SA6 was indicated.

3. PARK, J.Y. Mitochondrial DNA control region sequencing analysis of by-caught J-stock minke whales from Japan and Korea.
4. MIYASHITA, T. Cruise report of the IO sighting survey in the northern Sea of Japan in 2005.
5. MIYASHITA, T. Cruise report of the sighting survey in the waters west of the Kuril Islands and the Kamchatka Peninsula in 2005.
6. MIYASHITA, T. AND SHIMADA, H. Plan of sighting surveys in the western North Pacific in 2006.

SC/58/PFI – Preparation for *Implementation*

1. PUNT, A.E. A note related to the impact of different ages-at-recruitment for the western North Pacific Bryde's whales. +

It was proposed during the First Intersessional Workshop for the western North Pacific Bryde's whales that the associated Implementation Simulation Trials be based on an age-at-recruitment of five years (corresponding to the legal minimum size limit for previous coastal whaling operations) rather than nine years (corresponding to the legal minimum size limit for previous pelagic whaling operations). This paper explores the implications of an age-at-recruitment of five rather than nine years, in terms of its impact on Maximum Sustainable Yield, MSY. MSY is higher for an age-at-recruitment of five years for all choices for MSYR between 0.005 and 0.06 and M between 0.05 and 0.15yr⁻¹.

2. PASTENE, L.A. An examination of the plausibility of different stock structure hypotheses of North Pacific Bryde's whale based on the available information.
3. VÍKINGSSON, G.A. AND GUNNLAUGSSON, T. Analysis of biological parameters in fin whales with respect to segregation on the whaling grounds west of Iceland.
4. SIGURJÓNSSON, J. AND GUNNLAUGSSON, T. Revised catch series and CPUE for fin whales taken from the early modern whaling land stations in Iceland.

Catch record data (some partial and some incomplete) is presented for just over half the catches from land stations in Iceland during the early whaling period 1883 to 1915 when whaling was banned in Iceland. Complete geographical presentation is given of the data but a part of the data had been presented graphically in an earlier. The data is split as requested between the Northwest (Vestfjord peninsula) and east coast regions but stations operated on the east coast only during the years 1901-1913. Only totals by year for all stations combined can be found complete in the published literature. Some totals by station and even species composition have though been published and are used to complement the data where the catch record data is missing. Still some totals by station are missing for the years 1893-1900 where the published totals have to be used, and for the Westfjord operation in the years 1901-1903 when the totals by station for the east coast were subtracted from the published totals to get totals for the West. The total fin whale catch is then prorated from the observed proportion fin whales by year and region. The available sex determined catch shows 52% females and gives no indication for a change over time or space. Catch position records are plotted and show that there is very little overlap in the range of the east and west operations, but the range expands with time. Different cpue indexes are derived. CpB as used in previous fin whale assessments is based on total catch of all species per boat-season and now also split by region. FpB is fin catch per boat rectified for chasing and handling times of all species. No time budget data exists for any of these stations but, where individual catch records are available, the operation time is taken to be from the first to the last whale caught to derive a catch per boat month index (CpBM) and analog to FpB an FpBM index. This index is too scant for the Vestfjord operation but superior for the east coast. Operational factors are discussed.

5. VÍKINGSSON, G.A. Preparations for RMP implementation of North Atlantic fin whales (*Balaenoptera physalus*).
6. BÉRUBÉ, M., DÁNIELSDÓTTIR, A.K. AND PALSBØLL, P.J. Nuclear and mitochondrial DNA differentiation among North Atlantic fin whales.
7. DÁNIELSDÓTTIR, A.K. Genetic stock structure of North Atlantic fin whales based on microsatellite loci.
8. DÁNIELSDÓTTIR, A.K. Reanalysis of North Atlantic fin whale allozyme data.
9. SKAUG, H. AND DÁNIELSDÓTTIR, A.K. Relatedness of North Atlantic fin whales.

SC/58/RMP – Revised Management Procedure

1. PERRIN, W.F. The Philippine fishery for Bryde's whales in the Western North Pacific, 1983-1986. +

The brief episode of Philippine commercial whaling in the 1980s took an unknown number of Bryde's whales and possibly the pygmy species of Bryde's-like whales. The putative shore-based whaling operation in the Philippine EEZ was actually conducted pelagically from a small catcher/factory ship in international waters, documented here by an appendix summarizing internal and external Philippine correspondence and official documents.

2. PUNT, A.E. AND ALLISON, C. Evaluating criteria for defining conservation performance for *Implementation*

Simulation Trials. +

IWC (2005) developed a set of guidelines and requirements for the Scientific Committee when it attempts to *Implement* the RMP for a given species and *Region*. It is necessary to specify criteria for defining conservation performance to finalize these guidelines, and IWC (2006) provided some specifications in this regard. This document evaluates these criteria using the three scenarios (sensitivity to initial depletion level for single-stock trials, performance when applied to the North Atlantic minke trials, and performance when applied to the North Pacific minke trials) identified by IWC (2006).

3. PASTENE, L.A. A review of the process to define stocks during the RMP *Implementations* of North Pacific common minke and Bryde's whales. +

A summary of experiences and suggestions for the future. The IWC/SC has conducted assessments of North Pacific common minke and Bryde's whales in the context of RMP *Implementations*. The *Implementation* process was completed for common minke whale during the 2003 SC meeting and an *Implementation Review* is expected for the 2008 SC meeting. The *pre-implementation assessment* of North Pacific Bryde's whales was completed by the 2005 SC meeting and the First Intersessional Implementation Workshop was carried out in October 2005. Some general aspects of stock structure in these two North Pacific assessment cases are summarized in this paper, namely; a) the kind of data available and analyses conducted and, b) how the information on stock structure was used in the IWC/SC *Implementation* process. The information and experience obtained from these two cases can be used as a reference to facilitate the definition of stocks in the assessments conducted by the SC on other species and regions. There are some difficult issues inherent to the analysis and interpretation of stock structure, which made it difficult to reach reasonable agreement on this topic in the North Pacific cases. As a consequence, unrealistic stock scenarios were considered during the *Implementation* process, particularly in the case of the common minke whale. These issues are identified and discussed in this paper, namely; i) different views on how to define stocks, ii) stock delineation based on samples from migratory corridors or feeding grounds, iii) use of novel and yet to be validated analytical techniques during assessments and, iv) lack of agreed methodology to evaluate quantitatively the plausibility of different stock scenarios. It is argued in this paper that all these issues, although complex, should not be over-emphasized and used as an argument that delay a reasonable agreement on stock structure scenarios. Realistically speaking, there is no way to completely address all of the issues listed above. However stock scenarios should be defined taking into account the best available scientific data recognizing that these could be improved during the *Implementation Review*. Discussion on stock structure for different SC assessments should be carried out on a consistent basis, as a scientific approach demands and the same criteria should be used to define stocks in different assessments.

4. ØIEN, N. Report of the Norwegian 2005 survey for minke whales in the *Small Management Area* CM around Jan Mayen. +

As part of a six-year program over the period 2002-2007 with the aim to get a new estimate of minke whale abundance in the Northeast Atlantic, the areas around Jan Mayen in the Greenland Sea, the Small Management Area CM, was surveyed with two vessels during the summer 2005. There were three planned blocks with a planned basic coverage of about 2,000 nautical miles. In total about 2,100 nautical miles were searched with primary effort. The most common species sighted were minke whales (67 groups seen from the primary platform), humpback whales (33 groups), fin whales (27 groups) and sperm whales (18 groups). In addition sightings were made of killer whales, Northern bottlenose whales, blue whales and unspecified dolphins. Opportunistic collections were made of biopsy samples from one minke whale and two fin whales, and photo IDs were collected from 16 humpback whales.

5. BØTHUN, G. AND ØIEN, N. Estimating measurement errors in distance experiments using GPS. +

This paper discusses the advantages and drawbacks of radar and gps as reference points for estimating measurement error for visual observations of marine mammals during line transect surveys with reference to the distance and angle experiments as conducted during the Norwegian minke whale sightings surveys. Radar and gps give very similar and consistent results but the convenience of the gps method makes it preferable to using the radar as a calibration reference.

6. ALDRIN, M., STORVIK, B. AND SCHWEDER, T. Standardized catch per unit effort in minke whaling in Norwegian waters, 1952-1983 and 1993-2004. +

We construct a catch per unit effort (CPUE) index for minke whales caught in the E-areas of north-eastern Atlantic, adjusted for boat efficiency and spatial effects. The index is interpreted as an unsmoothed relative index of abundance, also including variation in catch conditions due to weather, migration and local clustering of minke whales. Norwegian minke whaling was interrupted from 1984 to 1992. Two series are therefore constructed, one for the period 1952-1983 and another for the period 1993-2004. The estimated index value for 1983 is 63% of the value in 1952, while the estimated index value for 2004 is 186% of the value in 1993.

7. ALDRIN, M., HUSEBY, R.B. AND SCHWEDER, T. Simulation trials for a re-tuned Catch Limit Algorithm. +

The catch limit algorithm (CLA) is a central part of the revised management procedure (RMP) for whaling developed by the International Whaling Commission (IWC), and used by Norway to manage its minke whaling. CLA has previously been tuned to a specified final depletion after 100 years of management, based on simulations from a population model with maximum sustainable yield (MSY) at 1% of the mature component of the stock. According to the "old" tuning procedure, median depletion after 100 years is set to 60%, 66% or 72% of carrying capacity. In this paper we change the horizon from 100 to 300 years to allow the managed population to come closer to a stable level. We also measure productivity of the stock (MSYR) in terms of the total stock, excluding calves, and we re-tune the catch limit algorithm. Our "new" tuning procedure assumes $MSY R1=1\%$, and target a given level of depletion after 300 years of management. The traditional tunings lead to target depletions of 0.72, 0.74 and 0.78 according to the "new" procedure. These three versions of the CLA together with two new versions tuned to 0.66 and 0.69, are investigated by simulation with respect to yield and stock conservation properties in a series of scenarios including the base case trials and the more taxing robustness trials that have been considered in previous studies and implementation reviews.

SC/58/SD – Stock Definition/DNA

1. POLJAK GREZ, D., PUNT, A.E., COPE, J.M. AND BRANDON, J.R. Application of a sequential hypotheses testing method to example TOSSM data sets.

2. MARTIEN, K. Progress on TOSSM dataset generation. +

This paper outlines progress made in the generation of simulated datasets for use in the Testing of Spatial Structure Methods (TOSSM) project, including changes made to the life history matrices being used in the simulations and changes made to Rmetasim (Strand, 2002), the program being used to run the simulations. During the TOSSM workshop held in La Jolla, CA, in January of 2003, a total of 90 different population structure scenarios were chosen for simulation during Phase I of the TOSSM project (IWC 2004). Descriptions of those 90 scenarios are given in Appendix 1. As of May 5, 2006, 12 scenarios have been completed, most of which have carrying capacities of $K=7,500$ individuals. With current computing capabilities, completion of all scenarios listed in Appendix 1 is expected to take an additional 6 months. I provide suggestions for changes in some parameter values and a more focused approach to sensitivity tests in order to speed the completion of the simulations.

3. GIVENS, G. AND OZAKSOY, I. Population structure and covariate analysis based on pairwise microsatellite allele matching frequencies.

SC/58/SH – Southern Hemisphere Assessments

1. COTTÉ, C., DUBROCA, L. AND GUINET, C. Importance of seasonal ice zone for blue and fin whales in the Southern Ocean feeding ground. +

Blue and fin whales were the major predators of krill in the Southern Ocean but intensive whaling industry dramatically reduced the populations by 99% and 95% respectively. We have used the whaling dataset in a new analysis on circumpolar abundance of these whales relatively to environmental (sea surface temperature (SST), seasonal ice zone (SIZ)) and trophic parameters (summer oceanic primary production (SOCC) and krill densities). Fin whale distribution corresponds to a wider SST range than blue whale. SIZ encompassed most of these whale catches and the greatest abundance was located in the Atlantic - West Indian sector. This global circumpolar analysis shows that historical abundances of whales were highly correlated to SIZ extent and only marginally related to the available densities of their krill prey. Although circumpolar biomasses of krill remain uncertain, possibly leading to an unreliable relationship between whales and krill abundance, sea ice acts as a major feature for krill-eating whales in the Southern Ocean. Large SIZ provides favourable summer feeding ground sought by blue and fin whales migrating in these high latitudes due to their high energy requirements.

2. ZERBINI, A.N., WARD, E., ENGEL, M., ANDRIOLO, A. AND KINAS, P.G. A Bayesian assessment of the conservation status of humpback whales in the western South Atlantic Ocean (Breeding Stock A).

