Annex G

Report of the Sub-Committee on In-Depth Assessments

Members: Palka (Convenor), Acquarone, Apostolaki, Baba, Bannister, Best, Borodin, Bøthun, Brandao, Bravington, Butterworth, Charrassin, Chilvers, Choi, Cipriano, Cooke, De Decker, de Moor, Double, Ensor, Findlay, Fujise, Gales, Gallego, Goodman, Goto, Gunnlaugsson, Hakamada, Hammond, Hatanaka, Hayashi, Hedley, Holloway, Hughes, Ilyashenko, Iñíguez, Jaramillo Legorreta, Johnston, Kanda, Kaschner, Kasuya, Kasuya, Kato, Kelly, Kishiro, Kitakado, Kock, Leaper, Lens, Liebschner, Lockyer, Lovell, Lyrholm, Matsuoka, Mikhalev, Miller, Miyashita, Morishita, Muller, Murase, Øien, Okada, Okamura, Pastene, Polacheck, Punt, Robbins, Rosenbaum, Siciliano, Skaug, Tamura, Uoya, Uozumi, Vasquez, Walløe, Williams, Yamakage, Yasokawa, Young, Zerbini.

1. ELECTION OF CHAIR

Palka welcomed everyone to the meeting and was elected Chair.

2. APPOINTMENT OF RAPPORTEURS

Cooke, Hedley, Leaper and Polacheck agreed to act as rapporteurs.

3. ADOPTION OF THE AGENDA

The adopted Agenda is given in Appendix 1.

4. DOCUMENTS AVAILABLE

The documents relevant to the work of the sub-committee were SC/61/IA1-21; SC/61/Rep7; SC/61/Rep9.

5. SOWER CRUISES

5.1 Report from the Tokyo Planning Meeting for the 2008/09 IWC/SOWER cruise

The planning meeting for the 2008/09 IWC/SOWER cruise and future cruises was held in Japan in September 2008 (SC/61/Rep7). The meeting reviewed the Scientific Committee's discussions at SC60 and noted that several ideas had been investigated, including possible collaboration with Australian and/or German sea ice research programmes and the commencement of a fourth circumpolar survey. However, due to logistic constraints these collaborations were not considered possible for 2008/09. The meeting agreed that the highest priority should be given to work investigating changes in Antarctic minke whale density with respect to ice recession. It was also agreed to undertake a combination of line transect survey and the collection of individual identification data (biopsy/mark-recapture). The objective was to combine some feasibility aspects (especially with respect to the biopsy/mark-recapture effort) with the ability to undertake combined analyses with data collected the previous year. The line transect would focus on BT Option II mode and SS-II mode (closure when abeam) while the Antarctic minke whale biopsy/photo-identification work would also provide an opportunity to carry out some preparatory work with respect to telemetry studies. Other objectives included continuation of research on blue, humpback and southern right whales as in previous years.

5.2 Results from the 2008/09 IWC/SOWER cruise

The cruise was conducted in Area IV aboard the Japanese Research Vessel, *Shonan Maru No.2* (SC/61/IA19). The planned research area, spanning 105°E-115°E, was selected to be the same as the 2007/08 SOWER cruise. However, AMSR-E satellite ice images indicated a paucity of pack ice. This information combined with a prediction of pack ice dynamics, led to the decision to modify the research area further west. A total of 1,441nm was covered during four repeat surveys which extended from the pack ice edge to a common northern boundary, and in two survey modes (SS-II mode and BT-Option II mode). The total number of minke whales sighted during the entire coverage of the research area was 49 groups comprising 56 animals. Biopsy samples and individual identification photographs were collected from 4, and 15 minke whales, respectively. No substantial southward recession of the ice edge was observed during the survey period. Thus, the objective of observing patterns of whale distribution in relation to ice recession was not possible. The AMSR-E satellite predictions of sea ice indicated extensive areas with low ice cover (0-3%) within the pack ice zone in the research area. However these areas were inaccessible for survey as they were south of the observed ice edge. Seven groups, comprising 17 Antarctic blue whales were sighted during the cruise, with biopsy samples from 6 blue whales and identification photos of 12 individuals. Acoustic recordings were conducted at a total of 25 stations using sonobuoys, and sounds attributed to Antarctic blue whales were recorded. Humpback whales were the most frequently sighted species with 373 groups comprising 682 animals observed. Biopsy samples were collected from 23 humpback whales and photo-ID images were obtained of 74 whales. By number of animals, killer whales were the second most frequently sighted species in the research area with a total of 255 animals observed (21 groups) with Types A, B and C seen. There was only one opportunity for a trial approach to test the feasibility of approaching minke whales close enough for potential deployment of telemetric devices, and the outcome was unsuccessful. Multiple re-surveys in the same research area were accomplished during this cruise and thus it was possible to monitor temporal changes in spatial distribution of whales within a season. Considerable research effort was also achieved on the transits between the home port of Benoa, Indonesia and the Antarctic research area.

The sub-committee thanked the Government of Japan for once again generously providing the vessel and crew for the SOWER programme. Appreciation was also expressed for the work of all involved, including the steering committee, cruise leader, researchers and crew.

It was noted that there were no sightings of right whales during the cruise. Ensor suggested that the distribution of right whales may be further to the east based on sightings from previous cruises, although one had been seen in the Prydz Bay area (further west). One possible explanation suggested for the low number of minke whale sightings was that minke whales may have been distributed further south than the ice conditions would allow the vessel to survey. Visual estimates of the size of whales observed during the cruise suggested that the whales seen were small which could be an indication that the survey was observing the more northerly distribution of the population. There were considerable discrepancies encountered during the cruise between the ice conditions observed from the survey vessel and AMSR-E satellite data. Ensor noted that representative photographs had been taken of the ice edge which could allow further analyses towards resolving differences between ice coverage as collected by the ship and satellite.

Collection of biopsy samples and satellite telemetry trial approaches to minke whales proved difficult on the cruise and it was noted that more time would need to be allocated to collect sufficient samples for mark-recapture type analyses. The small animals encountered and poor water colour made it difficult to slowly approach whales for telemetry trial attachments and collection of biopsy samples. Approaches to larger animals in larger groups may be easier, but overall it was felt that conditions during the 2008/09 were not unusual.

5.3 Results from previous IWC/SOWER cruises

On the last three SOWER cruises, experiments were conducted that used photogrammetric systems to measure angles and distances to sightings and to document observer's search patterns. SC/61/IA13 described results that emphasised angle measurements from the 2008/09 survey. Downward pointing digital cameras were used to measure bearings to sightings and search patterns of observers. Estimated and measured bearings were obtained for a total of 62 sightings, mainly of humpback whales. These suggested little bias in angle estimation and a root mean squared error of 4.9°. These errors are similar to other studies where similar angle measurements have been made and suggest errors in angle estimation may be almost as important as errors in distance estimation for calculation of perpendicular distances. During BT mode, observers were instructed to search within the sector 60° on either side of the trackline. Results showed that observers spent 80% of their time searching within 34° of the trackline and 5% of the angles were greater than 50°. This indicated a slightly wider search area than indicated by a similar experiment on the 1983/84 IDCR survey.

In addition to the ultimate goal of measuring angles and bearings with minimum error, analyses of the errors in angles and distances during SOWER cruises are important for interpreting the results of different analyses. In particular, different analytical methods based on perpendicular or radial distance methods differ in their sensitivity to angle and distance error. These estimates of angle and distance error from SOWER cruises could also be incorporated in simulated data sets.

It was noted that in additional to the 1983/84 cruise, there are additional data on search patterns of observers (Kasamatsu 1986), including modelling work on human perception and the mechanisms of the detection process (Doi 1974; Doi *et al.* 1981).

Comparisons of the distribution of observed angles of sightings with observer search effort can be informative, for example as a potential indicator of responsive movement prior to detection. In addition, knowing that observers are scanning the appropriate sectors is important for the BT method, particularly in the case of rapid responsive movement.

The sub-committee encouraged further data collection and analysis of angle measurement error and scanning patterns of observers on future SOWER cruises.

SC/61/IA12 summarised the data collected on minke and humpback whales in IO mode and BT-option 2 mode during the 2007/08 SOWER cruise. Given the small numbers of minke whales detected, only a crude estimate of abundance for minke whales was presented. Using the BT-option 2 mode data, the estimate of minke whales was 1,123 animals (CV=0.44). The estimate of humpback whales from the IO mode data was 4,885 animals (CV=0.2) which was nearly twice the estimate obtained from the BT-option 2 mode data. This was mainly due to a higher encounter rate obtained in IO mode; sightings from observers on three platforms were included whereas in BT-option 2 mode sightings from only one platform were included. This cruise was the first cruise to implement BT-option 2 as a survey methodology on systematic tracklines. This analysis provides an opportunity to inform future SOWER in regard to the utility of the methods. The cruise was also the first cruise in the series to re-survey a given research area in the same season providing the opportunity to investigate temporal changes in the spatial distribution of whale species. However, a complication was that different research modes were used during the initial survey and the resurvey time periods.

There was limited discussion of this paper because the first author was not able to be present. Questions were raised including the choice of model selection criteria and the inclusion of data from different platforms in the analyses. These issues may affect some of the conclusions of the paper, but were not discussed in detail.

