Annex F

Report of the Sub-Committee on Bowhead, Right and Gray Whales

Members: Walløe (Chair), Allison, Baba, Baker, Behel, Berggren, Bickham, Borodin, Borsani, Brandao, Bravington, Brownell, Butterworth, Childerhouse, Clapham, Clark, Cooke, Cosens, Deimer, DeMaster, Diake, Donovan, Forde, Friday, Fujise, Funahashi, Gales, George, Gidding, Givens, Goodman, Groch, Grønvik, Hatanaka, Haug, Ilyashenko, Iñiguez, Jeglinski, Kasuya, Kato, Kell, Kim, Z.G., Kim, K.W., Kingsley, Kitakado, Krahn, Leaper, LeDuc, Lee, Lima, Ludwig, Lyrholm, Manzanilla, Matsuda, Matsuoka, Mikhalev, Miyashita, Moore, Morishita, Murase, Nagatomo, Nishiwaki, Ohsumi, Øien, Okamura, Palazzo, Park, Pastene, Pike, Punt, Rademeyer, Read, Reeves, Reilly, Rennie, Ridoux, Robbins, Rogan, Rojas-Bracho, Rose, Sadler, Schweder, Senn, Skaug, Sohn, Stachowitsch, Suydam, Taylor, B., Taylor, M., Tomita, Tsidulko, Urban, Vikingsson, Wade, Weinrich, Weller, Witting, Yamakage, Yamamura, Yoshida, Zeh.

1. CONVENOR'S OPENING REMARKS, ELECTION OF CHAIR AND APPOINTMENT OF RAPPORTEURS

Walløe welcomed the participants and was elected Chair. Robbins acted as rapporteur, assisted by Manzanilla.

2. ADOPTION OF AGENDA

The adopted agenda is given as Appendix 1.

3. REVIEW OF AVAILABLE DOCUMENTS

The documents available for discussion by the sub-committee included SC/55/BRG1-5, BRG7-21, Zeh *et al.* (2002), SC/55/O6-8, 23, SC/55/Rep 4, SC/55/RMP9, SC/55/SD4 and SC/55/ProgRepUSA.

4. BOWHEAD WHALES

4.1 B-C-B Seas stock of bowhead whales

4.1.1 New scientific information

Zeh presented Zeh *et al.* (2002), which provides a distribution for annual survival probability of 'adult' bowheads suitable for use as a prior in a Bayesian assessment. Survival was estimated from aerial photographs of naturally marked bowheads collected between 1981 and 1998. The marked whales first photographed in a particular year provided the initial 'capture' and 'release' of those marked whales, and photographs in subsequent years the 'recaptures'. Methods used for scoring photo quality and whale identifiability, and selecting photographs suitable for capture-recapture analysis have been reviewed by the Scientific Committee previously (Rugh *et al.*, 1998; Zeh *et al.*, 2000). The Cormack-Jolly-Seber (CJS) model and program MARK were used to identify a model with a single survival and time-varying capture probabilities as the most appropriate for these data. A Bayesian Markov chain Monte Carlo (MCMC) implementation of the corresponding Jolly-Seber (JS) model, more appropriate than the CJS model for these data, was used to produce a posterior distribution for annual survival. Because the CJS model ignores much of the information on capture probabilities provided by the data, its results are less precise and more sensitive to the prior distributions used than results from the JS model. With priors for annual survival and capture probabilities uniform from 0 to 1, the posterior mean for bowhead survival rate from the JS model is 0.984, and 95% of the posterior probability lies between 0.948 and 1. A somewhat more realistic Beta (0.5,0.5) prior distribution resulted in a posterior with 2.5% point 0.958. Zeh commented that the sub-committee may wish to consider which of these distributions it considers most appropriate for use in the assessment.

SC/55/BRG4 reported on the acoustic survey conducted as part of the bowhead census off Point Barrow in 2001. This was the most successful acoustic survey to date. The methods used to record and analyse the array recordings were the same as in previous years. Arrays were operational for 43.3 days out of the entire 46-day period from 16 April through 31 May. *In situ* calibration of the acoustic method was carried out using visually determined theodolite positions as ground truth. Differences in bearings between visual and acoustic positions were always less than a degree, and range errors were 5-9% of the visual range. There was a slight but consistent bias for acoustic range to underestimate theodolite range. Analysis of all 1,044 hours of acoustic array data resulted in the detection of 90,554 bowhead sounds that yielded 27,023 reliable locations and 515 call tracks. Call tracks represent cases during which an individual animal produces a series of calls with similar acoustic features and groups of animals counter-call (see IWC, 2003b, p.238). From the reliable locations, 14,458 were used to determine the offshore distribution of animals throughout the migration. The results indicate that the majority (86%) of vocal whales were within 4km of the perch. This is slightly less than in 1993 (93%), a year with exceptionally good ice, visibility and acoustic conditions. Acoustic data reveal that there were periods, on the time scale of less than a day and the spatial scale of kilometres, when whales stalled or reversed their directions of movement. The extent to which environmental conditions (e.g. ice cover and current) influence the migration has implications for the tracking algorithm used in the Bayes-empirical-Bayes population assessment method.

The question was raised whether calls could be confirmed to be from bowhead whales, or whether there might be confusion with other marine mammals. Clark confirmed that the Arctic is an acoustically rich environment, but that the only other marine mammal with which bowheads can be

sometimes confused is the white whale; bearded seals and ring seals have very distinctive vocalisations that can be readily identified. He noted this issue had been considered quite carefully in previous years of the survey.

SC/55/BRG7 presented the completed analysis of the 2001 ice-based census of bowhead whales (Barrow, AK) using the N_4/P_4 methodology. Last year a preliminary estimate was presented with incomplete acoustic data (P_4 = proportion of acoustic locations within 4km of the lead edge). The acoustic analysis included the entire season (16 April to 31 May), which has never before been available (SC/55/BRG4). The variance of P_4 was 'properly' estimated in this analysis using a moving blocks bootstrap approach. This method is used to circumvent the problem of possible autocorrelation between days. The N_4 estimate (N_4 = number of whales within 4km of the lead edge) did not change in this analysis (8,637) from the estimate presented last year. Using the revised P_4 estimate (0.862), the 2001 abundance estimate is 10,020 (SE = 1,290; 95% CI of 7,800-12,900). The SE of the estimate is over twice that of 1993, which is expected given the poor viewing conditions in 2001. The annual rate of increase (ROI) was also calculated. A generalised least squares (GLS) model resulted in a ROI of 3.4% (95% CI 2.1% to 4.8%), which is nearly identical to the previous estimate of 3.3% based on the 1978-1993 time series. Using the methods of Cooke (1996), 'process error' in the number of whales passing Point Barrow in different years was estimated as zero. If the 2001 value of P_4 was treated as providing information about the expected proportion of the whales within 4km, ROI was estimated as 3.8%. George expressed his appreciation for the support of the whale hunters and the technicians who assisted with the study.

A question was raised as to whether a Bayes-empirical-Bayes (BEB) estimate would also be calculated, as it had been for 1993 data. The discussion elaborated on the complexity of the BEB technique and what the ultimate value of that additional estimate would be, given that the N_4/P_4 estimate carried the same weight. Furthermore, the sub-committee recalled that the BEB was only ultimately used with the N_4/P_4 to calculate a scaling factor. It was considered that the scaling factor was only based on one year and so it might be important to know if the ratio has changed. However, Zeh noted that there was no reason to scale the N_4/P_4 with the BEB, as they are both absolute abundance estimates. Furthermore, if a scaling factor was desirable, it would be more appropriately based on the 1993 data, given that environmental conditions were better at that time. Finally, it was noted that the additional acoustic data now available for 2001 may be problematic for the tracking algorithm. As a result of this discussion, it was agreed that a BEB estimate would not be calculated for 2001 data.