3. CLAPHAM, P. AND ZERBINI, A. Is social aggregation driving high rates of increase in some Southern Hemisphere humpback whale populations?

4. CLAPHAM, P. AND ROBBINS, J. Plausible rates of population growth in humpback whales revisited.

5. ROBBINS, J. AND MATTILA, D.K. Summary of humpback whale research at American Samoa, 2003-2005.

American Samoa is a poorly understood wintering site for humpback whales in Oceania. Here we describe the results of photo-identification and biopsy sampling performed on a total of 27 days between September 18 and October 7, 2003-2005. Work was performed from a 7-meter vessel working in the coastal waters of Tutuila, the primary island of American Samoa. The detection rate was consistently low, averaging 5.5 humpback whales per day in all three years. The most common sightings were of singletons (31%) and paired whales (23%). Four singletons were confirmed to be singing, but not all were checked for that behavior. Mother-calf pairs were alone (15%) or escorted by a single large whale (12%). One mother was observed on two occasions prior to her first sighting with a calf, making it likely that the birth took place in American Samoa waters. Competitive activity was observed in 9% of groups sighted, despite the low densities observed. Competitive groups were small, ranging from only three to six whales (average=3.8). Overall, the behaviors observed were consistent with those at other low-density breeding grounds, although apparent feeding was also noted on one occasion. Of 50 individuals with sufficient photo-documentation, none were re-sighted there between years. However, 11% ($n=4$) of those photo-identified prior to 2005 were successfully matched to other breeding sites in Oceania, including the Cooke Islands, Tonga and Moorea. Together, these results indicate that American Samoa is part of a widely dispersed breeding population. In the future, molecular genetic analysis of skin samples from this area ($n=45$) may help to clarify breeding stock structure and migratory destinations.

6. HAKAMADA, T. AND MATSUOKA, K. Examination of the effect of survey mode on abundance estimate for Southern Hemisphere humpback whales using JARPA sighting data. +

This paper examines whether abundance estimates for Southern Hemisphere humpback whales (*Megaptera novaeangliae*) are biased due to the survey modes in JARPA. The result of the Generalised Linear Model (GLM) showed that there was no significant effect of "survey modes" on the abundance estimate for humpback whales and supported the estimates in Matsuoka *et al.*

7. MATSUOKA, K., HAKAMADA, T., KIWADA, H., MURASE, H. AND NISHIWAKI, S. Distribution and abundance estimates of blue whales in the Antarctic Areas III, IV, V and VI (35°E-145°W) based on JARPA data. +

This paper reports current distributions and abundance estimates of blue (*Balaenoptera musculus intermedia*) whales in the Antarctic Areas III (35°E-70°E), IV (70°E-130°E), V (130°E-170°W) and VI (170°W-145°W) in the waters south of 60°S. These estimates were based on JARPA sighting data between 1989/90 and 2004/05 seasons (for 16 years) using the DISTANCE analysis program. Current abundance of blue whale (south of 60°S, 35°E-145°W) was 1,300 (CI: 690-2,440) in 2003/04 + 2004/05 seasons. This estimate (2003/04+2004/05) is the half of Antarctic IWC management Areas is reasonable compared to recent result. Anyway, they are so far from the pristine level.

8. BRANCH, T.A. Separating pygmy and Antarctic blue whales using ovarian corpora. +

Two Southern Hemisphere subspecies of blue whales exist: pygmy blue whales are shorter (= 79 ft, 24.2 m) and generally found north of 54°S in summer, while Antarctic (true) blue whales exceed 100 ft (30.5 m) and are found in more southerly waters. Abundance estimates of Antarctic blue whales rely on sightings south of 60°S but at-sea identification is difficult and these sightings may include some proportion of pygmy blue whales. Ovarian corpora (corpora lutea plus corpora albicantia) are permanent ovulation records that can be used to estimate this proportion. Pregnant females of the two subspecies may overlap at 72-79 ft (21.9-24.1 m), but pygmy blue whales at these lengths have high (> 4) corpora counts, contrasting with immature or newly mature Antarctic blue whales (0-3 corpora). Published papers yielded pairs of length-corpora data for 104 pygmy and 2,064 Antarctic region blue whales. The relationship between length and ovarian corpora counts is well fitted by logistic models (with negative binomial variability). A mixture model estimates that 0.4% (95% confidence interval 0.0-1.1%) of Antarctic region blue whales were pygmy blue whales, much

lower than the “less than 7%” currently accepted by the IWC. If later ovarian corpora data (1947-51) are separately analysed, the estimated proportion is zero (95% CI = 0.0-0.5%), suggesting that the pygmy proportion in the Antarctic did not increase when Antarctic blue whales were greatly depleted. No support is found for Ichihara’s suggestion that high (>7) ovarian corpora counts in 78-81 ft Antarctic region catches were pygmy blue whales. These whales are instead explained by natural variability in Antarctic blue whales. These methods could be applied to blue whale males through the analysis of testes weight, and may hold promise in separating catches of other species with diminutive forms such as fin and minke whales.

9. HUCKE-GAETE, R., ROSENBAUM, H., TORRES, J.P., MONTECINOS, Y., CUELLAR, S., RUIZ, J. AND VIDDI, F.A. Blue whale research off southern Chile: update 2006.

10. HUCKE-GAETE, R., TORRES, J.P., MONTECINOS, Y., CUELLAR, S., RUIZ, J. AND VIDDI, F.A. A new humpback whale (*Megaptera novaeangliae*) summer feeding ground off Chiloe and the Corcovado Gulf, southern Chile, as suggested by dedicated and opportunistic surveys (2001-2006).

11. GALES, N. Priority research for Southern Hemisphere humpback whales: comprehensive assessment outcomes and JARPA II relevance.

12. LEAPER, R., PEEL, S., PEEL, D., BRAVINGTON, M. AND GALES, N. An assessment of the west and east Australian breeding stocks of humpback whales; simulating different mixing and catch allocation on feeding grounds.

13. PEEL, D. AND THIELE, D. An estimate of abundance of humpback whales within Antarctic Area IV from the BROKE survey data.

14. WARD, E., ZERBINI, A.N., KINAS, P.G., ENGEL, M.H. AND ANDRIOLO, A. Estimates of population growth rates (r) of humpback whales (*Megaptera novaeangliae*) in the wintering grounds along the coast of Brazil (Breeding Stock A).

15. ANDRIOLO, A., KINAS, P.G., ENGEL, M.H. AND ALBUQUERQUE MARTINS, C.C. Monitoring humpback whale (*Megaptera novaeangliae*) population in the Brazilian breeding ground, 2002-2005. +

The potential impact of increasing vessel traffic and shoreline development has made the conservationists concerned about the future of the Brazilian humpback population. Our objective was to monitor the humpback whale abundance in the Brazilian coastal breeding ground in order to provide information to support future strategies for species conservation. A series of 4 years (2002-2005) to survey the humpback whale population was implemented at the Brazilian breeding ground. Abundance was estimated according to standard line-transect. Data analysis was undertaken with the software DISTANCE 5.0. Perpendicular sighting data were modeled with various models: using the uniform function with cosine and simple polynomial adjustments, half-normal function with cosine, and the hazard-rate function with a cosine and with a simple polynomial series expansion. The model that best fitted the data was selected according to the Bayesian Information Criterion (BIC). We estimated the population off Brazilian coast in 6251 (CV=0.16) individuals in 2005.

16. BRANCH, T.A., PALACIOS, D.M., STAFFORD, K.M., ALLISON, C., BANNISTER, J.L., BURTON, C.L.K., GILL, P.C., JENNER, K.C.S., JENNER, M.-N.M., MIYASHITA, T., MORRICE, M.G., STURROCK, V.J., ANDERSON, R.C., BAKER, A.N., BEST, P.B., BORSA, P., CHILDERHOUSE, S., FINDLAY, K.P., ILANGAKOON, A.D., JOERGENSEN, M., KAHN, B., MAUGHAN, B., MIKHALEV, Y.A., OMAN WHALE AND DOLPHIN RESEARCH GROUP, THIELE, D., TORMOSOV, D., VAN WAEREBEEK, K. AND WARNEKE, R.M. Past and present distribution of blue whales in the Southern Hemisphere and northern Indian Ocean.

17. GALLETTI, B., CARLSON, C.A., CABRERA, E. AND BROWNELL, R.L., Jr. Blue, sei and humpback whale sightings during 2006 field season in northwestern Chiloe Island, Chile. ØØ

18. CABRERA, E., CARLSON, C.A., GALLETTI, B. AND BROWNELL, R.L., Jr. First recapture between years of individual photo-identified blue whales off Chiloe Island, Chile.

19. ALLEN, J.M., CARLSON, C. AND STEVICK, P. Interim report: IWC Research Contract 16: Antarctic Humpback Whale Catalogue. +

College of the Atlantic (COA) has maintained a collection of humpback whale (*Megaptera novaeangliae*) identification photographs from the Antarctic since 1987. In 1998 the International Whaling Commission (IWC) approved funding to support the expansion of this catalogue to members of the IWC, with an aim to substantially improve the accessibility and organization of the database. The collection has been internationally collaborative, with photographic contributions from 198 researchers and opportunistic sources. During the contract period, the Antarctic Humpback Whale Catalogue (AHWC) catalogued 1182 photo-identification images representing 823 individual humpback whales from Antarctic and southern Hemisphere waters. These images were submitted by 28 individuals and research organizations. Photographic comparison of submitted photographs to the AHWC during the contract period yielded 127 previously known individuals. These submissions bring the total number of catalogued whales to 2925. This report details these findings, and other advances in the AHWC.

20. NO PAPER.

21. MATSUOKA Updated distribution and abundance estimates of humpback whales in the Antarctic Areas IV and V (70E-170W).

SC/58/SM – Small cetaceans

1. GERO, S. AND WHITEHEAD, H. Opportunistic sightings of small cetaceans off the leeward shore of the Commonwealth of Dominica. +

While large scale surveys would provide more accurate data on distribution and abundance, the pooling of opportunistic sightings data from a multitude of projects provides a relatively economical way of achieving a large data set over a multinational area such as the Caribbean Sea. Here, we provide details of the opportunistic small cetacean sightings made in the national waters of the Commonwealth of Dominica during two field seasons of

research focused on sperm whale social behaviour, in the hopes that it can be used as a small part of a growing body of data from around the Caribbean. A total of 84 small cetacean sightings over the 74 days of effort off the coast of Dominica included the following species: Atlantic Spotted Dolphin (*Stenella frontalis*), Pantropical Spotted Dolphins (*Stenella attenuata*), Fraser's Dolphins (*Lagenodelphis hosei*), Rough-Toothed Dolphin (*Steno bredanensis*), Striped Dolphin (*Stenella coeruleoalba*), Common Bottlenose Dolphin (*Tursiops truncatus*), Short-Finned Pilot Whale (*Globicephala macrorhynchus*), Melon-headed Whales (*Peponocephala electra*), Pygmy Killer Whales (*Feresa attenuata*), and Cuvier's Beaked Whale (*Ziphius cavirostris*). It is important that all research activity in the Caribbean report their opportunistic sightings of small cetaceans; so that a better overall picture can be produced through a synthesis of these sparse data sets. The establishment of a collaborative searchable database for the Caribbean region is recommended.

2. MIGNUCCI-GIANNONI, A.A. Status of cetaceans in the Puerto Rican Bank.

3. MIGNUCCI-GIANNONI, A.A. Cetacean strandings in Puerto Rico and the Virgin Islands, 1996-2005.

4. GAMBOA-POVEDA, M. AND MAY-COLLADO, L.J. Insights on the occurrence, residency and behaviour of two coastal dolphins from Gandoca-Manzanillo, Costa Rica: *Sotalia guianensis* and *Tursiops truncatus* (Family Delphinidae). +

Although 30 cetacean species are expected to occur in Costa Rica, only six of these have been confirmed to the Costa Rican Caribbean. The two most common species are the bottlenose dolphin and the Guyanese dolphin, which appear to have resident populations. The purpose of this study is to generate baseline information on these two species in occurrence, residency, and habitat use in the Gandoca-Manzanillo Wildlife Refuge. Sixty-five groups were observed between 2003-2005. *Sotalia guianensis* was the most commonly of the two dolphin species. However, both species have individuals that are regularly observed in the study area. About 26.8% of the animals surveyed were photo-identified and had been frequently observed in the study area. Both species varied in how they used the habitat in the refuge, but when are found in mixed-species group both spend most of the time interacting with each other. Based on occurrence, habitat used and photoidentification we propose that *S. guianensis* holds a resident population in the area, whereas *T. truncatus* seems to be a common visitor to the refuge which home range appears to go beyond the refuge limits. The government should consider expand the marine limits of the refuge to protect this other specie. Bottlenose dolphins are regularly observed interacting sexually with *S. guianensis* the genetics and conservation consequences of this possibility are unknown.