5.4 Results from other Antarctic cruises

Following a successful pilot study in 2006 the German research vessel *Polarstern* conducted a cetacean sighting survey in the Southern Ocean using helicopters in December 2008 (SC/61/IA11). Two transects were covered: the first more westerly one started at 57° S 00°40' E and went to Atka Bay (70°30'S 07°58'W) whereas the second (return leg) followed a more easterly course. No observations could be conducted from 63°S to 57°S on the return cruise due to fog and swell. Standard line transect survey protocols were followed when the helicopter flew predesigned track lines. A key objective was to survey the distribution and abundance of minke whales in the pack-ice. Helicopter tracklines covered a total of 6321 km. Environmental information, including proportion ice coverage, was collected continuously. A total of 24 sightings of 28 minke whales were recorded with a maximum group size of 3. In addition 5 southern bottlenose whales and 1 killer whale were sighted within the ice.

The sub-committee welcomed these efforts to survey minke whales in sea ice habitat. The timing of the surveys was limited by operational constraints and surveys later in the season may have been preferable if this had been possible. The sub-committee noted that the data collected demonstrated the value of helicopter surveys of sea ice habitat and that further analyses were planned including incorporation of sea ice covariates. The ability of helicopters to fly slowly also offers opportunities to confirm species and school size. In addition, previous Committee discussions have noted the value of understanding the age-structure of whales in relation to sea ice. The potential for helicopter surveys to measure lengths using photogrammetric methods was noted. Kock noted that the animals observed were believed to be adults and that some photographs were available which could potentially be analysed to estimate lengths.

Following on from test flights undertaken in 2008, a pilot aerial survey for Antarctic minke whales was conducted by the Australian Antarctic Division in sea ice in Vincennes Bay, East Antarctica, throughout a 20 day period in December 2008 (SC/61/IA3). The survey was completed using a fixed-wing aircraft flying from a base at Casey station. The survey was double-platform, with two observers on each side of the aircraft. A total area of 60,600 km^2 was surveyed with parallel transects at 10 nautical mile spacings and orientated north-south. The survey covered 6,293km on effort (a number of transects were repeated) in 41 hours of flying (over nine days). Around 76 Antarctic minke whales were observed, in 53 sightings, with group size ranging from one to four. A preliminary estimate of minke whale abundance in Vincennes Bay and a comparison to a minke whale abundance estimate from the most recent nearby IWC/SOWER voyage (2007/08) were offered, but these were accompanied by strong caveats indicating there may be little value in these numbers. Despite this, minke whales were observed in pack ice in Vincennes Bay, but it remains to be seen if these numbers can be considered substantial.

There was some discussion about whether the aerial survey was in fact conducted over 'inaccessible' pack ice or if the Vincennes Bay was ice-free enough, particularly at the end of December, to allow access to non-ice strengthened vessels, such as the SOWER vessels. It appeared from AMSR-E data that the area was free of sea ice, but ice was still observed from the aircraft. This discrepancy points to a limitation in scale of the

AMSR-E sea ice data. Unfortunately, it is unknown at this time whether SOWER vessels could have accessed the Vincennes Bay area, but this information will likely be available when digital still images taken beneath the aircraft are analysed. After completion of both test flights and a pilot study, the utility of the CASA-212 aircraft for aerial survey studies of minke whales in Antarctica has been demonstrated. A limitation of the analysis in SC/60/IA3 were the assumptions about the availability of minke whales at the surface required to estimate g(0). Currently more data are needed to refine these assumptions and telemetry studies are planned. It was noted that minke whale surfacing behaviour may be affected by the presence of killer whales.

5.5 Recommendations for the 2009/10 season

Continuing on from the small-scale aerial survey for minke whales undertaken in east Antarctica described in SC/61/IA3, the Australian Antarctic Division is planning another aerial survey in the 2009/10 summer season (SC/61/IA4). As in previous seasons, this aerial survey will be flown using fixed-wing CASA-212 aircraft and will be double-platform on each side of the aircraft. The survey has two aims: to test the hypothesis that Antarctic minke whales occur in significant numbers within sea ice inaccessible to research vessels; and to provide data to model their distribution relative to sea ice habitat. It is planned that the 2009/10 aerial survey will be split into three phases in order to address a number of different hypotheses about the relationship of Antarctic minke whales and sea ice in east Antarctica; this survey will also span nearly 20° of longitude. The first phase, scheduled for December, 2009, will be a repeat of the aerial survey undertaken in Vincennes Bay and will cover around 5,000 km of transect effort. This first phase will allow a between-year comparison of whale abundance and distribution in the Vincennes Bay area. The second phase, scheduled from late December 2009 to mid-January, 2010, will shift survey effort north into the eastern section of Davis Sea and will cover around 4,700 km of transect effort. Historically, whale research voyages such as IDCR/SOWER have surveyed in this area but have not been able to access the Davis Sea or the polynias that open up around the Shackleton Ice Shelf. In the third phase, scheduled to run from mid-January to early February, 2010, survey effort will return to the Vincennes Bay area and will cover around 5,500 km. This last phase will allow an intra-season comparison of whale abundance and distribution.

The sub-committee noted that it would be of great benefit if cetacean shipboard research vessels could also be surveying in open water around Vincennes Bay/Shackleton Ice Shelf region simultaneous to the aerial survey. This would enable direct comparison of observed minke whale densities. However, it is not known at this time whether this would be feasible.

The Committee has had extensive previous discussions of the effect of minke whales in the sea ice on the differences between abundance estimates from CPII and CPIII. The sea ice working group has been trying to develop models of minke whale abundance in the ice. The recent aerial surveys will help to understand minke whale abundance in sea ice habitat and analyses are planned using available sea ice covariates. However, these covariates may not be available for direct modelling of historical data from previous SOWER cruises. The sub-committee recommended that the IWC/SOWER 2009/10 cruise should take advantage of the planned Australian aerial survey and consider collaborating with the Australian aerial survey to continue its investigation of the distribution of minke whales in relation to sea ice. The sub-committee also considered an alternative plan should be developed in case the cooperative study proved to be impractical.

An additional proposal for the SOWER research vessel to survey a region in the northern part of Area IV, from 55ºS to 60ºS was presented (SC/61/IA15). A working group under Best was formed to recommend specific objectives and to discuss details needed to conduct the 2009/10 IWC/SOWER cruise (Appendix 2). The sub-committee endorsed the working group's report and recommended that the inquires suggested in Appendix 2 be made as soon as is possible to confirm the logistic details, particularly those with a financial implication.

6. ANTARCTIC MINKE WHALES

6.1 Abundance and trends

6.1.1 Report from intersessional workshop

SC/61/Rep9 was the Report of the SOWER Abundance Workshop held in St Andrews, Scotland, from 7-10 April, 2009. Following on from a similar Workshop held in the previous intersessional period in Seattle (SC/60/Rep4), the aim of this second Workshop was to facilitate the completion of the analyses of Antarctic minke whale data from the CPII and CPIII IDCR/SOWER surveys. Two external reviewers were invited to attend (Borchers and Buckland), to provide comments on, *inter alia*, the three new models being developed to analyse the data (Bravington's SPLINTR model, Cooke's Integrated Model (IM), and Okamura and Kitakado's hazard probability OK model), the adequacy of the diagnostics to be able to assess lack of fit from any of these models, and the results from applying these models to the IWC simulated data sets.

The Workshop also provided the opportunity for the model developers to interact and discuss if or how their models had changed since SC60. Feedback on the preliminary results from fitting the models was received, and substantial progress was made in specifying diagnostics to be presented at SC61. New results estimating *g*(0) from the BT experiment conducted on recent SOWER surveys were presented, and a method for estimating additional variance when computing circumpolar estimates was agreed. Resulting from these discussions, Kitakado distributed a program to each of the developers shortly after the Workshop to enable them to estimate the additional variance.

6.1.2 Abundance estimation methods

This year, the sub-committee was pleased to receive two papers (SC/61/IA6 and SC/61/IA14) reporting estimates of Antarctic minke whales from the second and third circumpolar IDCR/SOWER surveys (CPII and CPIII). In addition, SC/61/IA10 directly arose from discussions at SC60 where concerns about the parametric form used in the hazard probability model (Okamura and Kitakado 2008) had been expressed.

SC/61/IA6 described the OK hazard probability model, and presented abundance estimates of Antarctic minke whales from applying this model to the IDCR/SOWER data. The authors noted three changes in the model described this year as compared with the version in Okamura and Kitakado (2008) presented at SC60. Firstly, cue detection probability was now formulated on radial distances and sighting angles, rather than forward and perpendicular distances. This was expected to improve the fitting (for further details, see SC/61/IA10). Secondly, the mean school size parameter was now stratum-dependent, increasing flexibility as compared to the previous version which had been Area-dependent. This modification was expected to better reflect spatial variation in mean school size at the stratum level. Thirdly, detection functions were estimated separately for each Area and circumpolar set. This was intended to make any [Area-specific] differences between CPII and CPIII more apparent. In all other respects, the basic structure of the model was unchanged. The authors concluded that the new model formulation resulted in improved fits in the diagnostics plots. In particular, the new handling of mean school size was considered more suitable in terms of modelling school size variation by stratum. Total abundance was estimated as 1,287,000 (CV: 0.202) for CPII and 688,000 (CV: 0.182) for CPIII.