Schweder and Ianelli (2000) concluded that the age-length data of George *et al.* (1999) and Braham (2000) were inconsistent with other data available for assessing the B-C-B stock of bowhead whales. SC/55/BRG10 questioned the approach taken to construct the catch age-composition data in Schweder and Ianelli (2000) and how these data were included in the assessment model. It showed that the assumption that the harvest is removed uniformly from the 1+ component of the population is violated, given differences in the mean length of the catch among villages and changes over time in the proportion of the catch taken by each village. SC/55/BRG10 further outlined an approach for including the catch size-composition data (both historical and recent) in the assessment.

Schweder welcomed renewed discussion of this topic and additional approaches. However, he disagreed that the assumption of a time-invariant age distribution from 1973 to 1992 was likely to have had a significant impact on his previous results. He agreed that the analysis presented in Schweder and Ianelli (2000) could be improved, but argued that the discrepancy between datasets remains an issue.

The sub-committee discussed the relative importance of resolving this issue prior to the 2004 in-depth assessment. It was concluded that, although worth pursuing, a lack of resolution on this issue would not necessarily prevent the sub-committee from developing advice based on an in-depth assessment in 2004.

SC/55/RMP9 presented a brief review of the discussions on stock structure in B-C-B bowhead and western North Pacific minke whales. Based on this review the author identified what he believed are different criteria by the Committee to define stocks in these two cases: (1) citing the lack of information on stock structure the Committee has repeatedly required additional information in the case of the minke whale; in the case of the bowhead whale, the lack of perfect information on stock structure has not been a reason for the Committee to reject the single stock scenario for B-C-B; (2) on many occasions the Committee has recommended the attainment of data from minke whale putative breeding grounds (which is scientifically correct but logistically difficult to achieve); however it has not put similar emphasis on recommending the attainment of samples in the Chukchi Sea and Bering Sea islands in summer (which is scientifically correct but also logistically difficult to achieve), which could elucidate the hypothesis of sub-stocks in the case of B-C-B stock; (3) the possibility of more than one stock passing Point Barrow has been rejected by the Committee citing that segregation by sexual component during migration is consistent with a single stock scenario; the same argument has been rejected for minke whales, where a segregation by age and sex is observed during migration; (4) the possibility that animals from depleted stocks move into the distribution area of the B-C-B stock has not been a cause of concern by the Committee; the movement and mixing of animals from the J stock into the area of distribution of the O stock has been a cause of large concern by the Committee; (5) a larger number of analytical methods have been used to examine DNA data in the case of the minke whale; the Committee has shown little interest in using different analytical methods on the available DNA data from bowhead whale. The author of SC/55/RMP9 urged the Committee to consider the two cases on a consistent basis, as a scientific approach demands. The author noted that sampling and analysis of genetic samples along the Chukotka Peninsula in summer could help to elucidate the possibility of sub-stock scenario. He also suggested that the >100 genetic samples available from the northern coast of Alaska could be examined genetically on a temporal basis in order to investigate any genetic heterogeneity among migrating whales.

In response to SC/55/RMP9, it was noted that the Scientific Committee has assessed the status of this stock nine times since 1984. A comprehensive review of bowhead whale stock identification was submitted in 2000 to the 52nd meeting in response to a request by the Scientific Committee the previous year.

In addition, Taylor felt that data criteria for stock definition should be case specific and, in particular, should depend on both the biology of the target species and the exploitation pattern. The salient differences between the bowhead and minke cases are the pattern of migration and

the pattern of intended exploitation. She argued that these factors substantively alter risk considerations.

Bowhead whales have a concentrated migration, both temporally and spatially, that allows for a very precise abundance estimate of the harvested population. Migration takes place within a few miles of the coast and within about a seven week period. In contrast, minke whales migrate from unknown breeding grounds to northern feeding grounds, essentially over the entire North Pacific and over a period of months. While the bowhead whale hunt takes place within the migratory corridor, the preferred minke whale harvest scenario would base the quota for coastal whaling upon the abundance across a large latitudinal range. Even if it were the case that all whales in the Okhotsk Sea migrated through coastal Japanese waters, there would still be the risk of substantially overestimating the abundance of the harvested stock if the offshore animals belong to an offshore stock. Further, it is known that some of the whales in the Okhotsk Sea belong to J stock and likely some belong to the offshore stock(s). Taylor noted that from the perspective of the RMP that seeks to achieve sustainable management of whales, and management that manages stocks 'safely', there is therefore good cause to treat minke whales and bowhead whales differently. It is not obvious that the same 'criteria' should be applied to each case because the biology of the animals together with the catch history and the intended catch imply different risks.

Taylor also addressed the separate question of harvest of potential small stocks: a purported 'Chukchi' stock for bowheads or J-stock for minke whales. In the J-stock case, it is known that whales in the Sea of Japan/East Sea strongly differ from their pelagic counterparts (morphology, timing of breeding and genetics). Further, more than 100 are typically taken as fishery bycatch each year and the status of the stock or stocks (see Lavery *et al.*, 2002) remains unknown. The commercial catch would be in addition to the unregulated bycatch. In the bowhead case, it remains unknown whether there is a separate Chukchi stock and if such a stock exists how big it is and whether it would ever come into whaling areas during the whaling period. The entire bowhead catch averages less than 50 whales (1/4 of the bycatch for Japan and Korea last year) and more than 90% are taken in the migratory area to the north of Alaska that is beyond the area where the putative 'Chukchi-stock' animals might range.

4.1.2 Catch information

SC/55/BRG5 reported catch information for the 2002 Alaskan subsistence harvest. A total of 50 bowhead whales was struck resulting in 39 animals landed. The efficiency (the ratio of the number landed to the number struck) of the hunt was 78%, which is similar to the average efficiency over the past 10 years (77%). Two of the landed whales had to be abandoned before butchering when ice and ocean current conditions became unsafe for the hunters. Of the remaining 37 whales, 16 were males and 21 were females. Of the 21 females, 7 were presumably mature (> 14.2m in length). Two of these large females were closely examined and determined not to be pregnant.

One member commented that the relatively low hunting efficiency was not unexpected given the difficult working conditions in the region.

In response to a query, Suydam explained that landed whales are measured and sampled in cooperation with local hunters. Tissue samples are obtained for analysis of genetics, contaminants, endocrinology and anatomical studies. Reproductive tracts are generally taken. The majority of the sampling is performed in Barrow, where snowmobiles are used to get to the ice-edge. Although sampling is also performed in Kaktovik, it has not been practical to station biologists in areas where fewer whales are landed. He confirmed that much of the data obtained from landed whales will be available for the in-depth assessment in 2004.

Borodin reported that three bowhead whales (1 male, 1 female, 1 struck and lost) were harvested in the Russian aboriginal subsistence whaling. The female was 17.2m long and weighed 86.6 metric tons. The male was 14.8m long and weighed 34.6 metric tons.

4.1.3 Management advice

The sub-committee agreed that there is no reason to change the management advice given last year (IWC, 2003a, p.28). Should the Commission decide that the current need is not covered by that advice, the *bowhead SLA* should be used to determine whether the new need could be satisfied.

4.1.4 Preparation for in-depth assessment

The sub-committee reviewed the availability of existing data and additional data needs for the in-depth assessment planned for 2004.

Zeh noted that she does not anticipate any modifications to the 2001 N_4/P_4 abundance estimate in the coming year. After some discussion, the sub-committee agreed to forgo the additional calculation of a Bayes-empirical-Bayes (BEB) estimate for 2001 data. It was decided that the N_4/P_4 estimate carries the same weight as the BEB and the methodology is more straightforward. Although the BEB was previously used with the N_4/P_4 to calculate a scaling factor, Zeh noted that this should not be necessary and that in fact the additional acoustic data now available may be problematic for the tracking algorithm. She noted that if a scaling factor is desirable, it would be more appropriately based on the 1993 data, given that environmental conditions were better at that time.