5. SICILIANO, S., RAMOS, R.M.A., DI BENEDITTO, A.P.M., SANTOS, M.C.O., FRAGOSO, A.B., LAILSON-BRITO, J., Jr., AZEVEDO, A.F., CASTRO VINCENTE, A.F., ZAMPIROLI, E., ALVARENGA, F.S., BARBOSA, L. AND LIMA, N.R.W. Age and growth of some delphinids in the southeastern Brazil. +

This study provides the first compilation on age and growth of some delphinids in southeastern Brazil (18°25'S-25°45'S). A total of 154 delphinids was reported: 44 *Stenella frontalis*; 36 *Tursiops truncatus*; 26 *Delphinus capensis*; 20 *Steno bredanensis*; 16 *Lagenodelphis hosei*; 3 *Pseudorca crassidens*; 3 *Stenella* sp.; 2 *Stenella attenuata*; 2 *Globicephala macrorhynchus*; 1 *Stenella longirostris* and 1 *Stenella coeruleoalba*. Age was estimated by counting the number of growth layers group present in the dentine in 74.5% of the sample. The growth of 92 individuals of the first five species was determined by Gompertz model to length-at-age data. *S. frontalis* (n=27) - the oldest specimen was 23 years and the asymptotic length of 224.4 cm predicted by growth curve occurred at about 20 years. *T. truncatus* (n=22) - the oldest specimen was 26 years and the asymptotic length of 301.3 cm predicted by growth curve occurred at about 20 years. *D. capensis* (n=17) - the oldest dolphin was 18 years old and the asymptotic length of 215.9 cm predicted by growth curve occurred at about 5-6 years. *S. bredanensis* (n=13) - the oldest specimen was 24 years and the asymptotic length of 258.1 cm predicted by growth curve occurred at about 10 years. *L. hosei* (n=13) - the oldest specimen was 19 years and the asymptotic length of 231.2 cm predicted by growth curve occurred at about 7-8 years. Only age was estimated for the other species. The age-at-length data for *S. frontalis*, *D. capensis*, *S. bredanensis* and *L. hosei* were consistent, suggesting a good agreement with previous work on these species. For *T. truncatus*, the age at asymptotic length obtained in this study might be confirmed by increasing the sample size. The present study will be helpful to create a new scenario about the biological knowledge of the delphinids in the western south Atlantic coast.

6. DANILEWICZ, D. Abundance estimation for a threatened population of franciscana dolphins in southern Brazil: uncertainties and conservation considerations.

7. DANILEWICZ, D. Habitat use patterns by franciscana dolphins (*Pontoporia blainvillei*) off southern Brazil in relation to water depth.

8. BROWNELL, R.L., Jr., YAMADA, T.K., MEAD, J.G. AND ALLEN, B.M. Mass strandings of melon-headed whales, *Peponocephala electra*: a worldwide review.

9. BOLAÑOS-JIMÉNEZ, J., BERMÚDEZ-VILLAPOL, L. AND SAYEGH, A. Current status of small cetaceans in Venezuela.

Interest in the research and conservation of cetaceans in Venezuela has increased remarkably during the past 10 years. As a result, the amount and quality of information regarding small cetaceans have also steadily improved, especially regarding strandings, causes of mortality, abundance, distribution, behaviour, legal aspects and whalewatching. In this paper, we review the current status of small cetaceans in Venezuela based on unpublished data and published information by the authors and a questionnaire sent to researchers who have worked on cetaceans. Species studied could be broadly classified into three categories: (I) only a few records known from strandings and/or sightings; (II) moderate number of sightings and (III) frequent sightings and biological/ecological information gathered. Category I includes *Kogia sima*, *Steno bredanensis*, *Lagenodelphis hosei*, *Feresa attenuata*, *Peponocephala electra*, *Grampus griseus*, *Pseudorca crassidens*, *Globicephala macrorhynchus*, *Ziphius cavirostris* and *Mesoplodon europaeus*. Category II includes *Orcinus orca*, *Stenella coeruleoalba*, *S. longirostris* and *S. attenuata*. Category III includes *Tursiops truncatus*, *Stenella frontalis*, *Delphinus capensis*, *Sotalia* sp. and *Inia geoffrensis*. Regarding category III, both *Tursiops truncatus* and *Stenella frontalis* are commonly found all along the Venezuelan coast. In the state of Aragua, both species are the target of a responsible dolphin-watching program. In northeastern Venezuela, the long-beaked common dolphin is the most common and abundant species. About 74% of cetacean strandings in the region are of *Delphinus capensis*. In the Mochima National Park, commercial trips for dolphinwatching are offered on a regular basis since the early 90's and a management plan is urgently required for an improved protection of the species. Both direct catches and bycatches of this species have been documented. Sightings of tucuxi *Sotalia* sp. are common inside the Lake of Maracaibo and in the Orinoco River Delta. These populations should be considered vulnerable because of high levels of anthropogenic pressure including bycatches and development projects. Some level of human consumption has been documented although there is no evidence of direct catches. The taxonomic status of the Lake of Maracaibo *Sotalia* populations is uncertain and deserves additional research effort. The boto *Inia geoffrensis* occurs in most areas of the Orinoco River basin where sightings are quite

common. Some level of direct captures and/or bycatch may occur and specimens are suspected to be used as bait in some specific fisheries for *Callophrys* catfish. Nation-wide cetacean conservation and management measures implemented up to now include the presence of independent observers and/or government officers aboard vessels involved in seismic surveys; inclusion of cetaceans in the terms of reference of development projects in coastal and offshore areas and proposals for responsible management of whale-watching presented to the authorities by local non-governmental organizations, among others. Conservation and research priorities for Venezuelan small cetaceans should include: 1) evaluation, monitoring and management of bycatch, 2) to stimulate and promote research efforts for evaluating the abundance, distribution, habitat use, natural history and threats of cetaceans in Venezuelan EEZ waters and 3) update the regulatory and legal framework. These and additional measures could be accomplished by means of the design and implementation of an "Action plan for the conservation of marine mammals of Venezuela" on the basis of the "Marine Mammal Action Plan for the conservation of Marine Mammals of the Wider Caribbean Region", itself part of the Caribbean Environment Program (CEP) of the United Nations Environment Program (UNEP).

10. ROJAS-BRACHO, L., JARAMILLO-LEGORRETA, A. AND URBÁN, J. Current research and conservation action for the vaquita.

11. PARSONS, E.C.M., BONNELLY DE CALVENTI, I., WHALEY, A., ROSE, N.A. AND SHERWIN, S. A note on illegal captures of wild bottlenose dolphins (*Tursiops truncatus*) from the coastal waters of the Dominican Republic. +

12. WHALEY, A.R., PARSONS, E.C.M., SELLARES, R. AND BONNELLY DI CALVENTI, I. Dolphin ecology in the southeastern waters of the Dominican Republic: preliminary observations. +

Between June 2004 and April 2006, 381 hours of dolphin surveys were undertaken in the waters off the village of Bayahibe and Parque Nacional del Este on the southeastern coast of the Dominican Republic. This was the first time that dedicated dolphin surveys have been conducted in this area. In the Parque Nacional del Este, six species of cetaceans were identified: bottlenose dolphin (*Tursiops truncatus*), Atlantic spotted dolphin (*Stenella frontalis*), Pan-tropical spotted dolphin (*Stenella attenuata*), humpback whale (*Megaptera novaeangliae*), short-finned pilot whale (*Globicephala macrorhynchus*) and sperm whale (*Physeter macrocephalus*). The two predominant species were the bottlenose dolphins and Atlantic spotted dolphins, which appear to be resident year round in the area. Bottlenose dolphin group sizes ranged from 8 to 33 (mean 14.11, SD 8.05) and Atlantic spotted dolphin group sizes from 8 to 36 (mean 17.33, SD 12.12). Calves of both species were seen throughout the year, indicating that there is no particular season for reproduction. Mixed groups containing both species were also recorded. Animals with dorsal fin injuries suggestive of propeller injuries were observed. Humpback whales, with calves, also were recorded in the area between January and March. In Samana Bay, in the northern Dominican Republic, opportunistic surveys, using whalewatching vessels as platforms of opportunity, were conducted. Both bottlenose dolphins and Atlantic spotted dolphins were again identified and whalewatching operators reported a sighting of short-finned pilot whales. Bottlenose dolphin group sizes ranged from 1-18 (mean 5.16, SD 6.67) and from 2-20 for Atlantic spotted dolphins (mean 12.5, SD 8.43). Dolphins were observed interacting with humpback whales. Further research in the Dominican Republic will improve our understanding of the social structure and ecology of these populations and will allow us to evaluate anthropogenic threats, but coastal development and tourism are increasing rapidly and may pose risks to coastal cetacean populations in the Dominican Republic.

13. SAGARMINAGA, R. AND BROTONS, J.M. Initiatives in Spain about fisheries-cetaceans interactions.

Some of the most common interaction between fisheries and cetaceans in Spanish waters concerns the bycatch of small cetaceans in pelagic driftnets (Mediterranean) and pelagic trawls (Bay of Biscay). However, with regards to the Spanish fleet the most common interactions involve bottlenose dolphins foraging behind bottom trawlers, in gill nets and around fish farms (most coastal areas) and orcas feeding on bluefin tuna caught either in tuna maze nets or on deep set longlines (Strait of Gibraltar). Diverse research programmes have been carried out in recent years to assess the impact of these interactions, as the "Proyecto Mediterraneo" programme for the identification of areas of special interest for the conservation of cetaceans, studies conducted in the Balearic Islands and in the Alborán Sea focusing on the degree of competition between the bottlenose dolphin and coastal fisheries. Establishing the degree of interactions in Atlantic waters has also been a priority in recent years, and Spain has participated in programmes as SCANS II or the preparatory phase of CODA. A matter of growing concern is the reaction of fishermen with regards to interactions with cetaceans, and especially the use of acoustic devices of different types. The use of these acoustic deterrent or acoustic harassment devices (ADD, AHD) is rapidly spreading. In response, and based on results of studies carried out in the Balearic Islands and in the Alborán sea, in this latter case in cooperation with the European Commission NECESSITY project, a proposal is presented for a legislative action to regulate the acquisition and use of ADDs and AHDs. The concern for the uncontrolled use of these devices has recently resulted in the establishment of a law by the regional government of the Balearic Islands, and is very much in line with the recent resolutions and guidelines of the Bonn Convention agreement for the conservation of cetaceans in the Black Sea and Mediterranean Sea (ACCOBAMS).

14. BARROS, N.B. AND DEBROT, A.O. Status of small cetaceans in the leeward Dutch Antilles.

The cetacean fauna of the Leeward Dutch Antilles has been studied through sightings and examination of stranded animals. During the period 1990-2006 a total of 97 records (62 sightings, 35 strandings), representing 15 confirmed species have been recorded for the islands of Curaçao and Bonaire. The most commonly sighted species are Bryde's whales, particularly during summer and late fall, and short-finned pilot whales, seen throughout the year. Cuvier's beaked whale and the Antillean beaked whale are the most commonly stranded cetaceans in the Dutch archipelago. Sightings of calves of spinner dolphins, bottlenose dolphins and short-finned pilot whales have been documented, suggesting that these species utilize the area as calving grounds at different times of the year. Systematic collection of data from stranded animals has provided insights into aspects of life history and feeding ecology of several species. As deep waters are found a short distance from the coast in Curaçao and Bonaire, the cetacean fauna is represented primarily by pelagic species; the coastal tucuxi from South America has yet to be recorded in the islands. Most cetacean sightings have been of animals moving east/southeast, possibly an indication of large scale migration towards biologically productive feeding grounds. Whereas sighting and stranding frequency data may only partially reflect relative abundance of cetaceans in this area, this study contributes to the paucity of data available for cetaceans in the deep southern Caribbean.

15. BOROBIA, M. AND BARROS, N.B. Major threats to small cetaceans in the Caribbean region: a summary report.

A general overview of major threats to small cetaceans in the Caribbean region (excluding the Gulf of Mexico) is presented based on a literature review, where at least 23 species of small cetaceans have been documented. For many countries minimal information is available on their biology, distribution and status. Small cetaceans are vulnerable to human-related threats in the region, including direct exploitation (removal from populations by live-captures), fishery interactions (by-catch), habitat degradation or loss from coastal development, pollution, acoustic disturbances and vessel

strikes. Some species may be exposed to multiple threats, which should be considered when addressing management and conservation measures.