SC/61/IA10 compared the sensitivity in estimated effective strip half-width with respect to choice of hazard probability function (Q). The model was fitted under different erroneous assumptions about the parametric form of Q, using a parameter setting which is relevant to minke whale sighting surveys both in the Antarctic and in the Northeastern Atlantic. It was found that the hazard probability model is fairly robust. The largest observed bias in the estimated effective strip half-width was around 8%, while for most situations there was almost no bias.

SC/61/IA14 described the SPLINTR (SPatial Line TRansect) method for spatial modelling and abundance estimation from IDCR/SOWER data, and presented estimates of Antarctic minke whales obtained from SPLINTR. There are four main statistical components in SPLINTR: (1) estimation of detection probability as a function of school size, sighting conditions, and perpendicular distance, assuming Trackline Conditional Independence (TLCI; Laake 1999; Laake and Borchers 2004); (2) allowance for possible school size under-estimation in IO mode, using a binomial model; (3) spatial variation in school size, using smooth polytomous regression to control the mean of a nonparametric frequency distribution for school size; and (4) spatial variation in school density via a soap-film smoother (Wood *et al*. 2008), with sighting probability computed from the previous steps, and with fine-scale local clustering of schools modelled via a Markov-modulated Poisson Process (Skaug 2006). Although very preliminary results from this method were shown at SC60, there have since been a number of changes to SPLINTR, primarily in the TLCI aspects. The authors considered that the diagnostic plots for distance-sampling aspects looked generally good. The soap-film smoother in SC/61/IA14 was designed specifically to both handle the strangely-shaped boundaries found in the Antarctic, and to avoid the log-linear extrapolation that standard smoothers exhibit. Indeed, the estimated density surfaces seemed plausible, without the problems of unlikely-looking extrapolation in regions of poor coverage that some spatial models of line-transect data have shown in the past. For the 2003/04 survey in Area V, though, the density surface seemed insufficiently flexible to cope with the very strong peak in density; the authors believed that a finer spacing of knots in the smoothing construction would resolve this, but noted that there had not been time to try this before the meeting. Total abundance was estimated as 747,000 (CV: 0.13) for CPII and 461,000 (CV=0.09) for CPIII.

As these methods had been presented to the SC previously, the discussion focussed on evaluating the diagnostics of the new models and in trying to explain the reasons for the differences in the estimates from the two papers. In this regard, it was considered important to focus on the two fundamental differences between the models: (i) in the way that detection probability (and associated parameters) are estimated – the OK model uses a two-dimensional cue-based hazard probability model which assumes independence in the probability of detecting a particular cue, whilst SPLINTR uses a detection probability model based on perpendicular distances to sightings, and assumes detections are independent on the trackline; and (ii) in the way that density is estimated – the OK model uses a Horvitz-Thompson-like stratified approach, whilst the SPLINTR model uses spatial modelling.

The sub-committee examined the diagnostics from the two methods in detail. It was noted that for most of the specified diagnostics, both the OK and SPLINTR models fitted the data well, with the following exceptions:

- The radial distance fits (disaggregated by CP series and vessel) from the OK model showed some substantial underestimation of numbers seen at small radial distances.
- The predicted number of duplicate sightings at small perpendicular distances from the OK model was generally too high.
- The spatial model fitted by SPLINTR to the 2003/04 data (Area V) appeared to predict too many whales in one region of the Ross Sea, compared to the observed sightings in that region.
- The fits to perpendicular distances by SPLINTR (and to a lesser extent, OK) failed to capture the observed spike in the data at very small distances.

The sub-committee noted that, because of the ways that the components of both models were inter-dependent, the resultant effect on the abundance estimates from lack-of-fit to the diagnostics was not necessarily easy to infer. Specifically, discrepant diagnostic fits do not necessarily imply serious bias in estimation. It was agreed that these discrepancies on their own may not necessarily be of sufficient concern to fail to adopt the estimates in either paper. However, the fact that the point estimates between the two different approaches were so different meant that further detailed examination of the methods was necessary (see below).

6.1.3 Simulated datasets

As reported previously (e.g. Palka and Smith 2005), in order to evaluate the new methods being developed to analyses the IDCR/SOWER data, some simulated datasets have been produced. These datasets were intended to capture – at least partially – the complexities of the real IDCR/SOWER data, and to examine the robustness of the new methods to various factors which may affect abundance estimation. Noting how useful these had been for both assisting with model development, and with examining differences between the methods, the sub-committee thanked Palka for her tremendous efforts in providing these datasets.

SC/61/IA7 presented a summary of results applying the OK method to the simulated data, where the authors used a slightly simplified model of that used in SC/61/IA6. Specifically, for analyses of the simulated data, a constant true mean school size was assumed, while for the IDCR/SOWER analyses, true mean school size was modelled as a function of distance from ice edge and with a W/E stratum effect. Furthermore, for the simulated data analyses, the covariates of the detection function were simplified (e.g. there was no vessel covariate), and the confirmation status probability component was not used (because the confirmation status was not provided probabilistically at least for the earlier scenarios). The authors of SC/61/IA7 considered that the density estimates showed slightly more bias in general compared with their previous model (Okamura and Kitakado 2008), but that the model fits were better. They concluded that the OK model was still performing satisfactorily, that is, the model could provide near-unbiased density estimates under various uncertainties and heterogeneities, except for the cases with high rates of duplicate mis-identification.

Results from applying the IM (Cooke 2009), OK, SPLINTR and IWC 'standard' analysis method (Branch, 2006) to IWC simulated datasets were presented (SC/61/IA9). These datasets incorporated biases due to heterogeneity in factors related to the distribution, density and behaviour of minke whales and to the manner in which the sightings surveys were conducted. The mirror-image fold-over partial factorial design of the simulation scenarios allowed ANOVAs to be used to investigate model robustness to individual factors contained in datasets. The ANOVAs indicated that the estimates from the SPLINTR model were generally less biased than those from the OK model for the more complex scenarios, and vice versa for the less complex scenarios. The direction and level of bias for each model varied for both models by scenario, but the SPLINTR model was consistently negatively biased in the less complex scenarios. The scenarios where the estimates from the OK model were higher than those from the SPLINTR model were in general those scenarios with unmodelled heterogeneity, specifically those scenarios which contained the following factors: (i) detection probability dependent on cue; (ii) complex interactions between school size, weather and density gradients; and (iii) non-synchronised diving.

The sub-committee considered whether the difference in the OK and SPLINTR estimates from the real data was also reflected in the simulation results. For this purpose, it was noted that an iteration-by-iteration examination of results was necessary; averaging the results for a particular scenario across the 100 iterations may obscure any such difference. This investigation revealed that for the more complex scenarios, the difference between estimates from the two methods could be large and was highly variable; for the less complex scenarios there was generally less variation, but the difference could still be large. In most cases, the estimates from the OK model were higher.

Noting the high levels of bias from both SPLINTR and OK models when duplicate mis-identification was a factor in the simulations, the St Andrews Workshop had requested that the developers include, as a sensitivity test, abundance estimates with 'Possible+Definite' duplicates in addition to the baseline case of just 'Definite' duplicates. The authors of SC/61/IA6 completed this request; the results indicated that it made little difference. The sub-committee agreed that the levels of duplicate mis-identification present in the simulated datasets are therefore likely to be much higher than is actually present in the real data.

It was pointed out that although where available, the existing IDCR/SOWER data had been used to make the simulation scenarios similar to what was observed on the surveys, for some parameters there had been little data available at the time the datasets were produced to condition the parameters. New data are now available that could be used to either parameterise the scenarios differently or to be used in creating new scenarios. At this point, there were no specific requests for either different conditioning or new scenarios, but Palka indicated that it would be possible to add more scenarios if required. This matter was referred to the intersessional working group (see item 6.1.6), but it was noted that were any further work needed, specifications would have to be supplied to her by the end of August 2009.

The results in SC/61/IA9 had focussed on assessing bias in the point estimates of density from the methods. The ability of the models to estimate variance has not yet been tested. The sub-committee recommended that a limited amount of testing should be done intersessionally, and it was suggested that one of the existing scenarios be used to do this. Specific details of how this should be done were referred to the intersessional working group.

6.1.4 Differences between estimates from OK and SPLINTR

Taking the diagnostics together with the simulation results, it was clear that there was no simple answer to the reasons for the difference in the estimates. A 'top-down' approach was suggested for examining the models more closely. Thus, the sub-committee agreed to focus initially on comparisons between the effective strip widths for whales (esw_W) for each model. This component of the estimation includes estimation of (true) school size, detectability and *g*(0), so deviations from expected values of this parameter, and/or large differences in its value between models, would indicate avenues for further investigation. Alternatively if there were no discernible differences in esw_W, then this would imply that the differences in estimates from the two methods must arise from the difference between the stratified and spatial modelling approaches to density estimation.

A preliminary analysis was presented to assess the influence of spatial modelling on the estimates compared to the stratified approach, all other aspects being equal. It concluded that differences between the estimates from the OK and SPLINTR model could largely be attributed to the model-based approach taken in the latter. The approximations necessary for this calculation were, however, quite broad, with several confounding effects. Noting that this conclusion might change if a more direct comparison of the density-estimation component of the models were possible, the sub-committee recommended that the SPLINTR model be fitted with a uniform density within each stratum to assess this.