With regard to the question of stock structure, it was noted that DeMaster *et al.* (2000) summarised Scientific Committee discussions that led to the conclusion that Bering-Chukchi-Beaufort Seas bowheads comprise a single stock. Genetic data for investigating possible sub-stocks were limited, but studies completed to date provided no evidence of sub-stock structure. They noted that additional samples from times and places in which a putative Chukchi Peninsula sub-stock was found would need to be analysed if tests of population differentiation were to have adequate power to identify such a sub-stock.

The sub-committee agreed that, as the bowhead *SLA* was developed and tested under a single stock assumption, it was important for the 2004 assessment to examine data acquired since the DeMaster *et al.* (2000) review, as well as old data, to determine whether they support this assumption. Appendix 2 summarises all of the relevant samples now available. These will be used to investigate possible sub-stock structure and results will be reported during the 2004 assessment.

It was noted that additional data would be required to reconcile the discrepancy between age-length data and other available information for this population. However, it was agreed that this issue will not necessarily prevent the sub-committee from providing advice based on an in-depth assessment in 2004.

Donovan noted that the primary focus of the in-depth assessment should be: (1) the data required for the *SLA*; and (2) examining whether the present situation is within the tested parameter space. The latter effort will include such issues as stock identity and biological parameters. Previous assessment models will be used to investigate this, but it is not necessary to determine the 'best' model or to calculate Q_0 quantities.

4.2 Davis Strait/Baffin Bay and Hudson Bay/Foxe Basin bowhead whales

4.2.1 New scientific information

SC/55/BRG3 summarised satellite tracking results from 11 bowhead whales tagged in northwest Disko Bay, West Greenland, in May 2002. Transmitters were either mounted in steel cans or embedded in tethered floats and anchored with titanium spears or harpoon heads. Although can-type tags had the highest initial failure rates, the longest lasting transmission record was from a can-type tag. Tethered tags had the lowest initial failure rate but lasted for shorter periods of time. In May, whales remained in northwest Disko Bay then moved northwest towards Lancaster Sound, Canada, in late May. Activity was centred west of Bylot Island. By June, only one tag continued to transmit. This whale travelled long distances: south along Baffin Island in July, north to Admiralty Inlet where it remained for part of August, west to Barrow Strait in September, then south along the east coast of Baffin Island in October to Hudson Strait where the tag stopped transmitting in November. Tag results confirm that whales wintering off the west coast of Greenland move into Canadian waters during the summer period and suggest that Hudson Strait may be a wintering location. The long distances which the tagged whale travelled and its presence in Hudson Strait where Hudson Bay-Foxe Basin whales are thought to over-winter suggests that there could be interchange of bowheads between Baffin Bay and Hudson Bay-Foxe Basin.

SC/55/BRG17 reported on the major findings of research projects being conducted by the Department of Fisheries and Oceans in Canada. With assistance from the Greenland Institute of Natural Resources, a tagging programme has been developed in Foxe Basin. In 2003, seven bowheads were tagged with either can-type or tethered tags. The best results were collected from the tethered tags. Movement patterns were extensive and variable with one whale moving north through Fury and Hecla Strait to the southern Gulf of Boothia in August and as far as Prince Regent Inlet in September. There are plans to complete another survey of the Hudson Bay-Foxe Basin stock that will incorporate the new range information. There are also plans to try using a discovery curve approach to estimate stock size from genetic samples taken in Foxe Basin. Work on Baffin Bay/Davis Strait bowheads has included aerial surveys. Strip survey estimates from 2003 were 128 (95%CI = 28-228) bowheads in Eclipse Sound and 256 (95%CI = 154-358) whales in Prince Regent Inlet and northern Gulf of Boothia. The 57 (95%CI = 23-91) whales estimated in the southern Gulf of Boothia are thought to be Foxe Basin whales. More surveys are expected to be done over the next two years. Additional skin samples have been analysed for mtDNA haplotypes. The H02 haplotype, the dominant haplotype in Hudson Bay-Foxe Basin samples, has now been found in West Greenland and Cumberland Sound samples. An analysis of molecular variance, however, indicates that haplotype frequencies differ significantly between whales thought to be from the Baffin Bay-Davis Strait stock and those thought to be from the Hudson Bay-Foxe Basin stock.

The sub-committee expressed its appreciation to Cosens for providing this information.

Brownell described ongoing efforts by Howard Rosenbaum, Cosens (Department of Fisheries and Oceans, Winnipeg, Canada) and the US National Marine Fisheries Service (La Jolla, California) to compare ancient and modern bowhead whales on the basis of mitochondrial DNA. Available samples span three eras of human contact: (1) 1,500-500 years before present (yBP); (2) 500-100 yBP; and (3) present day populations. Genetic data will be used to evaluate current and past stock relationships, especially BCB, BB-DS, HB-FB, in light of extensive exploitation, historical information and ice conditions. This work will also evaluate changes in bowhead whale genetic variation over the period. The impact of long-term climate change on bowhead genetic diversity and stock structure will be tested using specimens dating back to 1,500 yBP. Furthermore, because ice conditions in the early Holocene presumably allowed greater panmixis among stocks, this work will attempt to reconstruct temporal patterns of genetic variability related to potential periods of population interchange and separation.

4.2.2 Catch information

Cosens informed the sub-committee that a 14.1m female was landed by Inuit hunters in August 2002, near Igloolik, Nunavut, Canada. One strike was used. There was no evidence that the landed female was lactating or pregnant. There are no plans for a hunt in Canada in 2003.

The sub-committee recognised that it is the policy of Canada to authorise the harvest of a single whale from the HB-FB stock of bowheads every two years. Nonetheless, the sub-committee expressed concern about these limited catches from this stock.

5. RIGHT WHALES

5.1 North Atlantic right whales

Clapham presented updated information on recent research and management activities for North Atlantic right whales (SC/55/BRG15). This population remains critically endangered, and several analyses have concluded that survival has declined (see SC/55/BRG16, summarised below). However, reproduction has improved substantially in the last three years: the calf count to date this year is 18, with no observed mortalities. In 2001 and 2002, 31 and 21 calves were born, respectively. There were five known mortalities in the population in 2002: 2 were due to probable ship strikes, 1 was due to entanglement and the other 2 were of unknown cause.

The number of entanglements appears to have increased since 1997. In response to a query, Clapham commented that it was not clear whether the apparent increase was real or an artefact of reporting effort.

The US National Marine Fisheries Service (NMFS) has implemented regulations designed to reduce the likelihood of entanglement; these include gear modifications and closing of specific areas to fishing. The effectiveness of these measures is not yet clear. In 2002, eight right whales were entangled, the highest number ever recorded for a single year. One entanglement is known to have been fatal, one whale lost the gear of its own accord and six whales are presumed to still be entangled. An analysis of gear type and parts of gear involved in serious entanglements was conducted during 2003 (SC/55/BC4). This analysis found

that any type of fixed gear, and all parts of that gear, can be involved in life-threatening entanglements. NMFS convened an International Disentanglement Workshop in March 2003 to discuss expanding the disentanglement response network, developing new techniques and improving training programmes.

NMFS has developed a comprehensive strategy to address the issues of ship strikes to right whales which will establish new operational measures for the shipping industry along the US Atlantic coast, and additional mariner education and outreach programmes. The strategy is currently in federal agency review; full implementation will likely take several years. Meanwhile, the International Maritime Organisation (IMO) approved a change (effective July 2003) to move the shipping lane in the Bay of Fundy away from major summer concentrations of right whales in that area.