16. WINSHIP, A.J., BERGGREN, P. AND HAMMOND, P. Management procedures, simulation testing, and data sources for determining appropriate limits to the bycatch of small cetaceans in the European Atlantic and North Sea.

Bycatch of small cetaceans in European Atlantic and North Sea fisheries is an international conservation issue. Scientific working groups have recommended the development of a management procedure for setting appropriate bycatch limits to achieve management objectives. We describe and consider two candidate management procedures: the Potential Biological Removals (PBR) procedure used by the USA Government, and a Bycatch Limit Algorithm (BLA) procedure that we develop based on the Catch Limit Algorithm of the IWC's Revised Management Procedure. The former operates on a current estimate of absolute abundance, while the latter operates on time-series of estimates of absolute abundance, relative abundance and bycatch. Performance simulation testing is used to compare and contrast the behaviours of the two management procedures and to 'tune' them so that specific management objectives are achieved. We describe an operating model that we have developed for simulation testing that incorporates a population with age structure, density dependence and subpopulation structure, and allows for bias and random error in the observation and implementation processes. We outline the data that will be used with the management procedure to determine bycatch limits for small cetaceans in this region including estimates of absolute abundance from the SCANS and SCANS-II surveys (July 1994 and 2005), estimates of relative abundance from the European Seabirds at Sea database, and estimates of bycatch from observer programmes and fishing effort.

17. RINALDI, C., RINALDI, R. AND SAHAGIAN, P. Report of surveys conducted on small cetaceans off Guadeloupe 1998 to 2005. +

Thirty-one cetacean species have been recorded in the Wider Caribbean Region. Considering the diversity of cetaceans, as well as the potential for developing tourism activities in some areas, data on and knowledge of some cetacean species including small odontocete populations in the area are limited or non-existent, and research efforts minimal. Since 1992, Association Evasion Tropicale (A.E.T.) has been conducting dedicated research and conservation programs on sea turtles and cetaceans in the Eastern Caribbean. To date, 16 odontocete species have been recorded. The most commonly observed species include: the pantropical spotted dolphin (*Stenella attenuata*), bottlenose dolphin (*Tursiops truncatus*), beaked whales species and short-finned pilot whale (*Globicephala macrorhynchus*).

18. WENSHI, P., PORTER, L., YAMIN, W., DAGONG, Q., YU, L., TONG, J., ZUHONG, L., DEZHI, W., YUN, S., ZIXING, P. AND VAN WAEREBEEK, K. The importance of the Indo-Pacific humpback dolphin (*Sousa chinensis*) population off Sanniang Bay, Guangxi Province, PR China: recommendations for habitat protection. +

During the period June 2004 - January 2006, a research team from the Qinzhou Bay Chinese White Dolphins Research Center of Peking University, the Peoples Republic of China, conducted systematic and opportunistic boat surveys of Sanniang Bay, Guangxi Province, in which Indo-Pacific humpback dolphins *Sousa chinensis* were regularly seen. Ninety eight dolphins were photographically identified. The dolphins appear to inhabit a small, shallow area of core habitat within the greater Sanniang Bay area. They do not appear to travel up the two rivers which are located to each side of the bay. Of the five populations known from the coastal area of China, the one that resides in Sanniang Bay is determined as having the least impact from anthropogenic activities. The area itself has been designated as a nature tourism location and considerable effort and money has been spent on developing appropriate tourist facilities. The dolphin watching industry in the area is strictly monitored and controlled by one local authority. The largest estuary adjacent to Sanniang Bay has been allocated for industrial development and a paper pulp mill will be established there. Considering the investment already made in the nature tourism industry, the natural beauty of the bay and the surrounding area and the likelihood that this is the only population of Indo-Pacific humpback dolphins which remain in uncompromised and relatively pristine habitat in all of China, it is urged that all effort be made to maintain the natural integrity of the bay. It is recommended that all development and operational aspects of the paper pulp be thoroughly scrutinized and all efforts made to minimize impact upon the environment and that all current and future industries and activities in this area must not detrimentally impact the dolphin population or compromise the integrity of the bay ecosystem.

19. SCHEIDAT, M., GILLES, A., KOCK, K.-H. AND SIEBERT, U. Harbour porpoise (*Phocoena phocoena*) abundance in German waters (July 2004 and May 2005). +

Harbour porpoise abundance in German waters is of interest for different management aims, such as estimating the impact of anthropogenic activities on the local population. Here, we present first results from density estimates of harbour porpoise in the German waters of the North Sea and the Baltic. The estimates are based on line transect aerial surveys conducted in July 2004 and May 2005. Two survey strata (North Sea and Baltic), subdivided into different survey blocks, were defined. Abundance and corresponding confidence intervals were calculated for each stratum and each block, separately for each survey. In July 2004 overall abundance in the North Sea strata was estimated to be 34,309 animals (95% C.I. 17,463 - 69,866) and in the Baltic Sea strata 2,031 animals (95% C.I. 921 - 4,243). In May 2005 abundance was estimated to be 64,506 (95% C.I. 36,776 - 127,036) in the North Sea strata and 4,793 (95% C.I. 2,440 - 9,752) in the Baltic Sea strata. The highest densities during both surveys were found in North Sea block CN with 3.23 animals per km² (C.V. 0.39) in July 2004 and 3.16 animals per km² (C.V. 0.30) in May 2005.

20. DI TULLIO, J.C., GOODALL, R.N.P., SECCHI, E.R., SICILIANO, S. AND SANTOS, M.C.O. Strandings of beaked whales along the western South Atlantic: species relative frequency, seasonality and zoogeography.

21. SECCHI, E.R., ZERBINI, A.N., BOROBIA, M. AND BARROS, N.B. Status of small cetaceans along the coast of Brazil.

22. HAMMOND, P.S. Preliminary estimates of abundance of harbour porpoise and other small cetaceans from the SCANS-II surveys in 2005.

23. JÉRÉMIE, S., GANNIER, A., BORREAU, S. AND NICOLAS, J.C. Cetaceans of Martinique Island (Lesser Antilles): occurrence and distribution obtained from a small boat dedicated survey.

A dedicated survey of the cetacean population of Martinique Island (14°30'N and 61°W) took place from a 11m catamaran sailship between 14 march to 4 april 2003 and included systematic visual searching and acoustic sampling with a towed hydrophone. A total effective effort of 1315 km was logged in the territorial waters around the island during two consecutive periods. The boat moved on zig-zag tracks dictated by sea and wind conditions, cruising on engine most of the time, at a mean speed of 9 km/h. Sighting rate for *Delphinids* was obtained by processing visual datas obtained at ≤ Beaufort 3 sea conditions, using *Distance* 2.2 software. A total of 33 on-effort sightings were made of 11 identified species including the pantropical spotted dolphin *Stenella attenuata* (5), bottlenose dolphin *Tursiops truncatus* (4), dwarf sperm whale *Kogia sima* (3),

short-finned pilot whale *Globicephala macrorhynchus* (3), false killer whale *Pseudorca crassidens* (3), humpback whale *Megaptera novaeangliae* (3), Fraser's dolphin *Lagenodelphis hosei* (2), Risso's dolphin *Grampus griseus* (2), Sperm whale *Physeter macrocephalus* (2), and Cuvier's beaked whale *Ziphius cavirostris* (1). Four other taxa were identified as probable or possible: the Atlantic spotted dolphin *Stenella frontalis* (1), short-beaked spinner dolphin *Stenella clymene* (3), pygmy killer whale *Feresa attenuata* (1) and one *Mesoplodon* sp. (1). *S. attenuata* represented 14.3 % of the observed individuals while *T.truncatus* and *P.crassidens* represented 11.4 %. A sighting rate of 0.57.10-2 school/km (CV=36.2%) was estimated for the first period of the survey and 0.51.10-2 obs/km (CV= 40.4%) for the second. The sighting rate for individuals estimated for the delphinids was lower during the first period, 0.155 ind/km (CV=43.0%), than for the second, 0.381 ind/km (CV=56.4), during which the entrance of a different water mass was observed. This relative abundance index could be compared to those in the Greater Antilles, or Marquesas and Society Islands in the eastern tropical pacific.

SC/58/WW – Whalewatching

1. PARSONS, E.C.M., LÜCK, M. AND LEWANDOWSKI, J.K. Recent advances in whalewatching research: 2005-2006. +

Whalewatching research encompasses a wide variety of disciplines and fields of study including monitoring the biological impacts of whalewatching activities on cetaceans and assessments of the effectiveness of whalewatching management and regulations, to the sociological and economic aspects of whalewatching on communities hosting such activities. Many of these research activities are of interest to the Whalewatching Sub-Committee of the International Whaling Commission, in particular research on the impacts of whalewatching, and whalewatching as a source of scientific data that could be used in management decisions. This paper is the latest of a series of annual digests that describes the variety and findings of whalewatching studies published since the 57th Annual meeting of the IWC, in 2005.

2. WHALEY, A., WRIGHT, A.J., BONNELLY DE CALVENTI, I. AND PARSONS, E.C.M. Humpback whale sightings in southern waters of the Dominican Republic lead to proactive conservation measures. +

3. ROBBINS, J. AND CARLSON, C. Preliminary worldwide index of cetacean data collection from opportunistic platforms.

4. LOTT, R., WILLIAMS-GREY, V. AND SIMMONDS, M.P. Responsible whale watching - the way forward. A brief statement is provided here of the factors that may be said to constitute responsible whale-watching. +

5. SIMMONDS, M.P., WILLIAMS-GREY, V. AND STANSFIELD, L. Managing human interactions with solitary sociable dolphins - two case studies. +

'Solitary sociable' cetaceans often become the focus for intensive human interactions and this has been found to put them and their admirers at high risk. The recent histories of two solitary sociable bottlenose dolphins in UK waters are considered here. One, Georges, spent ten weeks frequenting a busy part of the south coast of England in 2002 and the other, Marra, became trapped in a dock in Cumbria on the northwest coast of England in January, 2006. Both animals became the focus of considerable human attention, creating urgent management problems. Marra was ultimately captured and released back into the open sea and Georges eventually moved away on his own.

6. LUSSEAU, D., SLOOTEN, E. AND CURREY, R. Unsustainable dolphin watching activities in Fiordland, New Zealand. +

Bottlenose dolphins are a key resource of the tourism industry in Fiordland and are used on a daily basis by the tour operators offering cruises on the fiords. Recent studies have shown that the current levels of dolphin-boat interactions in this region cannot be sustained by bottlenose dolphins. Interactions have both short- and long-term effects on both individuals and their populations. Recent preliminary modelling work is showing that these effects can consequently be affecting the viability of the three bottlenose dolphin populations living in Fiordland, particularly the Doubtful Sound population and the population utilising Milford Sound which are exposed to higher interaction intensities. While we provided advice in 2002 to mitigate these effects, no management steps have been taken since then. As predicted in 2002, we are currently observing drastic changes in the bottlenose dolphin population living in Doubtful Sound which can be linked to the level of boat interactions to which they are currently exposed. We argue that immediate steps need to be taken to mitigate the impact of tourism on this population which now numbers 56 individuals, representing a 20% decline in population abundance over the past 5 years. The creation of a multi-level marine mammal sanctuary would help, as we previously argued, minimise dolphin-boat interactions and still allow for the tourism sector to continue growing in Fiordland.

7. LUSSEAU, D., LUSSEAU, S.M., BEJDER, L. AND WILLIAMS, R. An individual-based model to infer the impact of whalewatching on cetacean population dynamics. +

Whalewatching play an important socioeconomic role in many countries. Yet after 20 years of research in its effects on the targeted populations, its sustainability is now questioned. While much progress has been made to understand the short-term influences of boat-cetacean interactions for individuals and schools, the long-term consequences of those remain uncertain. Recent studies showed that the stress related to both interactions themselves and the avoidance strategies individuals used can affect the fitness of individuals and their reproductive success. The decrease in individual fitness can itself result in lowered survival probabilities, because of increases in either mortality or emigration rates. We introduce an individual-based model of population dynamics which attempt to incorporate these findings to understand their potential consequences for the dynamics of populations. This model is based on realistic scenarios in which schools of individuals are exposed to boat interactions on a daily basis. This results in different yearly cumulative exposure to boat for each individual. The relationship between survival and reproductive parameters are then linked for each individual to their boat exposure using logistic functions. Variance is introduced in these functions to highlight both the uncertainty in the relationships as well as individual variation in effect size. Using two case studies we show that whalewatching can influence the dynamics of cetacean populations and can also jeopardise the viability of populations which are already at risk.