Although most discussions concerned differences between the OK and SPLINTR models, it was also noted that while the *g*(0) estimates from SPLINTR were well below one for small school sizes, the abundance estimates from SPLINTR were not much larger than those from the 'standard' IWC method (e.g. Branch 2006), where *g*(0) is assumed to be 1 – with consequent negative bias. However, because of spatial correlations between school size, school density, and good sighting conditions in the IDCR/SOWER surveys, the authors of SC/61/IA14 considered that these would cause positive bias in the 'standard' method but not in SPLINTR.

6.1.4.1 EFFECTIVE STRIP WIDTHS FOR WHALES, esw_W

Tables of esw_W were presented for each method for comparison. For the OK model, estimation of esw_W includes estimation of Area-specific parameters within CP series, as well as vessel, school size, and Beaufort factors. The sub-committee noted that, *a priori*, detection probability would not be expected to vary by Area, assuming sightability, school size and other effects were affecting detectability in similar ways, and the variability evident made Area-specific comparisons between CP series difficult to interpret. The formulation introduced high variability in the estimates of esw_W and was primarily introduced for computational reasons, following a recommendation at SC60 to estimate mean school size by stratum. The sub-committee noted that this new formulation had indeed resulted in more variation of mean school size by stratum compared to the results presented previously (Okamura and Kitakado 2008), but there was concern expressed that the resulting variability induced in the esw_W estimates was more than could be explained by sampling variation. If this variability represented 'truth', then it would imply that there was some other factor causing such variation that was not recorded in the data. The sub-committee considered that it was unlikely that unmodelled effects could account for the extent of variation that was observed. Furthermore, in some Areas, the esw_W estimates were extremely low, particularly for small school sizes. It was noted that this concern would not have been strongly highlighted by the results from the simulated data because large sample sizes in those datasets allowed more precise parameter estimation. As an initial, clear visual check on the impact of the esw_W estimates on abundance estimates, the sub-committee recommended that a scatterplot of esw_W against density by stratum be produced. Additionally, while it was recognised that this may be impractical due to computational difficulties, it was recommended that ideally, the OK analysis be refitted excluding Area-specific parameters for esw_W.

There was little discussion on the esw_W estimates produced from the SPLINTR model, except to note that these estimates were calculated at a circumpolar survey level, taking into account vessel, school size and either Beaufort or Sightability effects. On a philosophical modelling level, the sub-committee considered that this approach was preferable. The estimates showed some variation by Beaufort, but the effect was quite small (for CPII). For CPIII, Sightability was included as a covariate so the estimates were not directly comparable with the OK results, but more variation between 'good' and 'poor' Sightability was observed.

6.1.4.2 INDEPENDENT COMPARISONS

SC/61/IA18 presented updated analyses of BT mode experiments conducted on the IWC-SOWER surveys in 2005/06-2007/08. One reason that these experiments were suggested was to provide an independent comparison of *g*(0) for the topman (Platform A). The sub-committee welcomed these new results. Of particular relevance to the evaluation of OK and SPLINTR were models which fitted the estimated probability of detection separately for schools of size 1. The authors had done this in two ways: (i) by estimating a separate factor for school size 1 and fitting larger schools using a continuous function; and (ii) as for (i), but with Beaufort sea state category (good/poor) additionally fitted as an interaction. For school size 1, the results from the SPLINTR model were consistent with the results in SC/61/IA18; the latter predicted higher g(0) values than SPLINTR for schools of size 2. For school size 1, the corresponding g(0) estimates from the OK model were generally lower than those in SC/61/IA18, particularly in good conditions. As for SPLINTR, the estimates of *g*(0) for larger schools were also lower, and the differences in the estimates between those in SC/61/IA18 and in the OK analyses were greater than the corresponding SPLINTR comparisons.

Matsuoka, who had been responsible for installing the Big Eye binoculars used on the recent SOWER surveys, commented that he was very pleased to see the data from the BT experiment being analysed and used to good effect in interpreting estimates from the OK and SPLINTR models. In response to a query about why the experiment was no longer conducted, it was pointed out that there was now sufficient data to address the questions the experiment was set up for, and furthermore, there had been some operational difficulties. In particular, and owing at least in part to the primary (7x50 binocular) platform being located higher than the tracking (Big Eye) platform, the data had indicated that there was little separation in search area gained from using the Big Eyes on the SOWER surveys. Any comparisons of *g*(0) from the BT mode experiment and from the IDCR/SOWER IO mode data should bear this in mind. The sub-committee expressed its thanks to Palka and Hammond for providing the Big Eyes used in the BT mode experiments.

6.1.4.3 DATA PROCESSING AND USAGE ISSUES

In addition to the main differences between the models described in 6.1.2 above, the sub-committee noted that some other differences between the analyses using the OK and SPLINTR model related to the use of the ‘standardised’ dataset (Burt 2006). Confirmation status and sighting distances for duplicates were used differently, plus there were some differences in the ways that the data were processed.

With the OK model, school sizes which were designated as ‘confirmed’ regardless of survey mode were treated as ‘true’, and the error model to estimate true school size was applied to those that were ‘unconfirmed’. Probability of confirmation was modelled as a function of true school size. In SPLINTR, confirmation status was ignored; all Closing Mode sightings were treated as ‘true’, and all IO mode sightings were considered to be potentially recorded with error. One of the authors of SC/61/IA6 presented an additional analysis to examine the sensitivity of their results to this factor. Somewhat surprisingly, ignoring confirmation status in the OK model (as is done in the SPLINTR model) often increased the abundance estimate by Area; in Area VI in CPII and in Area II in CPIII, substantially so. On the basis of this analysis, the sub-committee concluded that the different usage of confirmation status between the methods was probably not sufficient to explain the differences in the estimates, but that it could still be important.

In their analyses, the authors of the SC/56/IA6 and SC/56/IA14 used different distances for duplicate (and triplicate) sightings: in the OK analysis, the distance to a school was taken as that from the platform that saw it last, whilst in the SPLINTR analysis, it was from the platform that saw it first. The sub-committee agreed that this would only matter if there was a substantial difference between the perpendicular distances of the first and last sightings, which may suggest some responsive or reactive movement. An examination of the duplicate sighting distances was undertaken; there was no strong evidence a difference, and it was concluded that the different use of duplicate/triplicate sighting distances made no appreciable contribution to the difference in abundance estimates between the OK and SPLINTR models.

It was pointed out that there were some basic data discrepancies (e.g. in number of observed sightings) between the two methods due to data processing differences. In the SPLINTR model, for example, one n.mile was added to the end of each section of effort prior to a significant break in effort, to represent the area searched but not travelled by the vessel. The sub-committee discussed this philosophy, and considered whether it would induce bias. It was noted that the SPLINTR fits to the simulated data had also modified the effort in this way, but that because there were fewer breaks in effort in the simulated data than in the real data, then this was not really being tested. Proper theoretical treatment of the start and end of transect legs was neither considered practical nor worthwhile, and there was no conclusion reached about its appropriateness, or about whether the start of each transect leg should also be censored. It was recommended that for comparison of the effect, and for comparing with results from other models that did not adjust the effort similarly, then results should be presented with and without the modification.

In some years (primarily in CPII), some inconsistencies in the standardised dataset files that were contributing to the difference in data used by the analysts concerned. Specifically, there were two ways of allocating effort and sightings to a particular stratum; one based on the position of the vessel and one based on the time/days when it surveying in the stratum. These should be consistent, but it was apparent that they were not. Some progress was made towards resolving the discrepancies at this meeting; it was agreed to continue this process as necessary intersessionally, to document fully any data processing ‘decisions’, and to inform the IWC Secretariat and the person responsible for DESS maintenance (Burt) of any such data validation issues. In addition, for the purposes of ensuring that the analysts were using the same stratum-dependent data as soon as possible, Bravington undertook to redefine the existing problematic stratum boundaries and distribute these by email to the other analysts by August 2009. In the interests of using as similar data as possible for each modelling approach, he also commented that in future analyses, he would include data from the 1991/1992 survey of Area V for estimation of sighting parameters, as in the OK analyses. Under the prescribed ‘survey-once’ method of producing circumpolar estimates, this survey does not contribute to the abundance estimates (but the data could be used to increase sample size for estimation of detection function parameters).

In conclusion, the sub-committee considered that data discrepancies could cause a difference of up to about 10-15% in the estimates in the direction observed, but were not sufficiently large to explain the difference between the two sets of estimates.

6.1.5 Additional variance

SC/61/IA8 outlined some approaches for estimating the extent of process errors, which are attributed to inter-annual changes in whale distribution. Two different options, fixed and random effects models, were assumed for annual rates of increase in abundance. The additional variance was estimated through an integrated likelihood method. The approaches were then applied to the actual IDCR/SOWER abundance estimates derived from the revised OK method (SC/61/IA6). Two sets of abundance estimates using different categories of duplicate status (‘Definite’ and ‘Definite+Possible’) were employed. The estimated values of the additional standard deviation on the log-scale of abundance under the fixed effect model without a mean adjustment were 0.576 (SE= 0.170) for abundance estimates using ‘Definite’ duplicates, and 0.583 (SE= 0.171) for abundance estimates with ‘Definite+Possible’ duplicates. The standard errors of the preferred OK abundance estimates in SC/61/IA6 were inflated by taking into account the extent of the additional standard errors estimated from the fixed effect model.