A total of $7 million dollars was appropriated by the US Congress for right whale work in 2002, and a further $10 million was appropriated for the current fiscal year. Current work funded by NMFS includes extensive aerial surveys in the feeding and calving grounds to document right whale distribution, to collect photo-identification data on individual right whales, to locate entangled or dead right whales, and to monitor specific areas of importance to mitigation of entanglement and ship strike risk. Work coordinated by Cornell University to acoustically monitor right whale occurrence in offshore habitats, or other areas which cannot be subject to constant surveys, continues and is being expanded in 2003. In July 2003, a visual and acoustic survey will be undertaken by the New England Aquarium of a major historical habitat for right whales, the Cape Farewell Ground. Whether whales still utilise this area is unknown, but it has been proposed as a candidate for a feeding ground of some of the many members of the population whose whereabouts in summer is unknown.

NMFS and collaborators continue to conduct analyses to monitor the status of the right whale population. Analyses include demographic studies and population modelling, with a focus on population trends and survival. Other ongoing work by several institutions includes studies of entanglement rates (derived from scarring), reproduction (including faecal steroid hormone analysis, which has been successful at detecting pregnancy, sexual maturity and stress levels), right whale responses to vessel traffic using digital tags and acoustic playbacks, and testing of whale alarms. Clapham noted that the tested alarms were either ineffective or potentially increased the risk of a whale being struck, since whales either did not react or reacted by coming to the surface.

In response to a query, Clapham commented that entangled right whales included both sexes and all age classes, but that juveniles were more likely to become entangled than adults.

It was also asked whether ship strikes or entanglements appear to represent a larger obstacle to population recovery. Clapham responded that a larger number of deaths have been attributed to ship strike, but felt that number may be misleading. Some entangled animals have not been re-sighted and are now presumed dead. When dead and presumed dead animals are considered together, entanglement and ship strike appear to be more comparable.

It was asked how much anthropogenic mortality would have to be reduced in order for the population to recover. Fujiwara and Caswell (2001) predicted the population growth rate could return to replacement level with the prevention of only two female right whale mortalities per year. However, it was noted in discussion that there remains some debate on this point.

Clapham presented the report of a working group convened in September 2002 by the US Northeast Fisheries Science Center to discuss survival estimation in North Atlantic right whales (SC/55/BRG16). The working group's objectives were to: (1) review recent estimates of right whale survival; (2) discuss methodological or other issues that might bias these estimates; and (3) suggest approaches to future work. Several approaches to estimating survival were presented by working group members. Having reviewed the updated work, the workshop participants agreed that, notwithstanding some uncertainties in survival estimation methods, the right whale population is not performing as one might expect, with rates of population growth (decline) and reproduction that are markedly below those reported for southern right whales.

Some working group participants remained concerned that the apparent trend in survival may be to some extent an artefact of heterogeneity in capture probability. It was suggested that it would not require very many individuals to exhibit major shifts in spatial distribution for a few years to impact apparent survival; this is particularly true for mature females, who appear to be disproportionately involved in the observed decline. Other working group participants disagreed with this position.

There was some discussion in the working group regarding the apparent correlation between survival and the North Atlantic Oscillation (NAO), as proposed by M. Fujiwara and H. Caswell. The mechanism by which survival could be affected in not clear; however, Caswell hypothesised that animals that were already stressed from entanglement or other problems might have a lower probability of survival if NAO-related nutritional stress was also in effect at the time.

Future approaches to right whale survival estimation will include examination of heterogeneity using simulated datasets, construction of an individual-based model, updating of existing analyses with new data, development of a spatially explicit capture probability model, and exploration of the applicability of Population Viability Analysis (PVA) to this population.

5.2 North Pacific right whales

SC/55/ProgRep USA provided a brief summary of a research cruise on North Pacific right whales in 2002. The current photographic catalogue at the Southwest Fisheries Science Center contained photographs from at least 21 right whale sightings. Thirteen individual whales from the Bering Sea were readily identifiable from their callosity patterns. The biopsy catalogue contained 10 individuals identifiable by microsatellite-based genotypes. Of the 10 individuals biopsied, nine were determined to be males and one a female. This sampled female was observed in 2002 and was accompanied by a calf, which was not sampled.

The sub-committee believes that the situation of eastern North Pacific right whales is equal to, if not worse than, the situation in the western North Atlantic. Numbers are estimated to be in the order of tens of individuals, with only two sightings of possible juveniles or calves this century. Both the photographic and biopsy catalogues contain several individuals that were sampled in multiple years. The sub-committee strongly recommends that research into the status of eastern North Pacific right whales be continued and intensified, specifically that:

(1) visual and acoustic surveys to establish the summer distribution and feeding ground be continued;
(2) photo-identification and photogrammetry effort be combined with attempts to obtain photographs suitable for examination of evidence of entanglement and ship strikes; and
(3) genetic sampling of individuals be continued and the use of genotypic mark-recapture methods for population estimation be investigated.

SC/55/O7 and SC/55/O8 reported western North Pacific right whale sightings during JARPN II surveys in 2002. Two individuals were sighted in two groups in the offshore waters of Hokaido Island (42°N), Western North Pacific.

5.3 Southern right whales

SC/55/BRG8 provided new information on sightings and strandings of Southern right whales (*Eubalaena australis*) off Santa Cruz, Argentina (1986-2003). Although the information presented in this study was preliminary, it appeared that the waters off Santa Cruz are of great importance for the migration and reproduction of this species.

It was asked whether the whales reported in SC/55/BRG8 might be part of the same population that uses the waters off Peninsula Valdés. The authors explained it was likely that this historic nursery area was simply being recolonised from the same population. However, it was noted that these findings are preliminary and the issue requires further investigation.

SC/55/O23 presented an analysis of 30 years of photo-identification studies of the southern right whales which congregate in the waters surrounding Peninsula Valdés, Argentina, between June and December each year. Resightings of previously catalogued individuals enable the demography of the population to be analysed. A total of 1,828 distinct individuals have been catalogued up to and including the 2000 season, of which 564 have been observed to calve at least once. A 3-stage model of the adult female population, incorporating calving, resting and receptive stages, is fitted to the observed calving histories. The modal calving interval is three years, representing one year in each stage, but longer calving intervals can occur when animals wait an extra year in the resting stage, or return to the resting stage from the pregnant stage without producing a live calf. Parameters of the transition probability matrix between stages are estimated from the data. Results of fitting of alternative models of temporal variation in transition probabilities yields strong evidence for inter-annual variation in the probability of a backward transition from the receptive stage to the resting stage, but not in the probability of spending an extra year in the resting phase. The result indicates the point in the reproductive cycle at which environmental influences may have most effect. The estimates of annual variation in this parameter of the reproductive cycle can be correlated with environmental indices in feeding and breeding areas with the aim of identifying critical habitat for right whales in the South Atlantic.

The updated estimates of mean demographic parameters are hardly changed from previous analyses: mean calving interval 3.42 yr (SE = 0.11 yr); mean age at potential first calving 9.1 yr (SE = 0.4 yr); adult female annual mortality rate 0.020 (SE = 0.004); annual percentage rate of population increase 6.8% (SE = 0.5%). The reproductive female population in 2000 is estimated at 700 individuals (SE = 50).

In response to a query, it was noted that food abundance in South Georgia was one environmental index likely to be used to assess the change in calving intervals, given photographic matches to Península Valdéz. It was noted that the CCAMLR and SO-GLOBEC cruises had sighted a large number of whales in the area of South Georgia and that the British Antarctic Survey has accumulated an extensive environmental database from the same area.

SC/55/O6 provided information on sightings of southern right whales during the 2002 JARPA cruises. Three animals, in three different groups, were sighted near the ice edge at 65°S/130°E. Two animals were successfully biopsied and photo-identified.