8. BEJDER, L., MANN, J., SAMUELS, A., WHITEHEAD, H., CONNOR, R., GALES, N., HEITHAUS, M., WATSON-CAPPS, J. AND FLAHERTY, C. Female bottlenose dolphins exposed to vessel-based dolphin-watch tourism in Shark Bay, Australia, reproduce less successfully than those not targeted.

9. MORETE, M.E. AND BISI, T.L. Mother and calf humpback whale responses to vessels around Abrolhos Archipelago, Bahia, Brazil.

As the humpback whale population spreads along the Brazilian coast, whalewatching activities are becoming more frequent in special along the coast of the state of Bahia. In order to evaluate the appropriateness of the Brazilian legislation that regulates vessel approaches to cetaceans, the behavior of

humpback whale mothers and calves was studied around the Abrolhos Archipelago, an area with high concentration of tourism vessels. Mother and calf groups were observed by means of continuous sampling and tracked along with vessels using a theodolite. Three whale-vessel categories of distances were analyzed: closer than 100m (category 1), between 100 - 300m (category 2) and further than 300m (category 3). Rates of behavioral events and time spent in behavioral states of mothers and calves were compared separately in those 3 categories to observations of randomly selected mother and calf groups not involved in an interaction with a vessel (category 0). A total effort of 39h was analyzed including observations in each of the four categories. Our results showed that differences in humpback whale mother and calf behavior occurred mostly in the presence of vessels within distances of 100-300m. Mothers increased linearity and mean speed of movement, and decreased blow intervals and time spent resting. Calves exhibited less rolling, fluke-ups and others active behavioral events as well as diminished resting time. During the interaction with a vessel, the frequency of potentially important behaviors, both for mothers and calves, reduced, probably as a response to the approaching whalewatching vessels. Repeated short-term behavioral disturbances might lead to cumulative effects that may result in risks for the species conservation. Inasmuch, it is recommended that the Brazilian Legislation should include a 300-meter caution zone, where boats should reduce speed and avoid sudden changes in engine status and direction. The environmental education work with local communities along the coast must be continued and constant.

10. WILLIAMS, R. AND CROSBIE, K. Antarctic whales and Antarctic tourism. +

11. TRITES, A.W., HOCHACHKA, W.M., CARTER, S.K., WONG, M.M. AND WILLIAMS, R. Boats displace killer whales from a marine protected area. +

Movements of vessels and killer whales (*Orcinus orca*) were monitored during summer daylight hours from July to September (1991-94) to determine whether vessels affected killer whales in the Robson Bight - Michael Bigg Ecological Reserve, British Columbia. Killer whales were seen in all parts of the Reserve, but spent significantly more time near the rubbing beaches than anywhere else. Overall, killer whales partitioned their time in the Reserve among resting (12%), rubbing (25%) and other activities (63%). Vessels, primarily commercial fishing vessels, were observed entering the Reserve over 12,000 times during the 4-year study. They did not appear to have marked effects on the numbers of whales in the Reserve. However, vessels did appear to affect the movements of the whales in this near-shore habitat. Whales were more likely to move to another area of the Reserve or to leave the Reserve entirely when vessels were present than when they were absent, and were more sensitive to vessels near the rubbing beaches than anywhere else in the Reserve. Our findings suggest that boats can displace whales from areas that might be designated as critical habitat. However, the possible long-term consequences of such short-term effects are not known and require further study.

12. WILLIAMS, R. AND ASHE, E. Three's a crowd: killer whales attempt to evade few, but not several, boats. +

Vessel traffic has been implicated as a potential contributing factor to the at-risk status of two killer whale populations in western Canada and the US. Relevant guidelines can be informed by conducting experimental impact assessments that allow animal response to guide vessel management. Two published experimental studies documented stereotyped avoidance responses by killer whales to boats, and opportunistic observations from these studies suggested a shift in avoidance behaviour when approximately 3 boats approached within 1000m. Our study was designed to test experimentally whether whales did, in fact, respond differently to approach by few (1-3) versus many (>3) vessels. Data were collected in summer 2004 in Johnstone Strait, British Columbia, using a theodolite to track positions of boats and individually identifiable whales. Experimental trials included 20-minute 'no-boat' and 20-minute 'boat' phases, with local whalewatching vessels serving as experimental boats, and during which data were collected continuously on the focal whale. Responses of the 16 adult male killer whales differed significantly between treatment levels (Wilcoxon's test $P = 0.0148$). Swimming paths became less direct when whales were approached by few boats, but whales increased their path directness when approached by many boats. Pooling both treatments would have masked these significant responses with strong statistical confidence (Wilcoxon's test $P > 0.999$), falsely suggesting that boat presence had no effect. Consistent with previous studies, inter-breath interval, swimming speed, angle between successive dives, and rates of surface-active behaviour did not differ significantly. The distinction between 'few' and 'many' boats was supported by opportunistic observations on 26 whales from the population of 216. Generalised Additive Models were used to control for effects of potentially confounding variables, and confirmed a non-linear relationship between the number of boats approaching within 1000m and whales' swimming path directness, with more detailed analyses confirming an inflection point at approximately 3 boats. We recommend that whalewatching guidelines be modified to address crowding, and urge caution when designing impact assessments that rely on a simple absence-presence framework, which can mask significant multivariate or non-linear responses. Interpreting biological significance of null findings from impact assessments is problematic and therefore statistical power, experimental design, and appropriateness of response variables must be considered.

SC/58/O – Other

1. BROWNELL, R.L. AND SWARTZ, S.L. The floating factory ship *California* operations in Californian waters: 1932-1937.

2. SAMARAN, F. AND GUINET, C. Preliminary results of large whale calls recorded at low latitudes in the southwestern Indian Ocean. +

Large whale calls were detected from data recorded over one year (2003/2004) on a hydrophone of the International Monitoring System (IMS) deployed offshore off Possession Island, Crozet Archipelago in the Indian Ocean. The low frequency (< 100 Hz) sea noise spectrum was dominated by a band of sound at 18-35 Hz which intensity varies over one year. This band mainly contained abundant calls assimilated to baleen whale calls. Among the call detected, Antarctic blue whale (*Balaenoptera musculus intermedia*), Pygmy blue whale (*B. m. brevicauda*) and Fin whale (*B. physalus*) were positively identified and were the most frequently recorded.

3. PODESTÁ, M. AND COZZI, B. Analysis of cetacean strandings along the Italian coastline in the years 1986-2004. +

The authors report a summary of the cetacean strandings, bycatches and ship collisions occurred in Italy between 1986 and 2004. The data presented and analysed have been collected mainly by the Centro Studi Cetacei (Center for Cetacean Studies) based at the Museum of Natural History of Milan. An annual report is published with a list of the animals found dead on the coast or at sea, or found entangled in fishing nets or sighted in distress close to shore. Bycatches and ship collisions are enclosed in the list. At the same time, since its foundation in the 1988, another no-profit Organization, the Fondazione Cetacea onlus, worked in cooperation with CSC to rescue cetaceans stranded alive along the Italian coasts of the Adriatic Sea. Furthermore, a Mediterranean Marine Mammal Tissue Bank has been recently established (2002) at the Department of Experimental Veterinary Science of the University of Padua, Faculty of Veterinary Medicine. A total of 3341 animals have been reported during the years 1986-2004. Stranded

animals included 14 species belonging to 4 families; 761 specimens remained unidentified.

4. GERO, S., GORDON, J., CARLSON, C., EVANS, P. AND WHITEHEAD, H. Population, estimate and inter-island movement of sperm whales, *Physeter macrocephalus*, in the Eastern Caribbean. + (colour version also online)

When a population is spread across international boundaries management becomes increasingly more complex. This is especially true within a confined multinational area like the Caribbean Sea. Here we estimate the population size of sperm whales in the Eastern Caribbean and quantify the inter-island movements of individuals through a collaborative effort of four research groups based on 1394 opportunistic photographic identifications taken between 1984 and 2006. A total of 194 individual sperm whales were identified off the leeward coast of the Commonwealth of Dominica, Guadeloupe, Grenada, St. Lucia, and Martinique. None of the animals identified in 1984 were reidentified in later years, but 57 individuals were reidentified in different years from 2 and 5 times between 1995 and 2006. Long-term reidentification of associated females suggests that social units may be using the area for periods of at least 11 years. We made 27 confirmed matches between islands. The majority (92.6%) of which were between the neighbouring islands of Guadeloupe and Dominica. Two longer movements by single individuals between non-neighbouring islands were confirmed between Dominica and the islands of St. Lucia and Grenada. Assessments of the population of reliably marked individuals were made using two-component finite mixture models. About 100 sperm whales use the waters of the Eastern Caribbean Sea and this population appears to be growing. There are differences among the individuals in their probability of identification in studies based primarily in Dominica and Guadeloupe.

5. KISZKA, J., VAN CANNEYT, O., MACLEOD, K., WALKER, D. AND RIDOUX, V. Diversity, distribution and occurrence of toothed cetaceans in the Bay of Biscay and western English Channel (1998-2002). +

Data on diversity, distribution and occurrence of pelagic cetaceans are generally difficult to collect. Such information is beneficial to most management and conservation purposes. Data collected during ferry-based surveys in the western English Channel and Bay of Biscay between 1998 and 2002 were analysed to investigate the diversity, distribution and occurrence of toothed cetaceans in these waters. More than 17,800 nautical miles were surveyed and 1,008 encounters of mono-specific groups (20,481 individuals) were recorded. Thirteen species, including delphinids (*Delphinus delphis*, *Stenella coeruleoalba*, *Tursiops truncatus*, *Globicephala melas*, *Grampus griseus*, *Orcinus orca*, *Pseudorca crassidens*), ziphiids (*Ziphius cavirostris*, *Hyperoodon ampullatus*, *Mesoplodon bidens*, *Mesoplodon mirus*), the harbour porpoise (*Phocoena phocoena*) and the sperm whale (*Physeter macrocephalus*). The common dolphin was by far the commonest species encountered, followed in decreasing occurrence by striped and bottlenose dolphins, long-finned pilot whale, harbour porpoise, Cuvier's beaked whale and sperm whale. This study underlines an exceptional toothed cetacean diversity, may be attributable to the presence of a wide range of potential habitats in the Bay of Biscay. In addition, the Bay of Biscay is probably an interface for both cold temperate species (such as the harbour porpoise, the long-finned pilot whale and the northern bottlenose whale) and warm temperate species (striped dolphin, Cuvier's beaked whale). As many interactions between fisheries and small cetaceans are known to occur in the Bay of Biscay and western English Channel, these data provide a preliminary evidence on the importance of this area for toothed cetaceans.

6. KISZKA, J., VELY, M., BREYSSE, O. AND BOINALI, K. Marine mammals around the Comoros archipelago (Mozambique Channel): recent records and review of available information. +

The Comoros archipelago is situated in the northern Mozambique Channel. The islands of Mohéli, Anjouan and Grande Comore (Union of the Comoros) constitute volcanic islands, and are a proposed migration destination for humpback whales. Cetaceans have never been studied in the area and preliminary small boat-based surveys were conducted during the austral summer of 2002 and 2003. These surveys were primary dedicated to the assessment of the occurrence of humpback whales (*Megaptera novaeangliae*), but other cetacean species were also recorded. The collation of opportunistic sighting records was also used to provide information on the diversity of marine mammals inhabiting this area. A total of fourteen marine mammal species were recorded around the Union of the Comoros, including the dugong (*Dugong dugon*), humpback and sperm whale (*Physeter macrocephalus*), spinner dolphin (*Stenella longirostris*), pantropical spotted dolphin (*Stenella attenuata*), Fraser's dolphin (*Lagenodelphis hosei*), both offshore bottlenose (*Tursiops truncatus*) and presumed Indo-Pacific bottlenose dolphin (*Tursiops aduncus*), Risso's dolphin (*Grampus griseus*), melon-headed whale (*Peponocephala electra*), short-finned pilot whale (*Globicephala macrorhynchus*), pygmy killer whale (*Feresa attenuata*) but also Blainville's beaked whale (*Mesoplodon densirostris*) and Longman's beaked whale (*Mesoplodon pacificus*). During the dedicated surveys, humpback whale was the most encountered species (71.5%) followed by the spinner dolphin (15.3%). Humpback whale group composition was heterogeneous, but mother-calf pairs were the most commonly sighted. This study underlines the waters around the Union of the Comoros is an important site for wintering humpback whales in the western Indian Ocean and for a wide variety of cetacean species.