The sub-committee agreed that this method was a good approach for estimating additional variance and thanked the authors, both for applying the method to the OK model estimates, and for providing the code used to estimate additional variance to the developers of the SPLINTR and IM models.

6.1.6 Work plan

The sub-committee thanked the developers of the OK and SPLINTR model for the huge amount of work they had already invested in producing Antarctic minke whale estimates from the IDCR/SOWER data. To increase the chances that the differences between the estimates be explained the sub-committee recommended a work plan (Appendix 3) for an intersessional email working group, convened by Skaug. It was emphasised that this work plan involved a lot of work and would require an iterative approach. It was also suggested that a one-day meeting held during the pre-meeting days directly before SC62 may be needed to finalise the group's work.

6.2 Reasons for differences between minke whale abundance estimates from CPII and CPIII

At previous meetings, various hypotheses that might explain the apparent decline in minke whale abundance from CPII to CPIII have been proposed. At SC61, only one of these hypotheses was discussed by the sub-committee – namely that the difference may be explained, at least partially, by changing ice conditions and extent between the two sets of surveys, resulting in many more Antarctic minke whales being present in unsurveyed areas (within the pack ice itself and in polynias) during CPIII than during CPII.

6.2.1 Report from intersessional email group

Kitakado reported that he had replaced Shimada as convenor of this group, but that the group had not made any progress intersessionally as it was awaiting finalised minke whale abundance estimates.

6.2.2 Results

The relationship between sea ice condition and abundance estimates of Antarctic minke whales in the Ross Sea was examined using the IDCR/SOWER and JARPA II survey data (SC/54/IA16). For both IDCR/SOWER and JARPA II surveys in the Ross Sea, the abundance estimates were lower in years of high sea ice extent. Sea ice concentration anomalies in January from 1976 to 2008 were also examined. In the Ross Sea, SC/54/IA16 reported that the sea ice concentration anomaly in 1986 (during CPII) was at one of its lowest values in the past 30 years, indicating that during CPII the sighting survey was able to cover the research area thoroughly. In contrast, the sea ice concentration anomaly was high in 2004 (during CPIII), indicating that the sighting survey was unable to cover most of the potential research area. Furthermore, in the Ross Sea, the sea ice concentration anomaly during 2003 was the highest in the past 30 years. In fact, during the 2002/03 IWC SOWER survey, the vessels did not survey the Ross Sea due to the abnormal sea ice extent. All of the information in SC/54/IA16 indicated that the survey coverage differed markedly between CPII and CPIII. Estimates from the 2006/07 and 2008/09 JARPA II research suggested that there was a large fluctuation in abundance estimates between these two seasons. The magnitude of the fluctuation was fourfold, which the authors of SC/54.IA16 considered to be possibly due to a change in the sea ice extent, concentration and configurations in the Ross Sea. They noted that recent sighting surveys conducted on the Japanese, German and Australian ice breakers and aerial surveys reported the existence of Antarctic minke whales in the sea ice areas, and suggest that these observations indicate a relationship between abundance estimate and ice extent. In conclusion, they consider that estimation of trend in abundance requires consideration of the effect of sea ice, particularly of year-to-year changes observed in sea ice extent, concentration and configurations.

In discussion, it was pointed out that as the Ross Sea is a large embayment, the relationships between whale density and ice observed there may not be typical of other regions of the Antarctic with less complex ice configurations and dynamics. Nonetheless, if the hypothesis presented in SC/54/IA16 were true and of the magnitude suggested, then it implied that in years of high ice extent and high concentration anomaly, the densities of Antarctic minke whales in the ice must be higher than in open water regions. The plausibility of this was not discussed further, but it was noted that such a situation may have implications for other matters being considered by the SC, including: the effect on minke whale demographics of the removal of large whales; the interpretation of commercial minke whale catch data; the relationship between school size and ice extent; and the relationship between the length-age distribution and ice extent. Additionally, it was commented that another explanation for the difference in abundance between years was that in the years with high sea ice extent, the whales had travelled longitudinally to other Areas, although there is little information to assess this.

SC/61/IA17 examined the effect of days after sea ice melting on the estimated density of Antarctic minke whales in the Weddell Sea (0°-60°W; Area II). Its authors believed that it represented the first quantitative attempt to investigate the effect of sea ice dynamics on densities of minke whales. Area II was surveyed in 1986/87 (during CPII) and in 1996/97 and 1997/98 (during CPIII). Although the surveys took place during the same time of year, from late December to early February, the survey effort in IO mode with respect to the timing of sea ice melting was different between CPII and CPIII. In CPII, the peak of survey effort was after 20 days of sea ice melting, while it was after 50 days in CPIII. Minke whale densities were high in regions immediately after the sea ice melting and they declined subsequently. The authors of SC/61/IA17 therefore conclude that some consideration of the effect of days after sea ice melting on the abundance estimates of minke whales is critically important in order to understand the reasons for the difference in estimates between the CPII and CPIII surveys. Although this study was focussed initially only on Area II, the authors plan to extend their investigations to examine the relationship in other Areas, and to determine whether it is a regional or a circumpolar phenomenon. They will also investigate the effect of timing of sea ice melting on the estimation of effective strip width and mean school size in a future study.

Noting that these papers were both provided in response to requests for such work to be undertaken at SC60, the sub-committee thanked the authors of SC/61/IA16 and SC/61/IA17 and looked forward to receiving results from the extended study noted in SC/61/IA17.

6.2.3 Work Plan

The sub-committee considered the work on the relationship between sea-ice characteristics and Antarctic minke whale abundance estimates to be important in the investigation of potential reasons for the difference between the abundance estimates of Antarctic minke whales during the two CPII and CPIII time periods. To facilitate this work, the sub-committee recommended that the sea ice and abundance estimate intersessional working group be re-established under Kitakado as convenor. The terms of reference are 1) create the timing of the ice melt index for the entire time series of CPII and CPIII; then 2) investigate the relationship between abundance estimates and sea ice characteristics by modelling the abundance estimates using this index and other sea ice characteristics, and possibly including interactions between the sea ice characteristics. The sub-committee expected this work would take two years to accomplish and requested the intersessional working group report progress at SC62.

6.3 Past catch history

SC/61/IA20 reported that, contrary to general belief, illegal whaling by the USSR continued after introduction of the International Observer Scheme (IOS) in 1972. Data from the *Sovetskaya Ukraina* factory fleet showed that the Soviets killed many Antarctic minke whales that they failed to report to the IWC, and that data on the biological characteristics of these whales were falsified. In particular, lengths were exaggerated to hide the fact that additional whales had been taken (e.g. three whales would be killed and only two were reported, but the lengths of the two were increased in the reports). In response to a complaint about this from the senior author of SC/61/IA20, the Soviet Ministry of Fisheries set up a commission to investigate, whose members agreed that the reported data were false. Although a new team of biologists was sent to *Sovetskaya Ukraina* for the 1979/80 Antarctic season, the illegal whaling continued without penalty from the Ministry, and the biologists were forced to record the true data in field notebooks. The international inspectors aboard, from Japan, were fully aware of these violations, but ignored them. The authors of SC/61/IA20 noted that Japanese meat-dealers had a vested interest in Soviet whaling, because minke whale meat was transferred to Japanese meat dealers' vessels directly in the areas where whaling was conducted. They conclude that in reality, the factory fleets had no real independent international inspection, but rather exchanged observers between two countries with a major interest in the whaling.

Following up on the information and conclusions drawn in SC/61/IA20, SC/61/IA21 noted that the apparent lack of reliability of the post-IOS Soviet catch data introduced significant problems for the use of the existing catch record in IWC Comprehensive Assessments, notably as it relates to Antarctic minke whales. The authors proposed that a work plan be developed to determine whether sufficient records exist to help to clarify the extent of data falsification after 1972. The authors of SC/61/IA21 believed that the new information highlighted a major failing of the IOS, namely that inspectors were restricted to those from countries engaged in bilateral agreements (in this case the USSR and Japan), and were appointed from countries with a vested interest in the whaling being inspected.

The Chair ruled that a general evaluation of the IOS was not a topic for discussion in this sub-committee.

The sub-committee welcomed the reporting of the new, regrettable information contained in SC/61/IA20. It considered what effect the newly reported data would have on its work, particularly the catch-at-age analyses. These analyses require data on the number of whales caught, their lengths and the age-length key. Since it is thought that only age-length keys from the Soviet data are prior to 1973, they pre-date the newly reported records. Therefore it is also particularly important to have at least some idea of the extent to which the length mis-reporting occurred. The sub-committee recommended that further information sources be investigated that might provide this, and on the percentage of the catch record that was in error. Mikhalev agreed to undertake to find any data that could be valuable in these respects, and to present the information at SC62.

Noting that the type of mis-reporting described in SC/61/IA20 is a common phenomenon in many other managed fisheries, the sub-committee agreed that some alternative scenarios for the catch-at-age modelling would need to be developed in order to assess the sensitivity of the results to such mis-reporting. It was recommended that some scenarios would need to consider that mis-reporting may have occurred in all fleets. Some members considered that, unlike the situation for the Soviet fleet, there had been no incentives for the Japanese fleet to mis-report length data because there had not been any restrictions on length applicable to the catching of minke whales at that time. Kato commented that based on his experience on factory vessels, Japanese catch numbers had not been mis-reported either. Best added that as an independent researcher for a month on the *Nishin Maru No. 3* in the 1978/79 season, he was unaware of any such practices in the Japanese whaling operations. Therefore, in their view, there was no reason for the catch-at-age analyses to consider scenarios where mis-reporting may have occurred in the Japanese fleets. Formulation of the scenarios to be tested was referred to the intersessional working group on catch-at-age analyses (see item 6.4.4).