6. GRAY WHALES

6.1 Eastern North Pacific gray whales

6.1.1 Catch and stranding information

Nine gray whale strandings were reported from the west coast of the Baja California Peninsula, Mexico (SC/55/BRG21). Sex and length measurements were reported for 5 animals: 2 males (9.0-10.69m) and 3 females (5.10-13.6m). The remaining animals were estimated to be adult ($n = 2$) or calves ($n = 2$) based on aerial observations.

Borodin reported that 131 gray whales (70 male and 61 female) were harvested in the Russian aboriginal subsistence whaling. The length range of the animals was 8.0-14.0m, and the weight ranged from 6.0-29.3 metric tons, averaging 11.2 tons.

6.1.2 New scientific information

SC/55/BRG1 showed that the reason for the negative values for the quantity Q_0 during the 2002 assessment of the Eastern North Pacific stock of gray whales is Q_0 depending on the size of the total (1+) component of the population relative to *MSYL* when *MSYR* and *MSYL* are defined in terms of harvesting of the mature component of the population. SC/55/BRG1 showed that defining Q_0 (and Q_1) in terms of the exploitable component of the population eliminates this problem.

SC/55/BRG2 presented preliminary results of a shore-based survey of northbound gray whale calves in 2002, and a prediction for the 2003 estimate based on the spatial and temporal distribution of seasonal ice during the spring and early summer of 2002. As in the previous eight years, the survey was conducted from Pt Piedras Blancas, California, during the spring migration. During 703 hrs of watch effort, 302 calves were sighted. Correcting this count for periods not on watch and for calves missed by the standard watch team produced an estimate of 842 (SE = 79.17) northbound calves. This result is the first sign of recovery in calf production for this population after three consecutive years of very low estimates based on counts from this site. This recovery was predicted prior to the 2002 survey based on the distribution of seasonal ice in the Bering and Chukchi Seas. Predictions for the number of northbound calves in 2003 are 327 and 763, depending upon the number of predictor variables used in the model.

Last year, it was reported that sightings of 'skinny' whales had declined. As reported in SC/55/BRG2, this has been followed by an increase in calving rates. The sub-committee remarked that this pattern meets with expectations, given the likely importance of maternal resources to calving success and the one-year gestation period in this species.

SC/55/BRG11 presented a project to recover historical photographic identification for Eastern North Pacific (ENP) gray whales, converting this information to digital format, and archiving these datasets for analyses aimed at better understanding changes in reproductive and other population parameters. Once established, the photographic archive will be capable of receiving additional such data generated by ongoing research efforts throughout the geographic range of the population.

The first year objectives of this project are to: (1) rescue and digitise historical photographic identification collections for ENP gray whales obtained from their winter breeding lagoons along the Pacific coast of Baja California, Mexico from 1977 through 1985; (2) set up a digital photographic identification archive and catalogue for ENP gray whales that winter in Mexican waters; (3) develop software to manage, search, sort and match digital photographs for analyses; (4) add to the archive photographic identification data from ongoing studies in the breeding lagoons from 1996 to present; and (5) begin an initial comparison of life history parameters based on historical photographic data with those based on recent data from the same breeding areas.

The sub-committee commented on the importance of this work for understanding trends in biological parameters in this population over time, and strongly endorsed this project.

SC/55/BRG21 described the results of the monitoring project of the 2003 gray whale winter season in Mexican waters. The results showed a general decrease in the numbers of gray whales inside the breeding lagoons during the peak of the season, especially the Bahia Magdalena-Almejas complex. Three four-day aerial surveys were performed in January, February and March along the west coast of Baja California Peninsula showing important numbers of mother-calf pairs distributed outside of the lagoons. This increment in the use of the area outside the lagoons by mothers with calves could explain the discrepancy between the calf production estimates in California and the calf counts inside the breeding lagoons over the last winter seasons.

SC/55/BRG13 reported that the southbound migration of the Eastern North Pacific stock was documented by the National Marine Fisheries Service from 13 December 1997 to 24 February 1998, 13 December 2000 to 5 March 2001 and from 12 December 2001 to 5 March 2002. Research protocol was essentially identical to that used in previous surveys. This involved single observers independently searching for whales and recording data on effort and sighting time, location, count and direction-headed. In 1997/98, there were 2,346 pods (3,643 whales) counted during 435.0 hours of standard watch effort when visibility was recorded as fair to excellent. In 2000/01, a total of 1,694 pods (2,754 whales) were counted during 592.4 hours, and in 2001/02, there were 1,712 pods (2,800 whales) during 531.5 hours. The southbound migrations in 1997/98 and 2001/02 were normal, beginning in mid-December, centred on mid-January (mean date = 18 January 1998 and 15 January 2002) and ending by mid-February. However, in 2000/01 (mean date = 25 January 2001) the migration was more protracted than any other migration observed in the past 25 years, with many whales still travelling south three weeks after the typical end date. Data analysis procedures were comparable to those used in previous years. Abundance estimates were 27,958 whales in 1997/98 (CV = 10.21%; 95% log-normal CI = 22,901 to 34,131), 18,246 in 2000/01 (CV = 9.36%; 95% log-normal CI = 15,195 to 21,910) and 16,848 in 2001/2 (CV = 9.49%; 95% log-normal CI = 13,995 to 20,283). The latter two estimates were well below the estimate in 1997/98, which was the highest estimate since this project began in 1967/68. These low estimates might have been caused by an unusual number of whales that did not migrate as far south as Granite Canyon in these seasons, or the abundance may have declined following high mortality rates observed in 1999 and 2000.

6.1.3 Management advice

Last year the sub-committee carried out an in-depth assessment of the Eastern North Pacific stock of gray whales and agreed that a take of up to 463 whales per year is sustainable for at least the medium term (~ 30 years), and is likely to allow the population to remain above MSYL. No information was presented this year to change that advice. Furthermore, the sub-committee was encouraged to hear that strandings have returned to pre-1999 levels, and that calf production has improved to approximately the mid-range of pre-1999 levels (after low levels in 1999, 2000 and 2001).

6.2 Western North Pacific stock of gray whales

SC/55/Rep4 summarised the results of a Workshop on Western Gray Whale Research and Monitoring Needs, held in Ulsan, Korea, 22-25 October 2002 (published in this volume). The Government of Korea offered to host the meeting, and the US government provided seed money to help to organise the workshop. Brownell obtained additional funding from Exxon, Greenpeace, the International Fund for Animal Welfare, Sakhalin Energy Investment Corporation and the World Wildlife Fund. The Korean Government provided additional support to host the Workshop in Ulsan city.

Topics discussed included: stock identity; migration; distribution; catch history; population estimates; biological parameters; habitat-related problems; population assessment; existing research programmes; and objectives for future research. Specific recommendations and conclusions of this Workshop are summarised below.

(1) Given that a high percentage of calves sighted off Sakhalin have not been documented to return in subsequent years, the Workshop agreed that it would be very useful to match materials from strandings (photographs or tissue samples) to similar data collected by the joint Russian-US long-term research programme off Sakhalin.

(2) The Workshop agreed that minor differences in abundance estimates for this population do not alter the critically endangered status of this population. Precisely establishing absolute abundance was not considered as important as determining survival and population trend (positive or negative). This approach is consistent with that established by the IWC during status reviews for other highly endangered whale populations (e.g. North Atlantic right whales, IWC, 2001b, pp.209-221).

(3) The Workshop recommended that all relevant details of Russian survey effort in 2001, including methods, effort, conditions and results, be made available to the Scientific Committee at its next meeting. In keeping with this request, a paper was submitted to this annual meeting (SC/55/O3), but was not reviewed by the sub-committee. This document should be considered at the next annual meeting.