7. NISHIWAKI, S. Cruise report of the 2005/06 feasibility study of JARPA II.

8. TAMURA, T. Cruise report of the Japanese Whale Research Program under Special Permit in the western North Pacific - Phase II (JARPN II) in 2005. Part I - Offshore component.

9. YOSHIDA, H. Cruise report of the coastal survey on common minke whales off Sanriku coast, northeastern Japan: the Japanese Whale Research Program under Special Permit in the western North Pacific - Phase II (JARPN II) in 2005. Part II - Coastal component off Sanriku.

10. KISHIRO, T. Cruise report of the coastal survey on common minke whales off Kushiro, northern Japan: the 2005 JARPN II survey. Part II - Coastal component off Kushiro.

11. MATE, B.R. AND URBÁN-RAMIREZ, J. Spring migration and summer feeding destinations of humpback whales wintering at Socorro Island, Mexico.

Socorro Island, 400 km SSW of the tip of Baja California, Mexico is home to a winter breeding and calving population of about 1,000 humpback whales (*Megaptera novaeangliae*), which has not been matched to any summer feeding locations despite photo catalog comparisons. Two other breeding populations in Mexico, Banderas Bay along mainland Mexico and off the southern tip of Baja, both migrate to California and Oregon for summer feeding. To discover the summer feeding areas of Socorro whales, we tagged 11 of them during February, 2003 with implantable Argos satellite-monitored radio tags: 5 mothers with calves, 5 adults/juveniles and one calf. We obtained data from all tagged whales for 23-149 days for a total of 42,343 km traveled, averaging 3,849 km at 2.4 km/h in 59 d. The calf's tag operated the longest and traveled farthest (10,480 km). Migration speeds ranged from 4.1-6.4 km/h, with the calf at 5.3 km/h. Around Socorro Island, whales did not range far from shore. Within the reproductive season, single whales and mothers with calves moved from Socorro Island to the tip of Baja (N=4) and to Banderas Bay (N=2). This is the first time

movements between the offshore islands and other Mexican breeding areas have been confirmed. A series of reasonably direct migratory trajectories radiated from southern Baja. The three most westerly routes had headings generally toward the eastern end of the Aleutian Islands. Only two tags on whales stayed operational long enough to reach feeding areas (based on temporally and spatially clustered locations). An adult whale migrated within 200 km of shore to summer on the continental shelf 50+ km west of Vancouver Island (VI) for 54 days (55°N). The suckling calf (obviously in the company of its mother) migrated 1,500 km from shore to the northern Gulf of Alaska, where it spent 56 days on the continental shelf 150 km east of Kodiak Island (68°N). These offshore routes and destinations explain in part why no photo ID matches have been made for this stock. The tagging of the calf was a mistaken and a matter of great concern to us. However, we observed it nursing within 60 minutes of tagging and the subsequent superb performance based on tracking data was a reassuring. Because calves are dependent upon their mothers for energy until weaning (late in the feeding season), the tagged calf's migration at a speed equaling the mid-range for all other tagged whales could not have been achieved if it had separate from its mother as a result of tagging. This study provides the insights into the daily movements of individual humpback whales using exclusively offshore feeding areas and suggests that some such whales utilize very small home ranges.

12. CAÑADAS, A., FORTUNA, C., BIRKUN, A. AND DONOVAN, G. Plans for surveying the Mediterranean and Black Seas (the ACCOBAMS region).

At its 2nd meeting, the ACCOBAMS Scientific Committee noted the fundamental importance of obtaining baseline population estimates and distributional information of cetaceans within the area as soon as possible (including stock structure as well as abundance). Without such information (and a suitable monitoring programme) it will be impossible to inter alia determine whether ACCOBAMS is meeting its conservation objectives. Such information is essential for the assessment of risk, the determination of appropriate mitigation measures and the associated determination of priority actions. In order to take this work forward, an expert Workshop was held in December 2004. This document summarises the findings of the workshop and briefly discusses subsequent developments. The Workshop reviewed the available background information on species distribution and relative abundance, oceanography, etc. It examined the theoretical and practical aspects of available techniques to estimate abundance (primarily visual and acoustic surveys and mark-recapture using natural marks) for the key species within the region (harbour porpoise, common dolphin, striped dolphin, bottlenose dolphin, Cuvier's beaked whale, fin whale, sperm whale and, in a lower priority should compromises be necessary, Risso's dolphin, long-finned pilot whale and killer whale) and on this basis examined the most efficient way to design multi-species surveys for the region. In this regard it drew up preliminary survey blocks, examined various coverage options and noted the logistic and financial implications. It also briefly examined the question of how best to address stock structure issues.

13. KISZKA, J., ERSTS, P.J. AND RIDOUX, V. Cetacean diversity in the lagoon and surrounding waters of Mayotte, Comoros Archipelago.

The Indian Ocean has been designed as a whale sanctuary in 1979. However, very few studies have been conducted to assess the diversity, distribution and abundance of cetaceans in this area. In order to contribute to cetacean management and conservation in this area, a long-term research program is conducting around the island of Mayotte (Comoros, Mozambique Channel). From July 2004 to August 2005, preliminary small boat-based surveys have been undertaken to assess the diversity of cetaceans in the lagoon (1,200 km²) and in surrounding waters (external barrier reef slope, insular slope and deep oceanic waters). During the study period, more than 206 hours were spent at sea and 17 cetacean species have been recorded around Mayotte (n=282 sightings). One mysticete (1 Balaenopterid) and sixteen odontocetes (1 Kogid, 1 Physeterid, 13 Delphinids and 2 Ziphiids) species were observed, i.e. humpback whale (*Megaptera novaeangliae*, n=37), sperm whale (*Physeter macrocephalus*, n=1), spinner dolphin (*Stenella longirostris longirostris*, n=118), pantropical spotted dolphin (*Stenella attenuata*, n=61), Indo-Pacific bottlenose dolphin (*Tursiops aduncus*, n=44), melon-headed whale (*Peponocephala electra*, n=5), Blainville's beaked whale (*Mesoplodon densirostris*, n=4), Indo-Pacific humpback dolphin (*Sousa chinensis*, n=4), common bottlenose dolphin (*Tursiops truncatus*, n=2), Risso's dolphin (*Grampus griseus*, n=2), false killer whale (*Pseudorca crassidens*, n=2), dwarf sperm whale (*Kogia sima*, n=2), pygmy killer whale (*Feresa attenuata*, n=1), short-finned pilot whale (*Globicephala macrorhynchus*, n=1), Fraser's dolphin (*Lagenodelphis hosei*, n=1), and Longman's beaked whale (*Mesoplodon pacificus*, n=1). To these 17 species recorded during dedicated surveys, another cetacean species has been observed opportunistically in February 2005 and identified as a Ginkgo-toothed beaked whale (*Mesoplodon ginkgodens*). Around Mayotte, the diversity of cetaceans appears high, especially for a such restricted area (area of 2,500-3,000 km² effectively covered). This can be interpreted by the presence of a wide diversity of habitat types, both represented close to each other.

14. KATO, H. Status report of scientific survey and conservation of the western gray whales in Japan, May 2005-April 2006.

15. BAMY, I.L., VAN WAEREBEEK, K., BAH, S.S., DIA, M., DIALLO, S.T., KABA, B., KEITA, N., KONATÉ, S. AND TALL, H. The cetaceans of Guinea, a first check-list of documented species. +

A CMS workshop on West African Cetacea (Conakry, May 2000), called for i.a. 'carrying out inventory of cetacean species; collection, treatment and compilation of data for each state.' The present paper is a preliminary faunal checklist of cetaceans occurring in Guinea's EEZ. Information was gleaned from strandings, bycatches, scientific and opportunistic sightings and a literature review. Ten species are included for which supporting voucher material and data were available for examination. These are, three baleen whales: *Balaenoptera brydei*, *Balaenoptera acutorostrata* and *Megaptera novaeangliae*; and seven species of odontocetes: *Kogia breviceps*, *Tursiops truncatus*, *Sousa teuszii*, *Stenella frontalis*, *Delphinus delphis*, *Steno bredanensis* and *Globicephala macrorhynchus*. Another two species, *Physeter macrocephalus* and *Stenella attenuata* were sighted off Guinea but no photographic evidence was obtained. The current account is thought to reflect an incomplete picture of Guinea's cetacean biodiversity. Future surveys are expected to update and investigate spatial and temporal distribution patterns for each species along Guinea's coast. A few bycatches landed by artisanal fishers were utilised locally, but there are no signs of any substantial captures. Nonetheless, monitoring should be continued. The set-up of a national reference collection and database is recommended. The population identities of the encountered Atlantic humpback dolphin, minke whale and humpback whale are of particular interest.

16. GEDAMKE, J., ROBINSON, S. AND GALES, N. Acoustic survey of marine mammal distribution and occurrence in the waters of East Antarctica (30-80°E) during the Austral summer of 2006.

17. GEDAMKE, J., GALES, N., HILDEBRAND, J. AND WIGGINS, S. Seasonal occurrence of low frequency whale vocalisations in waters of East Antarctica, February 2005-February 2006.

18. ICR Research activities of the Institute of Cetacean Research (RAICR) May 2005 - April 2006.

19. WILLIAMS, R. AND THOMAS, L. Distribution and abundance of marine mammals in the coastal waters of British Columbia, Canada. +

Information on animal distribution and abundance is integral to wildlife conservation and management. However abundance estimates have not been available for most cetaceans inhabiting the coastal waters of Canada's Pacific coast, including those species that were heavily depleted by commercial whaling. We conducted systematic sightings surveys in the Inside Passage waters between the British Columbia (BC)-Washington and the BC-Alaska borders, covering 4,400km (2,400nm) of trackline in the summers of 2004 and 2005. Province-wide abundance estimates (with 95% confidence intervals) assuming certain trackline detection for seven cetacean species are as follows: harbour porpoise, 9,120 (4,210-19,760); Dall's porpoise, 4,910 (2,700-8,940); Pacific white-sided dolphin, 25,900 (12,900-52,100); humpback whale, 1,310 (755-2,280); fin whale, 496 (201-1,220); minke whale, 388 (222-680); and 'northern resident' killer whale, 161 (45-574). We also calculated density of harbour seals, and estimate that total abundance of harbour seals in the study area was 19,400 (14,900-25,200). To the best of our knowledge, these are the first abundance estimates for this region for each of these cetacean species except killer whales. Small sample size makes our killer whale estimate tenuous, but one worth noting, because it is close to the known number of northern resident killer whales (2004 census was 219 animals, Pacific Biological Station, DFO, Canada). Our minke whale abundance estimate is similarly tentative, however our results do indicate that minke whales were rare in this region. Minke whales were recently deemed to be Not at Risk in Canada's Pacific region by the Committee on the Status of Endangered Wildlife in Canada, but our abundance estimates suggest that minke whales were just as rare as the Threatened fin, humpback and killer whales. Our results provide a province-wide estimate of the proportion (roughly two-thirds) of harbour seals that were in the water on average at any point during our survey, while one-third were hauled out. While the majority of harbour seals were found as expected in the southern straits and in the mainland inlets, a substantial number of animals were on the north coast and in the Queen Charlotte Basin as well. These data also provide the first systematic snapshot of summertime distribution and abundance of marine mammals in the Queen Charlotte Basin, where offshore oil and gas development is being proposed. These data should provide a basis for risk assessment of seismic surveys on acoustically sensitive mammals. Similarly, our abundance estimates should be used to assess sustainable limits to incidental by-catch in commercial fisheries.

20. VÍKINGSSON, G.A., OLAFSDÓTTIR, D., GUNNLAUGSSON, T., HALLDÓRSSON, S.D., GALAN, A., SVANSSON, V., JÖRUNSSON, E., KJELD, M., DANÍELSDÓTTIR, A.K., GÍSLASON, D., AUDUNSSON, G.A., THORGILSSON, B., STEFÁNSSON, M. AND HJARTDÓTTIR, S. The Icelandic research programme on common minke whale (*Balaenoptera acutorostrata*) in Icelandic waters - a progress report.

SC/58/ProgRep – Progress Reports

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SC/58/For Info – Information documents

1. DERUITER, S.L., TYACK, P.L., LIN, Y.T., NEWHALL, A.E., LYNCH, J.F. AND MILLER, P.J.O. Modeling acoustic propagation of airgun array pulses recorded on tagged sperm whales (*Physeter macrocephalus*).