6.4 Catch-at-age analyses

6.4.1 Report from intersessional email group

The intersessional email working group reported that it had been inactive during the last year. The group had been awaiting the results from the independent age reading experiment (IWC 2009) that had been recommended last year. As this work would be undertaken only late in 2009, no substantive work was undertaken by the email working group. Punt, however, did produce some updated modelling results, which were discussed under 6.4.2 and 6.4.3.

6.4.2 Ageing estimation

A proposal involving independent age reading of 250 earplugs by Lockyer to help resolve questions concerning ageing of Antarctic minke whales was presented last year. The work had not been able to be undertaken but final logistic arrangements for the experiment are being made and it is expected that the work will be undertaken during November-December 2009, in Tokyo. The sub-committee re-iterated its previous statement that it considers this work to be critical in order to be able to finalise the current catch-at-age modelling work and recommended that the experiment be undertaken as a matter of high priority.

Last year the sub-committee considered investigating the feasibility of using bomb radiocarbon chronometer techniques for verifying the age estimations obtained from earplugs readings. This technique has been used successfully on fish otoliths (e.g. Kalish *et al.* 1996) and beluga whale teeth (Stewart *et al*. 2006) and could provide absolute calibration for ear plug age reading estimate. This would be particularly helpful for verifying age reading estimates from older animals, which tend to be difficult to age. No work had been done intersessionally on this. It was agreed that the technique would be valuable for the catch-at-age analyses, and it was recommended that it be further investigated. Lockyer will undertake to check the feasibility and assess the cost of this technique, and to report the conclusions at SC62.

It was suggested that data from Discovery-marked whales might provide information on the extent of aging error. That is, the time between marking and recapture could be compared to the age estimation based on reading the ear plugs, and in some situations could indicate the extent of aging error. After consulting with the Secretariat, it was reported that matching of the Discovery-marked data with the age data was not straightforward but was feasible. The matching could be done by anyone who had access to the two data sources and would not necessarily require the Secretariat. The sub-committee recommended that analyses of the marking and corresponding age estimates be undertaken.

It was also reported that analyses of fatty acids in killer whale blubber had been successful in aging killer whales. The sub-committee suggested that this methodology should be investigated as to whether such techniques could be used to age minke whales.

SC/61/IA2 used simulations to assess the implications of different levels of ageing bias on the performance of the statistical catch-at-age method of Punt and Polacheck (2008). Simulations based on deterministic data suggested that a 20% under-estimate of age in 1970 which changes linearly to zero in 1986 will lead to estimated time-trajectories of historical increases in carrying capacity which match those from actual applications of the statistical catch-at-age analysis method when the true carrying capacity is time-invariant. Allowing for observation error makes the results more variable.

The sub-committee noted that these results further confirm the importance of undertaking the independent aging experiment and reiterated its previous recommendation that the highest priority task for the catch-at-age modelling work is the development of 'appropriate error models for the catch-at-age data to be used in the population modelling to take into account potential errors and biases in the ageing and length data and how these may have been changed over time'.

6.4.3 Preliminary results

SC/61/IA1 provided the results from additional sensitivity tests conducted to examine the impact of ignoring the data from JARPA on the outputs from the statistical catch-at-age analysis method of Punt and Polacheck (2008). The results suggest that the estimates of trends and natural mortality are most sensitive to ignoring the JARPA length-composition and age-at-length data while these estimates (and the associated measures of their uncertainty) are not very sensitive to ignoring the JARPA indices of relative abundance. Trends in both total (1+) abundance and recruitment are shown to be insensitive to reducing the influence of the assumed stock-recruitment relationship and allowing vulnerability for the period of JARPA to vary over time.

Discussion on this paper, re-iterated discussion at last year's meeting that the lack of sensitivity to the JARPA abundance estimates was unexpected and may be due to structural constraints of the model (e.g. the stock recruitment relationship and/or the vulnerability functions). As such, within the current model structure, the JARPA abundance estimates may provide little additional information. The sub-committee agreed that this outcome still warrants further investigation. One suggestion was to investigate the effect of artificially introducing different trends into the JARPA abundance estimates.

6.4.4 Work plan

The sub-committee re-iterated its previous agreement that resolution of questions concerning aging of Antarctic minke was the highest priority task for the catch-at-age modelling work. In this context, it recommended that the work proposed last year (IWC 2009) be undertaken. Upon completion of the age reading work, analyses of these data should be taken to develop appropriate error models for the catch-at-age data.

In addition to this, the sub-committee recommended that the development of both of the catch-at-age models should be continued intersessionally and the data for this should be made available to the developers. The development work needs to include the application of error models for the catch at age data derived from the independent age reading experiment. Other recommended work is construction of scenarios for possible mis-reporting of catches and size data and evaluation of the sensitivity of the catch at age models to these alternative scenarios. The sub-committee recommended that the Working Group on catch-at-age analyses of Antarctic minke whales be continued to facilitate the work. It was noted that updated JARPA data were not required for the work to be conducted in the upcoming year as the modelling results will remain preliminary until the inputs for the models (e.g. the abundance estimates and ageing error models) are finalised. It was noted that the current data access agreement ended with the 2009 meeting. A renewal of the data access agreement which also provided for access to the data resulting from the independent age reading experiment would be required for the intersessional working group to undertake its work. Kato responded that he and his colleagues would examine the contents of the data requested under the Data Availability protocols, when the request was received.

7. PROGRESS TOWARDS AN IN-DEPTH ASSESSMENT FOR NORTH PACIFIC SEI WHALES

The sub-committee reviewed the available data on abundance, distribution, catch history, stock structure and biological parameters. Since last year, a new genetic study had been completed using samples from JARPN II and 1970s commercial whaling (SC/J09/JR32). Conventional line transect analyses of the JARPN II sightings surveys yielded abundance estimates for the JARPN II area (NW Pacific west of 170°E and north of 35°N). Some spatial modelling work had been conducted to extrapolate the abundance beyond the surveyed area (SC/J09/JR36); this had been reviewed and commented on in the SC/61/Rep1 in the context of the JARPN II review.

The sub-committee noted that the extensive surveys on the west coast of the USA had resulted in very few sei whale sightings (Barlow and Forney 2007), although this had been a common species in the catches before 1970. It appeared that sei whales have been rare there since a regime change around the 1970s. Surveys in British Columbia, Alaska and the Aleutians had also resulted in too few sei whale sightings to estimate abundance (Williams and Thomas 2007; Zerbini *et al*. 2006). The sub-committee emphasised the importance of taking account of negative information (survey effort resulting in zero sightings or too few to estimate abundance), especially when using spatial modelling to extrapolate densities.

The sub-committee noted the absence of recent survey data in the offshore area of the central and eastern North Pacific, and emphasised the importance of collecting new data in these areas. However, it considered that work on the in-depth assessment should proceed in parallel in the meantime. While current abundance and distribution is the most important data need, it is also important that the historical abundance data be analysed, to gain an understanding of the history of the population, including the extent to which it was impacted by commercial whaling in the 1960s and 1970s, and the extent of recovery since then.

Allison reported on progress with compiling a catch history. Further data on the Soviet catches were unlikely to become available, and a complete reconstruction of Soviet catches would not be possible, but reasonable inferences of the likely range of sei whale catches could be made based on the information already held.

The sub-committee agreed that the first phase of the in-depth assessment should focus on abundance and distribution (past and present), stock structure, and catch history (including the separation of the sei and Bryde's whale catches). Because there was no recent information on biological parameters, the sub-committee agreed to defer this topic to a later stage.

A summary of the available information and a proposed work plan are contained in Appendix 4. The sub-committee recommended that the in-depth assessment could start at the 2010 Annual Meeting, and endorsed the work plan in Appendix 4. The work plan includes the following tasks to be completed before the 2010 Annual Meeting: inventory of existing data holdings; approximate quantification of the negative information from US and Canadian surveys; genetic analysis of a subset of the sei whale sample held at SWFC; preliminary review of historical abundance and distribution data; compilation of a catch series (including upper and lower values if appropriate).

8. WORK PLAN AND BUDGET REQUESTS

The sub-committee agreed that completing the in-depth assessment of Antarctic minke whales was its primary objective. It identified the following priority topics for next year's meeting:

- To produce agreed abundance estimates of Antarctic minke whales;
- To conduct an analysis of ageing errors that could be used in catch-at-age analyses of Antarctic minke whales;

- To continue development of the catch-at-age models of the Antarctic minke whales;
- To continue the examination of the differences between minke abundance estimated from CPII and CPIII, particularly the impact of sea ice on the abundance estimates.

Highest priority next year will be given to obtaining the abundance estimates of Antarctic minke whales using the IDCR/SOWER survey data.

The sub-committee recommended IWC funds to support the IWC/SOWER 2009/10 survey. This survey will investigate the relationship between Antarctic minke whale abundance estimates and sea ice conditions by cooperating with the Australian aerial survey that will be conducting line transect surveys in the sea ice. This cooperative cruise could provide valuable information to help explain the difference in the abundance estimates from CPII and CPIII.