(4) During the 1990 IWC assessment of gray whales, it was stated 'that it was not useful to apply directly the values of biological parameters from one species to another' (IWC, 1993). The Workshop agreed with this statement, but noted that a key variable, that of pregnancy rate, does provide a useful measure for comparison. For example, in western North Atlantic right whales, there is some evidence that pregnancy rates are related to nutritional status; this may also be the case in both western and eastern gray whale populations. Comparative (inter-specific) studies of this type of issue can provide insights for application to western gray whales. However, it was noted that specific comparisons should be treated with caution.

(5) The Workshop heard an executive summary of industry reports relating to marine mammal mitigation and monitoring for the 2001 Odoptu 3-D seismic surveys off Sakhalin. Exxon-Neftegas was commended for its efforts, some going beyond what was required by law or permit. However, the data upon which conclusions were based were not made available for evaluation. The latter made it impossible to determine if the monitoring effort produced repeatable results, thereby putting interpretation of such results into question. The Workshop recommended that the detailed results of this programme go forward to the IWC Scientific Committee, in as timely a manner as possible, and be submitted to peer-reviewed scientific journals.

(6) Overall, the Workshop agreed with the conclusions of previous reviews on western gray whales. Specifically, that the population is very small, and suffers from a low number of reproductive females, low calf survival, male-biased sex ratio, dependence upon a restricted feeding area, and apparent nutritional stress (as reflected in a large number of skinny whales). Other major potential concerns include behavioural reactions to noise (notably in light of increasing industrial activity in the area), and the threat of an oil spill off Sakhalin which could cover all or part of the Piltun area and thus potentially exclude animals from this feeding ground.

The Workshop noted that assessments of the potential impact of any single threat to the survival and reproduction of western gray whales were insufficient, and strongly recommended that risk assessments consider *cumulative* impact of multiple threats (from both natural and anthropogenic sources). For example, past environmental assessments relating to oil and gas production activities off Sakhalin have assessed the impacts of each project in isolation; this ignores the possible cumulative impact on individual whales of all ongoing industrial projects, which may be further compounded by natural factors such as ecosystem variability leading to inadequate availability of prey.

(7) The Workshop recognised that Sakhalin remains the only known feeding ground for this population, and that neither the migration route nor the location of the breeding/calving ground(s) is clear.

(8) The Workshop agreed that, in addition to international cooperative studies, range states (including Russia, China, Korea and Japan) should organise studies of western gray whales within their respective territories and conduct these as national programmes; a special IWC Scientific Committee working group could coordinate this effort.

(9) Vladimirov summarised plans for a Russian national research programme to be implemented in 2003 and to continue until 2007. He also provided details of a proposed satellite tagging programme for western gray whales. The Scientific Committee and others have previously raised concerns about the use of satellite tags in small, critically endangered populations (notably North Atlantic right whales, IWC, 2001a, p.33) and have recommended that this work be conducted with extreme caution. Given the critically endangered state of the western gray whale, the Workshop agreed with this recommendation. Recalling that at its 2000 meeting (IWC, 2001a, p.33) the Scientific Committee stated:

> In view of the ready access of scientists to subsistence harvested bowheads at Barrow, Alaska, the Committee recommends that implantable tags proposed for use on the North Atlantic right whale be tested on harvested bowhead whales. Appropriate tests could include assessing depth and nature of the wound, extent to which epidermal material is carried into the wound, and the holding strength of attachment devices.

The Workshop urged that objective criteria be established for determining success during the test tagging of eastern gray whales. These criteria should involve both the duration/information yields of the tag and impact on tagged animals.

(10) The Workshop agreed that the principal objectives for future research on western gray whales should be as follows:

(a) Determine population status and trend, through investigation of: (i) abundance; (ii) reproduction; (iii) survival, and rates and causes of mortality; (iv) population composition; (v) effective population size; and (vi) genetic diversity.
(b) Characterise summer feeding habitat in terms of prey distribution and abundance, bottom topography, and physical and biological oceanography.
(c) Identify calving ground in southern Chinese waters.
(d) Determine patterns of habitat use and temporal/spatial distribution on the feeding ground and other portions of the range.
(e) Investigate the influence of human activities on distribution, occurrence, foraging success, reproduction and survival, with emphasis on oil and gas production on the feeding grounds.
(f) Assess the influence of variability in environmental factors such as climatic changes or ecosystem shifts, on distribution, occurrence, foraging success, reproduction and survival.
(g) Assess locations of historical feeding and calving grounds, and migratory pathways, by reviewing historical records (catches and sightings) of western gray whales throughout their range.

As directed in the Terms of Reference, the Workshop updated the 10-year research and monitoring programme developed at the 1999 La Jolla workshop (Brownell, 1999) in the context of the above objectives, and agreed to the tabulation given in Annex D of the report.

It was evident from discussion that substantial differences in viewpoint existed among scientists from the Russian programme, scientists from the Russian-American programme, and industry representatives; these differences related to how the required research should be conducted and how much data should be shared in order for management goals to be met. The Workshop was unable to resolve these issues, but considerable concern was expressed regarding potentially unnecessary duplication of research as well as the impact of such redundant effort on the animals.

(11) The Workshop reviewed recommendations made by the Scientific Committee at its 2002 meeting (IWC, 2003a, pp.47-49). These updates, and additional recommendations made by the Workshop, are given in Table 3 of the Workshop report.

In response to a query, Brownell considered it unlikely that another major feeding area remains undetected. There was considerable Russian aerial survey effort in the costal waters in the Okhotsk Sea in the 1980s (primarily for white, gray and bowhead whales), which is how this population was found.

Despite the recommendation of the report, it does not appear likely that industry findings will be made fully available in the near future. However, working papers from the Korean Workshop are available from the Secretariat.

The sub-committee agreed to adopt the Workshop report and to endorse its recommendations, including the research and monitoring plan. Furthermore, the sub-committee expressed its appreciation to Brownell for his efforts in organising the meeting and to Bannister for agreeing to serve as Chair. The involvement of range state scientists was particularly welcomed.

SC/55/BRG12 described the accidental discovery of a gray whale carcass on 19 March 2002 at Kizakihama beach, Miyazaki City, in the southern part of Japan (31.50°N-131.27°E). The animal was discovered during beach construction. Judging from the bleached condition of the skeleton, it was likely to have stranded several years ago. The carcass was cleaned and prepared by the local museum for future display. Although there were some missing vertebrae and other parts, such as phalanges, the skull was complete and its length was 171.2cm. The total estimated length was 7.7m, based on the known proportion of skull length to body length. Based on this length, the animal was considered to be a juvenile. SC/55/BRG12 also reported that two juveniles were sighted in Suruga Bay in May 2003. The present findings support the hypothesis of Kato and Tokuhiro (1997) that animals passing along the Pacific side of Japan are juveniles.

The animal described in SC/55/BRG12 was mentioned at last year's meeting and the value of a genetic comparison to missing juveniles from Sakhalin Island was discussed. Kato responded that the skeleton is being curated by the local museum and that they might be willing to provide data for this comparison. He offered to make this inquiry to the museum on behalf of the sub-committee.

SC/55/BRG9 summarised the result of attempts to match photographs of gray whales from two geographic locations, the Okhotsk Sea and the western Bering Sea, to a photo-catalogue of 118 western gray whales identified off Sakhalin Island between 1994 and 2002. Despite relatively extensive aerial and ship-based marine mammal surveys in the Okhotsk Seas over the past several decades, sightings of western gray whales are uncommon outside of the feeding ground off northeastern Sakhalin Island, Russia. Sightings of this species in other parts of its distribution, including waters off Japan, North Korea, South Korea and China, are also rare.