In 2002 and 2003, tagged sperm whales (*Physeter macrocephalus*) were experimentally exposed to airgun pulses in the Gulf of Mexico, with the tags providing acoustic recordings at measured ranges and depths. Ray trace and parabolic equation (PE) models provided information about sound propagation paths and accurately predicted time of arrival differences between multipath arrivals. With adequate environmental information, a broadband acoustic PE model predicted the relative levels of multipath arrivals recorded on the tagged whales. However, lack of array source signature data limited modeling of absolute received levels. Airguns produce energy primarily below 250Hz, with spectrum levels about 20-40dB lower at 1kHz. Some arrivals recorded near the surface in 2002 had energy predominantly above 500Hz; a surface duct in the 2002 sound speed profile helps explain this effect, and the beam pattern of the source array also indicates an increased proportion of high-frequency sound at near-horizontal launch angles. These findings indicate that airguns sometimes expose animals to measurable sound energy above 250Hz, and demonstrate the influences of source and environmental parameters on characteristics of received airgun pulses. The study also illustrates that on-axis source levels and simple geometric spreading inadequately describe airgun pulse propagation and the extent of exposure zones. Submitted January 2006.

2. MILLER, P.J.O., JOHNSON, M., MADSEN, P.T., QUERO, M.E., BIASSONI, N., KING, R. AND TYACK, P.L. At-sea experiments indicate that airguns affect the foraging behaviour of sperm whales in the Gulf of Mexico.

An archival tag was used to record acoustic exposure and foraging behaviors of 8 sperm whales before, during and after 1-2hr controlled sound exposures of industry-provided airgun arrays in the Gulf of Mexico in 2002-2003. No obvious changes in foraging dives or direction-of-movement were observed during gradual ramp-up at distances of 7-13km, or full array exposures at 1-13km. However, some changes in foraging behaviour were indicated. The whale that was approached most closely prolonged a surface resting bout hours longer than typical, but resumed foraging immediately after the airguns ceased, suggesting avoidance of deep diving near active airguns. Behavioural indices of foraging rate (echolocation buzzes produced during prey capture) and locomotion cost (from pitching movements generated by active swimming) of the 7 remaining exposed whales were compared to sham exposure and post-exposure control periods in 13 unexposed whales. Pitching movements were 6% lower during exposure ($P=0.014$) with all 7 whales reducing fluke strokes. Mean buzz rates were 19% lower during the exposure condition, but this difference was not statistically significant.

($P=0.141$). The substantial change in mean buzz rate from this small sample motivated a Bayesian analysis, which determined that models of reduced buzz rate and pitching movement had roughly three times more posterior support than models of no effect. These results provide motivation to perform additional studies to boost the sample size, particularly in waters without such a long history of seismic exploration as the Gulf of Mexico.

3. MADSEN, P.T., JOHNSON, M., MILLER, P.J.O., AGUILAR SOTO, N., LYNCH, J. AND TYACK, P. Quantitative measures of air gun pulses recorded on sperm whales (*Physeter macrocephalus*) using acoustic tags during controlled exposure experiments.

The widespread use of powerful, low-frequency airgun pulses for seismic seabed exploration has raised concern about their potential negative effects on marine wildlife. Here, we quantify the sound exposure levels recorded on acoustic tags attached to 8 sperm whales at ranges between 1.4 and 12.6 km from controlled airgun array sources operated in the Gulf of Mexico. Due to multipath propagation, the animals were exposed to multiple sound pulses during each firing of the array with received levels of analyzed pulses falling between 131- 67 dB re. 1 μ Pa (pp) [111-147 dB re. 1 μ Pa (rms) & 100-135 dB re. 1 μ Pa2s]. The received levels varied widely with range and depth of the exposed animal precluding reliable estimation of exposure zones based on simple geometric spreading laws. When the whales were close to the surface, the first arrivals of airgun pulses contained most energy between 0.3 and 3 kHz, a frequency range well beyond the normal frequencies of interest in seismic exploration. Therefore airgun arrays can generate significant sound energy at frequencies many octaves higher than the frequencies of interest for seismic exploration, which increases concern of the potential impact on toothed whales with poor low frequency hearing. *J. Acoust. Soc. Am.* Submitted.

4. HIGHAM, J.E.S. AND LUSSEAU, D. Whalewatching and whaling: a plea for empiricism. +

Recent International Whaling Commission debate on the interaction of whalewatching and whaling provides fertile ground for empirical research. Commentary to date on the relationship between whalewatching and whaling has been largely anecdotal, rendering the potential effect that whaling might have on whalewatching largely uninformed. From this situation emerges an urgent need for empirical research to address the relationship between two conflicting and probably mutually exclusive interests relating to whales. This opinion paper presents and discusses a framework in which this relationship may be more closely studied. The framework outlines different scenarios under which the evolution of a whalewatching system can interact with other human activities including whaling. The scenarios incorporated into the framework include optimum growth in the whalewatch system and variations on optimal growth subject to both constructive and destructive human activities. The framework accommodates stochastic events that may periodically impact the attractiveness of tourist destinations, perhaps to the point that whalewatch operations lack the robustness to remain viable. The authors conclude the paper with a plea for empiricism to address the various elements of the proposed framework. *Conserv. Biol.* Submitted.

5. LUSSEAU, D. Evidence for social role in a dolphin social network. +

Social animals have to take into consideration the behaviour of conspecifics when making decisions to go by their daily lives. These decisions affect their fitness and there is therefore an evolutionary pressure to try making the right choices. In many instances individuals will make their own choices and the behaviour of the group will be a democratic integration of everyone's decision. However, in some instances it can be advantageous to follow the choice of a few individuals in the group if they have more information regarding the situation that has arisen. Here I provide early evidence that decisions about shifts in activity states in a population of bottlenose dolphin follow such a decision making process. This unshared consensus is mediated by a non-vocal signal which can be communicated globally within the dolphin school. These signals are emitted by individuals that tend to have more information about the behaviour of potential competitors because of their position in the social network. I hypothesise that this decision making process emerged from the social structure of the population and the need to maintain mixed-sex schools. *Evol. Ecol.* Submitted.

6. BEJDER, L., SAMUELS, A., WHITEHEAD, H., GALES, N., MANN, J., CONNOR, R., HEITHAUS, M., WATSON-CAPPS, J. AND FLAHERTY, C. Decline in relative abundance of bottlenose dolphins exposed to long-term disturbance. *Conserv. Biol.* In Press.

7. BEJDER, L., SAMUELS, A., WHITEHEAD, H. AND GALES, N. Interpreting short-term behavioural responses to disturbance within a longitudinal perspective. *Anim. Behav.* In Review.

8. FERNÁNDEZ, A., EDWARDS, J.F., RODRIGUEZ, F., ESPINOSA DE LOS MONTEROS, A., HERRAEZ, P., CASTRO, P., JABER, J.R., MARTIN, V. AND ARBELO, M. "Gas and fat embolic syndrome" involving a mass stranding of beaked whales (family Ziphiidae) exposed to anthropogenic sonar signals. +

A study of the lesions of beaked whales (BW) in a recent mass stranding in the Canary Islands following naval exercises provides a possible explanation of the relationship between anthropogenic, acoustic (sonar) activities and the stranding and death of marine mammals. Fourteen BWs were stranded in the Canary Islands close to the site of an international naval exercise (Neo-Tapon 2002) held on 24 September 2002. Strandings began about 4 hours after the onset of midfrequency sonar activity. Eight Cuvier's BWs (*Ziphius cavirostris*), one Blainville's BW (*Mesoplodon densirostris*), and one Gervais' BW (*Mesoplodon europaeus*) were examined postmortem and studied histopathologically. No inflammatory or neoplastic processes were noted, and no pathogens were identified. Macroscopically, whales had severe, diffuse congestion and hemorrhage, especially around the acoustic jaw fat, ears, brain, and kidneys. Gas bubble-associated lesions and fat embolism were observed in the vessels and parenchyma of vital organs. In vivo bubble formation associated with sonar exposure that may have been exacerbated by modified diving behavior caused nitrogen supersaturation above a threshold value normally tolerated by the tissues (as occurs in decompression sickness). Alternatively, the effect that sonar has on tissues that have been supersaturated with nitrogen gas could be such that it lowers the threshold for the expansion of in vivo bubble precursors (gas nuclei). Exclusively or in combination, these mechanisms may enhance and maintain bubble growth or initiate embolism. Severely injured whales died or became stranded and died due to cardiovascular collapse during beaching. The present study demonstrates a new pathologic entity in cetaceans. The syndrome is apparently induced by exposure to mid-frequency sonar signals and particularly affects deep, long-duration, repetitive-diving species like BWs. 2005. *Vet. Pathol.* 42: 446-57.

9. MATE, B.R., LAGERQUIST, B.A. AND URBÁN-RAMÍREZ, J. A note on using satellite telemetry to document the use of San Ignacio Lagoon by gray whales (*Eschrichtius robustus*) during their reproductive season. +

In February 1996, 12 gray whales (*Eschrichtius robustus*), consisting of six animals without calves and six females with calves, were instrumented with Argos satellite-monitored radio tags in San Ignacio Lagoon, Baja California Sur, Mexico. San Ignacio is one of only three major breeding and calving

lagoons located along the Pacific Baja Coast. Tracking periods ranged from 1.5 to 20.8 days. Mothers stayed in the lagoon longer than animals without calves and made repeated excursions to and from the lagoon. The experiment took place at a time of year when the number of animals without calves usually declines, which likely influenced the residence time of these animals in the lagoon. The question of residence time and turnover of both animals with and without calves is important in establishing how many whales actually use the lagoon during the winter reproductive season. 2003. *J. Cetacean Res. Manage.* 5: 149-54

10. ETNOYER, P., CANNY, D., MATE, B. AND MORGAN, L. Persistent pelagic habitats in the Baja California to Bering Sea (B2B) Ecoregion. +

The Baja California to Bering Sea (B2B) Marine Conservation Initiative seeks to establish a network of Marine Protected Areas within the Exclusive Economic Zones of the NAFTA countries - Canada, Mexico, and the United States. This network is designed to capture ecologically significant habitat for marine species of common conservation concern and pelagic regions of high productivity, with due consideration for the inter-annual sea surface temperature fluctuations of the El Niño Southern Oscillation (ENSO). Here, we present analytical methods that define pelagic habitat based upon the density of steep temperature gradients, or fronts, and we quantify their spatial and temporal persistence over a single ENSO cycle (1996-1999) to benefit marine conservation and marine management strategies. We find that less than 1% of the Northeast Pacific ocean exhibits a persistent (> 8 mo/yr) concentration of temperature fronts ($> .2\text{km/km}^2$) within and between years. The Baja California Frontal System (BCFS) is the largest concentration found within the multinational federal waters, between 0 and 300 km east of Baja California Sur. The BCFS appears more active under La Niña conditions, while the next largest persistent concentration, North Pacific Transition Zone, appears more active under El Niño conditions. We demonstrate habitat functions associated with the BCFS for blue whales (*Balaenoptera musculus*), swordfish (*Xiphias gladius*), and striped marlin (*Tetrapturus audax*). We recommend management and protection for this pelagic "hotspot" to the Mexican government and the tri-national Commission for Environmental Cooperation. 2004. *Oceanography* 17: 90-101

11. MATE, B.R. AND URBÁN-RAMIREZ, J. A note on the route and speed of a gray whale on its northern migration from Mexico to central California, tracked by satellite-monitored radio tag. +

A gray whale (*Eschrichtius robustus*) tracked with an Argos satellite-monitored radio tag traveled 1,794 km during the northbound migration season from San Ignacio Lagoon (SIL), Baja California Sur, Mexico to north of San Francisco from 8-23 February 1996. The migration route was predominately nearshore and in water < 100 m deep, with 75% of the Argos-acquired locations averaging 7.3 ± 1.22 km from shore. Distances > 20 km from shore and water depths > 100 m were encountered only when the whale crossed Vizcaino Bay or through the Channel Islands. During migration, the whale maintained an average speed of 134 km/d (5.6 km/h), suggesting a coastal migration of 49 days from SIL to the Bering Sea. 2003. *J. Cetacean Res. Manage.* 5: 155-57.

12. PANIGADA, S., PESANTE, G., ZANARDELLI, M., CAPOULADE, F., GANNIER, A. AND WEINRICH, M.T. Mediterranean fin whales at risk from fatal ship strikes.