The sub-committee also recommended IWC funds to support work related to DESS. In particular this work involves the following: importation of the IWC/SOWER 2008/09 data into DESS; continuation of the ongoing maintenance and support of DESS; as needed, summarization and correction of the data in the DESS and 'standard dataset' which are being used to estimate the abundance of the Antarctic minke whales; and compilation of status of data collected during the SOWER experimental cruises.

Below are the intersessional working and steering groups recommended by the sub-committee:

Group	Terms of Reference	Membership
Abundance analysis methods (WG)	For each analysis method, prepare and document abundance estimates, diagnostics, results from analysing simulated datasets and differences between the two methods (Agenda item 6.1.4)	Skaug (Convenor), Branch, Bravington, Burt, Butterworth, Cooke, Hedley, Kitakado, Okamura, Polacheck
Catch-at-age analyses (WG)	Continue work on analyses of aging estimation and development of the catch-at-age analyses (Agenda item 6.2.3)	Punt (Convenor), Polacheck, Butterworth, Leaper, Mori
SOWER planning (SG)	Complete the planning of the 2009/10 SOWER cruise (Agenda item 5.5)	Kato (Convenor), Bannister, Best, Bravington, Brownell, Donovan, Ensor, Gales, Hedley, Kelly, Matsuoka
Abundance estimates and sea ice extent changes (WG)	(1) Create the timing of the ice melt index for the entire time series of CPII and CPIII; then 2) investigate the relationship between abundance estimates and sea ice characteristics by modelling the abundance estimates using this index and other sea ice characteristics, and possibly including interactions between the sea ice characteristics (Agenda item 6.2.3).	Kitakado (Convenor), Bravington, Ensor, Hedley, Kelly, Matsuoka, Murase, Okamura, Palka,

9. ADOPTION OF REPORT

The Chair thanked the sub-committee for its co-operative approach it has shown on addressing the differences between the two available abundance estimates of Antarctic minke whales. She also thanked the rapporteurs for their excellent work that enabled the sub-committee to complete its work before the 'tentative day off'. The report was adopted at 14:00 on 8 June 2009.

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Appendix 1

AGENDA

1. Election of chair
2. Appointment of rapporteurs
3. Adoption of agenda
4. Documents available
5. SOWER cruises
    - 5.1 Report from Tokyo planning meeting for the 2008/09 IWC/SOWER cruise
    - 5.2 Results from the 2008/09 IWC/SOWER field study
    - 5.3 Results from previous IWC/SOWER cruises
    - 5.4 Results from other Antarctic cruises
    - 5.5 Recommendations for the 2009/10 season

6. Antarctic minke whales
    - 6.1 Abundance and trends
        - 6.1.1 Report from intersessional workshop
        - 6.1.2 Abundance estimation methods
        - 6.1.3 Simulated datasets
        - 6.1.4 Differences between estimates from OK and SPLINTR
            - 6.1.4.1 Effective strip widths for whales, esw_w
            - 6.1.4.2 Independent comparisons
            - 6.1.4.3 Data processing and usage issues
        - 6.1.5 Additional variance
        - 6.1.6 Work plan

    - 6.2 Reasons for differences between minke abundance estimates from CPII and CPIII
        - 6.2.1 Report from intersessional email group
        - 6.2.2 Results
        - 6.2.3 Work plan

    - 6.3 Past catch history
    - 6.4 Catch-at-age analyses
        - 6.4.1 Report from intersessional email group
        - 6.4.2 Aging estimation
        - 6.4.3 Preliminary results
        - 6.4.4 Work plan

7. Progress towards an in-depth assessment on North Pacific sei whales
8. Work plan and budget requests
9. Adoption of report

Appendix 2

REPORT OF THE SMALL GROUP PLANNING THE 2009/10 IWC/SOWER CRUISE

Members: Best (Chair), Baker, Bannister, Bravington, Brownell, Clark, Donovan, Ensor, Findlay, Fujise, Gales, Gedamke, Goto, Hatanaka, Hayashi, Hedley, Hughes, Jackson, Kato, Kelly, Kishiro, Matsuoka, Miyashita, Murase, Okada, Palka, Pastene, Rosenbaum, Tamura, Uozumi, Uoya, Yamakage (I), Yasokawa (I), Zerbini

1. Chair's opening remarks and appointment of rapporteur

Best welcomed the participants. Ensor agreed to assist with rapporteuring.

2. Terms of reference

The sub-committee had agreed that, given the uncertainty surrounding the future of the SOWER cruise programme, the Group's terms of reference should be to recommend specific objectives/projects for the 2009/10 cruise only.

3. Adoption of agenda

The agenda was adopted, and forms the basis of this report.

4. Cruise logistics

4.1 Availability of vessel

Owing to changes in vessel availability, the Japanese Government was offering the 61.9 m *Kaiko-Maru* (860 tons) instead of the *Shonan Maru no. 2* used last year and in previous cruises. Unlike the *Shonan Maru no. 2*, the *Kaiko-Maru* was not an ex-whale catcher but a converted stern-trawler equipped with mast look-out positions that had been used as a dedicated sighting vessel in the JARPA II programme since the 2006/7 season. Because the *Kaiko-Maru* does not possess a ship inspection certificate for international voyages, it is unable to enter international ports (except in an emergency). This had several implications for the proposed cruise.

4.2 Length and timing of cruise

The Group was informed that the *Kaiko-Maru* would be available for 80 days, departing Japan on 17 December 2009 and returning to Japan on 6 March 2010, and that if a research plan in association with the Australian aerial survey was adopted, a total of about 30 research days would be available in the vicinity of the pack ice edge. At some stage in the Southern Ocean sector of the cruise it would be necessary to obtain fuel and provisions from a Japanese tanker, and this could reduce the available research time to some extent.

If no access to international ports was possible, it would mean that researchers would have to board the vessel in Japan and remain onboard for the duration of the cruise [OPTION A]. Some doubt was expressed that researchers would be available for this length of time, and the ~30% longer duration of the cruise would presumably mean their grants would have to be increased accordingly. It was also pointed out that under this option, the equipment from the 2008/09 cruise left in bond in Bali would have to be shipped to Japan before the start of the cruise, and this would also have financial implications. As this included biopsy guns, special permission for their importation into Japan would have to be sought, which the Group was informed might require a lead time of 3-6 months.

As an alternative [OPTION B], the sub-committee had suggested that it might be possible to trans-ship researchers between the *Kaiko-Maru* and a suitable port en route to the research area, in which case the length of the cruise for the researchers would be shortened and there might be no need to increase the grants substantially. As most of the equipment from the 2008/9 cruise was held in bond in Benoa, Bali, this would be the most appropriate port from which researchers could board and leave the vessel (and would enable the equipment to be loaded simultaneously). Such an operation would represent a minor deviation from the intended course of the vessel and would result in a cruise of 50-55 days.

4.3 Number of participants, including cruise leader

Four researchers, including one from Japan, would be needed for this research, and grants for each should be incorporated in the budget. Ensor was proposed as cruise leader.

Owing to the likelihood of an inflated budget if Option A was adopted, the Group enquired whether it would be possible to run the cruise with one less researcher, but Ensor informed them that this would seriously impact the programme of research to be carried out.

Although safety was not an issue, the possible implications of the status of the vessel for the personal insurance of researchers were also raised.

4.4 Conclusions

Because the viability of the cruise seemed to be highly dependent on whether Option B was at all feasible, and the adoption of Option A could have serious financial and logistic implications, a small group was set up under Ensor to formulate a list of issues that needed to be clarified as soon as possible.

These were as follows.

4.4.1 PERSONNEL

The Government of Japan and the IWC Secretariat should request advice from the Indonesian Government regarding the feasibility of transferring personnel (up to four people and their personal equipment) using a local small charter vessel from the port of Benoa to a Japanese vessel located off the coast of Indonesia. The same personnel would also need to disembark from the Japanese vessel and re-enter Indonesia using the same method after a period of approximately 50-55 days.

It is anticipated full compliance with Indonesian Customs and Immigration procedures.

The personnel (as members of a research complement) are classified as visitors to the Japanese vessel and are as such not members of the ship's crew.

4.4.2 IWC EQUIPMENT CURRENTLY IN CUSTOMS BOND IN BENOA

The Government of Japan and the IWC Secretariat should request advice from the Indonesian Government regarding the feasibility of transferring this equipment to the same Japanese vessel at the same time as the personnel embark. In addition, the Government of Japan and the IWC Secretariat should request advice from the Indonesian Government regarding the feasibility of transferring, under Customs Bond to Japan, all the IWC-owned equipment currently stored in Benoa (noting that this equipment includes sonobuoys, Larsen and Paxarms biopsy guns and associated equipment, crossbows, computers and cameras).

Estimates of the probable cost of these three issues would also be required.

Irrespective of whether Option A and Option B was adopted, the Group recommended that the IWC- owned equipment should remain on board the *Kaiko-Maru* at the end of the cruise and return to Japan, as future surveys were being proposed for the North Pacific.

Given the budgetary considerations of adopting either option, the Group stressed that answers to these queries should be available by the time of the Commission meeting, or ideally before the end of the SC meeting, if a realistic budget was to be adopted.