On 13 June 2000, a gray whale was photographed off Bering Island in the western Bering Sea. This whale was matched to the aforementioned Sakhalin Island photo-catalogue. On 26 August 2002, the Russia-US research team collected photographs of 10 gray whales in offshore waters of Sakhalin Island, a region approximately 60-65km southeast of their typical survey area. Nine of the 10 whales photo-identified during the survey were matched to the Sakhalin Island photo-catalogue.

Photographic matches of gray whales from Bering Island and offshore waters of northeastern Sakhalin Island, in combination with other supporting evidence (see Weller *et al.*, 2002) including the lack of any appreciable number of sightings from other areas within the known range of the population, support the idea that the western gray whale is very low in number. These findings also suggest it is unlikely that other, yet to be discovered, major concentrations of these whales will be found in the Okhotsk Sea or elsewhere.

Since 1997, ongoing studies of western gray whales have resulted in a photographic dataset that can be used for mark-recapture survival estimation. SC/55/BRG14 provided an update of Bradford *et al.* (2002) presented at last year's meeting, adding one more field season of data and additional models of temporary immigration. Pollock's robust design model was fitted to 116 individual whale encounter histories spanning 22 monthly capture occasions from 1997 to 2002. This model combines Huggins' closed model to estimate capture probability with a Cormack-Jolly-Seber model to estimate survival. Constant non-calf and calf (first-year post-weaning) survival and random temporary emigration that is either constant, group varying (between whales $\geq$2-yr-old and $<$2-yr-old, $\geq$3-yr-old and $<$3-yr-old, or $\geq$4-yr-old and $<$4-yr-old), time varying, or group and time varying were assumed. The effects of various combinations of time, survey effort, and an individual *residency* covariate were examined in models of capture probability. Using AICc model selection, models incorporating individual heterogeneity in residency patterns and higher temporary emigration probabilities for younger whales provided better fits to the data. The best model had a temporary emigration probability of 0.41 for whales aged 1 to 3 years old and 0.15 for whales 4 years old and older. The individual *residency* covariate was included in the 24 best models, indicating that it helped to explain capture probability. As anticipated, capture probability was higher for whales with longer residency times. In other words, the more often whales used the study area, the more likely they were to be encountered. The best model also allowed capture probability to vary by time, and thus capture probability differed between *secondary* sampling periods, but residency pattern was an important factor in determining the capture probability of an individual whale.

Non-calf and calf survival were estimated as 0.952 (SE = 0.0151, 95% CI = 0.912-0.975) and 0.709 (SE = 0.1178, 95% CI = 0.443-0.882), respectively, averaging across the best models (n = 13) in order to account for model uncertainty. Adult survival was slightly higher than previously calculated in Bradford *et al.* (2002), but calf survival was much higher, reflecting the return of several whales first seen as calves but subsequently absent from the sighting dataset until 2002. Given the relatively short duration of the study, these estimates of survival may change

with the collection of additional data, but provide an initial indication of the survival of calves and non-calves in this population.

In discussion, it was noted that SC/55/BRG14 is a very good example of how effectively photo-identification data can be used to estimate demographic parameters. However, given the substantial improvement in calf survival since Bradford *et al.* (2002), it is clear that caution is warranted when drawing conclusions from a relatively short time series.

SC/55/BRG18 estimated abundance of western gray whales off northeast Sakhalin Island, Russia using the same robust design model used in SC/55/BRG14 to estimate survival. Huggins' closed capture estimator was used to estimate the number of individuals annually associated with the study area. However, photo-identification results have suggested that some whales can be absent from the study area during any given field season. Therefore, temporary emigration probabilities estimated from the application of Pollock's robust design model to the photographic dataset were used to estimate the total population size of whales that occurred off northeastern Sakhalin Island. Abundance in the study area in a given year ranged from 52 to 78, and the estimates were only slightly more than the total number of whales identified in the same year, indicating the very high capture probability within a year. Total abundances from 1997 to 2002 were estimated as 61 (SE = 4, 95% CI = 53-72), 74 (SE = 5, 95% CI = 65-85), 85 (SE = 3, 95% CI = 79-93), 77 (SE = 5, 95% CI = 67-89), 90 (SE = 4, 95% CI = 83-99) and 98 (SE = 5, 95% CI = 89-110), respectively, and corresponded very closely with estimates of biennial abundance using a Lincoln-Peterson estimator. The analysis showed that the number of whales using the study area increased over the six-year study, but there was not conclusive evidence that the population was increasing. For comparison, a range of current finite population growth rates were estimated using life history parameters and age-structured modelling techniques. Depending on the combination of life history parameters, the growth rate estimates indicated a much lower rate of increase, about 1% per year using the observed percentage of calves seen, and about 3% per year using the mean observed calving interval. The relatively short duration of the study made it possible that the observed calving interval was biased towards shorter intervals, and there were not enough years to observe many longer intervals, suggesting that using the observed calving intervals could overestimate the rate of increase in the population. Available evidence suggests that aggregations of gray whales are uncommon outside of the study area, and that a high proportion of the western gray whale population passes through the study area over the course of several years. Thus, the abundance estimates presented here (particularly estimates from the later years of the study) may closely approximate the size of the entire western gray whale population.

In response to a query, Wade noted that survival may be underestimated if some animals exhibit extended, but temporary, emigration from the study area. He also speculated that new animals moving into the study area may have been some of those born in 1996 when no field work was performed.

There was some discussion regarding whether it is possible that a population can be maintained at the low levels of abundance indicated in SC/55/BRG18. Members commented that it is not known how long the population has been at its currently small size. Furthermore, Southern Hemisphere right whales were estimated to have once reached even lower levels of abundance than reported in SC/55/BRG18, but have subsequently rebounded. It was also noted that BALEEN II reconstructions in recent years (humpback and blue whale) have indicated minimum population size in the 10s of animals. Therefore, low present abundance does not necessarily indicate a fatal situation for the stock.

The collaborative Russia-US research programme on the western gray whale population summering off northeastern Sakhalin Island, Russia has been ongoing since 1995. SC/55/BRG19 reviewed recent findings from 2002 research activities. Photo-identification research in 2002 resulted in the identification of 76 whales, 92.8% of which were known from previous years, while the remaining whales consisted of 7 calves and 5 previously unidentified non-calves. A vessel survey (discussed in SC/55/BRG9) in offshore waters off northeastern Sakhalin Island identified 10 whales, 9 of which were known from previous years. These results, in combination with data collected between 1995 and 2001, result in a photo-catalogue of 118 identified whales. In tandem with the photo-identification programme, biopsy sampling has also been conducted. A total of 93 (78.8%) of the 118 whales photo-identified have now been biopsied, including 24 of 31 recorded calves. A male biased sex-ratio of approximately 60% males and 40% females exists. When the subset of sampled calves was examined, approximately 67% were male and 33% female. A minimum of 17 reproductive females has been documented. Of the 10 calving intervals recorded for these females, 10% ($n = 1$) are 2-year, 70% ($n = 7$) are 3-year and 20% ($n = 2$) 4-year. Nine 'skinny' whales were observed in 2002. Although this number is lower than in previous years (1999-2001), the persistence of the phenomenon remains of concern.

SC/55/BRG20 presented the planned Russia-US research programme on western gray whales off northeastern Sakhalin Island in 2003. The programme described will continue the ongoing study initiated in 1995, with overall objectives of evaluation of population status, including the health and condition of individual whales, and potential influence of industrial activity on the behaviour and biology of western gray whales. Specific goals of the 2003 programme include: continuation of photo-identification studies, recording calf production and documenting calving intervals for reproductive females; documenting habitat use and locations of primary feeding areas; continued collection of biopsy samples; documentation of the health status of skinny whales by visual assessment; training scientists from other range states (i.e. China, South Korea and Japan) in photo-identification, biopsy sampling and behaviour observation techniques.