The fin whale (*Balaenoptera physalus*) is the cetacean most often recorded as struck by vessels all over the world's oceans. This paper reviews and analyzes ship collision records for the relatively isolated population of fin whales in the Mediterranean Sea from 1972 to 2001. We collected records both from dead and live individuals. Out of 287 carcasses, 46 individuals (16.0%) were certainly killed by boats; this percentage rose to 19.9% if records including animals presumably killed by vessels or unidentified large specimens were considered. The minimum mean annual fatal collision rate increased from 1 to 1.7 whales per year from the 1970s to the 1990s. 82.2% of the fatal strike events were reported in or adjacent to the waters of the Pelagos Sanctuary for Marine Mammals, MPA characterized by high levels of traffic and whale concentrations. Among 383 photo-identified whales, 9 (2.4%) had marks that were attributed to a ship impact. The reported rates are unusually high for baleen whales. The high likelihood of unreported fatal strikes combined with other anthropogenic threats suggests an urgent need for a comprehensive, basin-wide conservation strategy, including ship strike mitigation requirements. These might include real-time monitoring of whale presence and distribution to re-locate ferry routes to areas of lower cetacean density, and reducing ship speed in high cetacean density areas. Future research to describe the whales' behavior in relation to approaching vessels including controlled-exposure-experiments combined with passive tracking and multi-sensor recording devices would be helpful to further understand and avoid these interactions. *Mar. Poll. Bull.* In Press.

13. FROHOFF, T., VAIL, C.S. AND BOSSLEY, M. Preliminary proceedings of the Workshop on the Research and Management of Solitary, Sociable Odontocetes. 16th Biennial Conference on the Biology of Marine Mammals, San Diego, California, December 10th 2005. +

This is a preliminary and general overview of the Workshop on the Research and Management of Solitary, Sociable Odontocetes, held on 10 December 2005 as part of the 16th Biennial Conference on the Biology of Marine Mammals in San Diego, California. The overall goal of this international workshop was to increase the effectiveness of individuals, organizations, and agencies working to improve research and management of these animals by a) sharing and compiling existing information, b) identifying and developing policy, management, and research recommendations and c) improving the exchange of information, communication, coordination, and collaboration between all involved parties. Since the activities initiated from this workshop are still in progress, this paper represents an on-going effort and serves only as an initial overview of objectives, background, action items, and recommendations that are continuing to be consolidated. Meeting objectives were defined prior to the workshop as follows: (1) Identify the most serious dangers to the safety of solitary cetaceans and humans, (2) Identify what aspects of protecting solitary cetaceans and humans (through management/guidelines, policy, and research): a) have proven to be the most and least successful at mitigating these dangers (dependent upon species and circumstances), b) have not yet been explored but show the most promise in exploring, (3) Evaluate the effects of interacting with solitary cetaceans as part of recreation and management, (4) Identify the origin of solitary cetaceans, and (5) Identify the most important needs and recommendations for government/legal policy, management, research, and establishing an international communications network for exchange and dissemination of information and updates about solitary cetaceans. This workshop served as a starting point to consolidate existing information and develop a network of interested and knowledgeable parties dedicated to the research, welfare, and protection of solitary, sociable odontocetes and the management and research challenges and opportunities that they provide. Overall goals that were identified at the workshop that require subsequent action, include: (1) Publication of formal proceedings from the workshop, including bibliography, literature review, compilation of existing guidelines and participant surveys; (2) Initiation and development of working groups to discuss and develop action plans and more definitive recommendations for certain aspects of solitary cetacean management in furtherance of workshop goals and objectives; and (3) Development of a web interface and portal to consolidate research and other information on 'solitary sociables' and creation of an email list serve to connect interested parties. Since the activities initiated from this

workshop are still in progress, this paper represents an on-going effort and serves only as an initial overview of objectives, background, action items, and recommendations that continue to be consolidated. The Workshop Workbook for the workshop, including presentations, bibliographies, compilation of existing guidelines created to manage solitary odontocetes, participant surveys and other supplemental information can be found at www.wdcs.org. The upcoming Workshop Proceedings (in progress) will also be available on this website when completed. 2005.

14. VISSER, F., HARTMAN, K.L., ROOD, E.J.J., HENDRIKS, A.J.E. AND WOLFF, W.J. Effects of whale watching activities on the behaviour of Risso's dolphin at the Azores. +

Behavioral response of Risso's dolphin (*Grampus griseus*) to whale-watching activities was studied by comparison of activity rates between the high and low season of whale watching. We had the exceptional opportunity to study Risso's dolphin behavior from land, enabling observations of both disturbed and undisturbed groups. Whale watching activities were divided in a low season and a high season of activities, based on the intensity of vessel presence. Daily whale watching activities were characterized by a bimodal distribution, with low abundance between 1 and 2 PM. Risso's dolphin daily pattern of resting behavior was strongly influenced by high intensity whale watching activities, but the natural resting pattern was maintained when whale-watching operators are present in low numbers. At high intensity of whale watching activities, Risso's dolphins did not react by decreasing their overall time spent resting, but shifted their daily, double peaked pattern of resting behavior towards a single-peaked pattern, with highest resting rates during periods of lowest vessel abundance. The difference from the usual pattern implies that the dolphins have to adopt an alternative and possibly less favorable pattern when whale watching activities are high. Their reaction is most likely primarily induced by vessel noise, implying that the impact of whale watching could be reduced by regulating both vessel abundance and vessel speed in the area.

15. POTTER, J.R., THILLET, M., DOUGLAS, C., CHITRE, M., DOBORZYNSKI, Z. AND SEEKINGS, P. Visual and passive acoustic marine mammal observations and high-frequency seismic source characteristics recorded during a seismic survey. +

We present marine mammal observation statistics, high-frequency seismic source characteristics and example denoising of marine mammal acoustic recordings using data collected during the mitigation and monitoring program for a 3D seismic survey by EnCana Corporation in the NW Atlantic during 2003. Marine mammals were observed both visually and acoustically. No marine mammal incidents or adverse reactions were observed during the survey. Acoustic observations were made by the Seamap Passive Acoustic Cetacean Monitoring System (SPACMS), consisting of two hydrophones placed 50 m apart, towed ahead of and to one side of the seismic source. Visual and acoustic detections were uncorrelated, indicating the complementary nature of the two observational techniques. Visual detections were more common per hour of effort than acoustic detections. Acoustic detection rates showed no significant day-night difference. Marine mammals appear to have avoided very close ranges (<100 m) from the seismic array during seismic acquisition, but the overall number of marine mammals in the observable radius (1-2 km) did not change significantly when the seismic source was 'on' compared to 'off'. Marine mammals were observed in larger groups and appeared to have become less vocal when the seismic source was active. It should be noted however, that the results from this data gathering effort may be affected by potential sources of bias (such as the combination of data from toothed and baleen whales). Signal processing of seismic source signatures indicated some high-frequency energy content consistent with expectations from earlier work. This analysis confirmed that most of the seismic energy was concentrated at lower frequencies (< 500 Hz). No low-frequency comparisons with near-field data could be made due to the geometry of the SPACMS recording hydrophones and seismic source, which resulted in the Lloyd's mirror effect obliterating low-frequency components in the SPACMS records. A wavelet-based denoising method was applied to improve the visibility of marine mammal vocalizations on a spectrogram display.

16. LEAPER, R., GILLESPIE, D. AND IFAW Second workshop on right whale acoustics: practical applications in conservation. +

17. WILLIAMS, R. AND LUSSEAU, D. Killer whale social networks can be vulnerable to targeted removals. +

Individuals play various roles in maintaining the social integrity of mammalian populations. However, many models developed for managing wildlife resources assume that all individuals are equal. Killer whales are social animals that rely on relationships within and among family groups for survival. In the northeastern Pacific, the fish-eating, "resident" killer whale populations are composed of matrilineal groups from which offspring do not disperse. We analysed the influence of various individuals' age, sex and matrilineal affiliation on their position in this social network. Here we show that some matrilineal groups appeared to play more central roles than others in the social network. Furthermore, juvenile whales, especially females, appeared to play a central role in maintaining network cohesion. This key finding was supported subsequently by simulating removal of different individuals. The network was robust to random removals; however simulations that mimicked historic live-captures from the northeastern Pacific were more likely to break the network graph into isolated groups. This finding raises concern regarding targeted takes, such as live-capture or drive fisheries, of matrilineal cetaceans. *Biology Letters* In Review.

18. WILLIAMS, R., LUSSEAU, D. AND HAMMOND, P.S. Estimating relative energetic costs of human disturbance to killer whales (*Orcinus orca*). +

This study examined the activities of "northern resident" killer whales (*Orcinus orca*) in Johnstone Strait, British Columbia, Canada, in July and August, from 1995 to 2002. Disturbance from vessels has been identified as a conservation concern for this population. The primary aims of the study were to test whether boat presence altered whales' activities, and if so, to estimate whether behavioural responses were likely to have carried energetic costs. A land-based observation site near a vessel-exclusion marine protected area allowed us to conduct a natural experiment to monitor whale activities in the presence and absence of boats. Using Time-Discrete Markov Chain models, boat presence was linked to significant changes in the probability that focal whales would switch from one activity state to another, which led to significantly different activity budgets in the presence and absence of boats. We estimated that the energetic cost of meeting these budgets differed by only 3-4%. In the presence of boats however, whales reduced their time spent feeding and the time spent rubbing their bodies on smooth pebble beaches. These lost feeding opportunities could have resulted in a substantial (18%) estimated decrease in energy intake. Our sensitivity analysis provides preliminary evidence that disturbance could carry higher costs to killer whales in terms of reducing energy acquisition than increasing energetic demand, and future research should address this directly. Meanwhile, our observations suggest that protected areas would confer greatest conservation benefit to endangered killer whale populations if they were designed to protect important foraging areas. *Biol. Conserv.* In Review.

19. WILLIAMS, R., HEDLEY, S.L. AND HAMMOND, P.S. Modeling distribution and abundance of Antarctic baleen whales using ships of opportunity. Information on animal abundance and distribution is at the cornerstone of many wildlife and

conservation strategies. +

However, these data can be difficult and costly to obtain for cetacean species. The expense of sufficient ship time to conduct design-unbiased line transect surveys may be simply out of reach for researchers in many countries, which nonetheless grapple with problems of conservation of endangered species, by-catch of small cetaceans in commercial fisheries, and progression toward ecosystem-based fisheries management. Recently developed spatial modeling techniques show promise for estimating wildlife abundance using non-randomized surveys, but have yet to receive much field-testing in areas where designed surveys have also been conducted. Effort and sightings data were collected along 9 650 km of transects aboard ships of opportunity in the Southern Ocean during the austral summers of 2000-2001 and 2001-2002. Generalized additive models with generalized cross-validation were used to express heterogeneity of cetacean sightings as functions of spatial covariates. Models were used to map predicted densities and to estimate abundance of humpback, minke, and fin whales in the Drake Passage and along the Antarctic Peninsula. All species' distribution maps showed strong density gradients, which were robust to jackknife resampling when each of 14 trips was removed sequentially with replacement. Looped animations of model predictions of whale density illustrate uncertainty in distribution estimates in a way that is informative to non-scientists. The best abundance estimate for humpback whales was 1 829 (95% CI: 978-3 422). Abundance of fin whales was 4 487 (95% CI: 1 326-15 179) and minke whales was 1,544 (95% CI: 1,221-1,953). These estimates agreed roughly with those reported from a designed survey conducted in the region during the previous austral summer. These estimates assumed that all animals on the trackline were detected, but preliminary results suggest that any negative bias due to violation of this assumption was likely small. Similarly, current methodological limitations prohibit inclusion of all known sources of uncertainty in the favored variance estimator. Meanwhile, our approach can be seen generally as an inexpensive pilot study to identify areas of predicted high density that could be targeted to: inform stratified designs for future line transect surveys, making them less expensive and more precise; increase efficiency of future photo-identification or biopsy studies; identify candidate time-area fisheries closures to minimize by-catch; or direct ecotourism activities. The techniques are likely to apply to areas where funding is limiting, where cetacean studies or wilderness-based tourism are just beginning, or in regions where even a very rough estimate of animal abundance is needed for conservation or management purposes. *Ecology and Society* 11: [online].

20. LAMBERTSEN, R.H. Crassicaudosis: a parasitic disease threatening the health and population recovery of large baleen whales. 1992. *Rev. Sci. Tech. O.I.E. (Off. Int. Epizoot.)* 11: 1131-41

21. LAMBERTSEN, R.H. AND HINTZ, R.J. Maxillomandibular cam articulation discovered in North Atlantic minke whale. 2004. *J. Mammal.* 85: 446-52

22. LAMBERTSEN, R.H., RASMUSSEN, K.J., LANCASTER, W.C. AND HINTZ, R.J. Functional morphology of the mouth of the bowhead whale and its implications for conservation. 2005. *J. Mammal.* 86: 342-52