With respect to the critically endangered status of the western gray whale population and its questionable future survival, the intent is to continue the ongoing research efforts of the Russia-US programme. The continuous dataset collected since 1995 has provided the current scientific understanding of this population and has also served to increase overall public awareness of western gray whales. Knowledge can be significantly improved by data collected in 2003, especially data on skinny whales, new calves and continued genetic sampling to validate long-term individual identification, determine the sex ratio in the population and examine the relatedness of individuals in the population.

It was noted that IWC funding is in place to support the activities described in SC/55/BRG20.

As in previous years, the sub-committee strongly recommends that the ongoing (1995-2002) Russia-US western gray whale research and monitoring programme

continue and expand into the future, and that the proposed Russian National Programme also be carried out. Results from these two programmes combined will be the only way for assessing the status of this critically endangered population.

To minimise disturbance to the whales, close coordination of research activities is needed. This can be accomplished if researchers keep in close contact with each other when in the presence of whales. Overall, the total disturbance resulting from the combined research activities will be minor compared to other anthropogenic sources of disturbance.

The sub-committee also strongly recommends that other range states (Japan, China and South Korea) develop national programmes on this population.

SC/55/SD4 proposed an international transfer of tissue sub-samples from gray whale products purchased in Japanese markets in 1999 to allow further investigation of stock and individual origins. Between July and October 1999, seven products purchased on two dates in two locations in the Wakayama prefecture were identified as having been derived from one or more female gray whales based on mtDNA control region sequences (Baker *et al.*, 2002). At the time, Baker *et al.* (2002) concluded from the circumstances that the gray whale(s) was/were likely a member of the critically endangered Western stock but noted the uncertainty in genetic assignment when based only on mtDNA sequences. Further, the authors noted the possibility that the products were attributable to a gray whale reported as 'stranded' near Suttsu, Hokkaido in 1996, and later shown to have been harpooned and flensed (Brownell *et al.*, 1999). Specific objectives are: (1) to investigate the issue of stock origin of the Wakayama products by transferring a sub-sample of these products to the Southwest Fisheries Science Center (SWFSC) of the US National Marine Fisheries Service, for comparison to reference samples from the Western and Eastern Pacific gray whales; and (2) to resolve the individual identity of the Wakayama and Suttsu whale(s) through transfer of sub-samples of the Wakayama products to the Fisheries Agency of Japan. The SWFSC holds samples from 93 of the 118 known individual gray whales of the Western stock from surveys since 1995 and is in a unique position to confirm stock origin of the Wakayama samples by assignment tests using allele frequencies of microsatellite loci from both Western and Eastern stocks as a baseline. The Fisheries Agency of Japan is reported to hold a sample of the Suttsu gray whale (Brownell *et al.*, 1999) and is in a unique position to confirm identity or non-identity of the Suttsu whale with the Wakayama samples by microsatellite genotyping. Transfer to both institutions will allow third party validation of any results. Export or import of the whale tissue via a transfer to the Secretariat will require permits issued by Japan, the UK and the US under provisions for scientific exchange of the Convention on International Trade in Endangered Species (CITES).

In the discussion, Nagatomo stated that Japan's position is that this is a domestic issue. Therefore if some illegality is alleged or some interesting evidence is available, the relevant authority of the Government of Japan should be notified before reporting these to an international organisation. The Government of Japan will investigate it, and pursue the matter according to Japan's domestic law. His belief was that this kind of political argument is not appropriate for this scientific meeting, as other members have insisted.

The sub-committee recommends that the proposed investigations be carried out, and encourages the relevant governments to facilitate the transfer of specimens between laboratories. The sub-committee decided not to express an opinion on whether the IWC Secretariat should be involved.

7. WORK PLAN

The following work plan was proposed for the coming year.

(1) The sub-committee agreed that the planned in-depth assessment of the B-C-B Seas stock of bowhead whales had the highest priority for its work in 2004.
(2) The sub-committee also plans to review new information on the Eastern North Pacific stock of gray whales to be able to advise the Commission as requested in Schedule 13(b)(2).
(3) To the extent that the allocated time will allow, the sub-committee plans to discuss new information on small stocks of bowhead, gray and right whales.

8. ADOPTION OF REPORT

The report was adopted at 11:00 on 1 July. On behalf of the sub-committee, the Chair expressed thanks to the two rapporteurs, especially Robbins, for their hard work. The sub-committee expressed its appreciation to Walløe for chairing the meeting.

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Appendix 1

AGENDA

1. Convenor's opening remarks, election of Chair and appointment of rapporteurs
2. Adoption of agenda
3. Review of available documents
4. Bowhead whales
   - 4.1 B-C-B Seas stock of bowhead whales
     - 4.1.1 New scientific information
     - 4.1.2 Catch information
     - 4.1.3 Management advice
     - 4.1.4 Preparation for in-depth assessment
   - 4.2 Davis Strait/Baffin Bay and Hudson Bay/Foxe Basin bowhead whales
     - 4.2.1 New scientific information
     - 4.2.2 Catch information
5. Right whales
   - 5.1 North Atlantic right whales
   - 5.2 North Pacific right whales
   - 5.3 Southern right whales
6. Gray whales
   - 6.1 Eastern North Pacific gray whales
     - 6.1.1 Catch and stranding information
     - 6.1.2 New scientific information
     - 6.1.3 Management advice
   - 6.2 Western North Pacific stock of gray whales
7. Work plan
8. Adoption of report

Appendix 2

CURRENT LISTING OF DNA SAMPLES AVAILABLE FOR CERTAIN BOWHEAD WHALE POPULATIONS

The issue of possible sub-structure within the B-C-B Seas stock was discussed at some length in the meeting. Members agreed that it would be useful to provide a table with approximate numbers of genetic samples and their disposition. Note that the samples from the North Slope of Alaska were collected by NSB Dept of Wildlife Management and distributed to the institutions below.

Listing of available genetic samples and sequence data (Gen Bank databases) for bowhead whales from the Okhotsk Sea (OS), Bering-Chukchi-Beaufort (BCB), Davis Strait (DS) and Hudson Bay (HB) stocks.

Stock	Collection location	Institution - disposition	Season collected	Sample size	References
BCB	Barrow, SL Island	TAMU; GenBank	Spring, Autumn	108	Rooney (1998); Rooney *et al.* (1999); Rooney *et al.* (2001)
BCB	Barrow, SL Island, Kaktovik, Pt. Hope	NSB-TAMU	Spring, Autumn	~100	Archived tissue samples; not analysed
BCB	Barrow	SWFC	Spring, Autumn	29	LeDuc *et al*. (1998)
BCB	Chukotka	SWFC	Summer, Autumn	12[a]+~10[b]	LeDuc *et al*. (1998); Brownell (1997)
OS	Shantar Islands	SWF-TAMU - GenBank[c]	Summer	91	LeDuc *et al*. (1998); MacLean (2002)
DS	Disko Bay; Cumberland Sound	DFO FWI, Winnipeg	Spring, Summer	71[d]	SC/55/BRG17 (includes Postma; Dueck; Heide-Jorgensen)
HB	Foxe Basin; Pelly Bay; Repulse Bay	DFO FWI, Winnipeg	Spring, Summer	191[d]	SC/55/BRG17 (includes Postma; Dueck; Heide-Jorgensen)

Abbreviations: TAMU = Texas A&M University, College Station, TX; SL Islands = St Lawrence Island; NSB = North Slope Borough, Barrow, AK; SWF = NMFS SW Fisheries Science Center, La Jolla, CA. [a]Includes baleen and skin samples (~1970-present); [b]10 bone samples from old specimens ('Whale Bone Alley'); [c]GenBank accession numbers: AF355204 - AF355271; [d]See table 2 in SC/55/BRG17 for the specific location where these samples were taken.

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