5. Options for 2009/10

5.1 First priority

Although SC/61/IA15 had proposed that the research plan for the cruise should be a sighting survey in Area IV north of latitude 60ºS, the sub-committee had stressed that the cruise should take advantage of the planned Australian aerial survey to continue its investigation of the distribution of minke whales in relation to sea ice. Such a project was of more direct relevance to the immediate work of the Scientific Committee, and the cruise programme had tried for the last two years to undertake such a joint project but it had not been possible to coordinate it. The sub-committee had therefore directed the group to consider collaboration with the aerial survey to be its first priority for the upcoming cruise.

The Australian plans for the aerial survey in 2009/10 were introduced (SC/61/IA4). The nominated research area was between 93º and 113ºE, and the survey would start about December 10 and last until early February. Initial flights would be in the vicinity of Casey Base (66º17S 110º31E) but would shift to off Bunger Hills (66º10S 100º53E) after two-three weeks, returning to the region of Casey around the middle of January. The survey would end about 8 February.

The Group decided that (as agreed previously) the overall strategy for collaboration between vessels and aircraft would be as follows:

(1) The aircraft will survey inside the ice to obtain a density estimate of minke whales;

(2) The aircraft will also survey outside the ice to obtain a density estimate of minke whales there;

(3) The results of (1) and (2) will be compared to provide information on the relative proportion of animals inside and outside the ice;

(4) The SOWER vessel will obtain an abundance estimate of minke whales in an area outside the ice, *i.e.* within the southern stratum, to include the area surveyed by the aircraft, and

(5) Comparison of the results of (2) and (4) will permit 'calibration' of the aircraft operation against that of the vessel.

Although the procedure proposed for the 2007/08 cruise had included coverage of the northern stratum, that survey had had a potential duration of 60 days compared to 34 days for the current proposed survey. The Group therefore considered it was impractical for the *Kaiko-Maru* to survey the northern stratum in the time available.

The success of the cruise would depend greatly on good communication between the ship and aircraft, and the Group noted that there several possible avenues open for this, including e-mail and telephone via satellite.

The Group also endorsed the methodology proposed for the 2007/08 cruise, with the understanding that this would be reviewed further at the Planning Meeting. Specifically, independent monitoring of the topmen's searching behaviour (as carried out in the 2008/09 cruise) was recommended to be included.

5.2 Alternative plan

The sub-committee had also requested the Group to consider an alternative plan in case the co-operative study with the aerial survey proved to be impractical (for example, owing to the last-minute unavailability of the aircraft or associated personnel, or the unsuitability of pack ice conditions for the experiment).

The Group considered that such a plan should involve the collection of biopsy samples and photo-identification images from humpback whales in Area IV. These could potentially help elucidate the degree of mixing of breeding stocks D and E on the Antarctic feeding grounds and so provide information that would contribute directly to the ongoing comprehensive assessment of southern humpback whales. Two possible areas of interest were suggested (60-110º E and 130-150º E), being either potential stock-mixing areas or areas where sample coverage from previous cruises was low. The choice between these was left to the Planning Meeting, where all available data on the distribution of available photos and samples would be considered, and the logistic considerations for the vessel, would also be considered. It was noted that the vessel available for this cruise was not as suitable as a catcher-type boat for approaching whales for biopsy sampling, as it was slower, less manoeuvrable and with a higher freeboard (making dart retrieval more difficult). These factors would substantially reduce the efficiency of the vessel for biopsy sampling. The possibility of deploying satellite tags on whales during this cruise was raised, as a powerful means of testing movements within feeding grounds and between feeding and breeding grounds. However, for the reasons given above, there would also be difficulties in approaching whales closely enough for this to be satisfactorily achieved from the *Kaiko-Maru*, and a small boat such as those that are normally used for deploying such tags could not be easily deployed from the *Kaiko Maru*.

Detailed planning of this back up plan was deferred to the Planning Meeting.

A further alternative (as outlined in SC/61/IA15) to survey mid-latitude areas of Area IV for fin, humpback, pygmy blue whales, dwarf minke whales and sei whales had not been supported by the sub-committee and was allocated a lower priority.

6. Planning meeting

A logistics planning meeting would be held in Tokyo, Japan, for three days from 16-18 September 2009. Apart from appropriate members of the ship's crew, the participants should include the cruise leader, an IWC representative, a survey design expert, a representative from the Australian aerial survey project, and as many members as possible of the Steering Group. Kato would be responsible for organising the meeting.

7. Home port(s) and responsible people

Matsuoka agreed to act as home port organiser in Japan, and if the cruise operated from Benoa, the ship's agent in Benoa would be asked to help coordinate arrangements there.

8. Recommendations from the 2008/2009 cruise

Those with financial implications were referred to the budget, while the others would be considered at the Tokyo Planning Meeting.

9. Budget

A preliminary budget is being developed.

Appendix 3

WORK PLAN FOR THE ABUNDANCE ESTIMATION INTERSESSIONAL WORKING GROUP

To fully evaluate any discrepancies between the OK and SPLINTR estimation methods and to produce an agreed abundance during SC/62 the following issues and methods to address the issues should be considered.

Data issues

1. Tabulate area (n.miles^2), and separately for IO and Closing mode, by stratum, tabulate number of sightings (n_s), and effort (L) in n.miles.
2. For each circumpolar survey, and by Area, tabulate the number of sightings per platform combination (i.e. AB, Ab, aB, Cab[1]).
3. Ensure that the same stratum boundaries are being used by both methods (Okamura has adjusted Branch's original boundaries). Bravington will provide revised stratum boundaries to the other analysts by mid-August 2009.
4. Evaluate the effect of adding one n.mile to the end of each section of effort prior to a significant break in effort, as was done in SPLINTR. This could be done by estimating the abundance with SPLINTR without adding the extra track length.
5. Evaluate the effect of the two ways of allocating effort and sightings to a particular stratum, i.e. using the time versus location of the ship.
6. Document fully any data processing 'decisions' and inform the IWC Secretariat and the person responsible for DESS maintenance of any data validation issues.
7. All methods should include data from the 1991/92 survey in Area V in the estimation of sighting parameters but not in the encounter rate in the 'survey-once' abundance estimates.

Spatial modelling

8. Compare the usual SPLINTR model with that from fitting a uniform density surface by pre-defined IWC stratum.
9. Adjust the knot spacing for spatial modelling of the 2003/04 survey when using the SPLINTR method, to improve the lack of fit in the CPIII Ross Sea.

Lack of fit to radial distances in diagnostics

10. Identify the platform that made the sightings at small radial distances, which had the poorest fit.
11. If needed after examining results from 10 (above), explore the effect of this lack of fit by removing Platform C data from the analyses when using both methods to estimate the abundance.

Lack of fit to spiked data at the origin in diagnostics

12. To explore the effect of this lack of fit, using the SPLINTR method, investigate other functions that more closely fit the 'spike' to the real data, rather than enforcing a shoulder.

Variability in esw_w

13. Ideally, the OK model should be refitted excluding Area-specific parameters for esw_w. This is valuable as a sensitivity analysis to the results presented this year. [Mean school size estimation]
14. Produce scatterplots of esw_w against density, by stratum.
15. Define additional diagnostics to examine lack-of-fit at the esw-level. Skaug will circulate these to the analysts, but the process will inevitably be iterative.

Variance estimation

16. Test the variance estimates using one scenario of the simulated data (see details in the SC/61/Rep9).

Simulated datasets

17. Consider incorporating into future simulated scenarios factors that represent characteristics of the IDCR/SOWER that are currently not in the simulated scenarios, such as: include gaps within track lines; more realistic encounter rates from the Bridge platform; lower percentage of mis-identified duplicates; use of the recently collected IWC/SOWER experimental data to condition the simulations, specifically errors in radial distances and angles, dive time distributions, and non-synchronised dive time patterns.

Comparison with the IWC 'standard' method, assuming g(0)=1

18. During SC61, Branch kindly provided the results from a standard analysis similar to those in Branch (2006) but with like-minke whales included. These should be compared for data, effective strip width and other baseline comparisons.

Ease of examining the results from different approaches

19. To assess any differences between estimates resulting from the different models, all analysts jointly produce a paper to be presented at SC62 that presents diagnostics and summary tables, etc. from the results of the estimation methods based on a reference-case model (not necessarily with their 'best' options selected). Specifications of the reference-case will be finalised by the intersessional working group.

[1] Four possible platform combinations: AB= seen by topman and IOP; Ab=seen by topman but not by the IOP; aB=seen by IOP but not by topman; Cab=seen by the bridge but not by either other platform.

Appendix 4

DATA SOURCES AND WORK PLAN FOR THE IN-DEPTH ASSESSMENT
OF NORTH PACIFIC SEI WHALES

1. Data sources

1.1 Catch history

The IWC Secretariat has apportioned past catches in the western North Pacific into sei and Bryde's whales, and the same apportionment can be used for the sei whale catch series.

The catches for the eastern North Pacific (east of 160°W) have not yet been apportioned, but it appears that an approximate apportionment will be relatively easy because: (i) the Japanese pelagic catches occurred mainly in the period since sei and Bryde's whales were distinguished in Japanese statistics (but not BIWS); (ii) the USA and Canadian land station catches included no Bryde's whales. Small catches by other pelagic whalers may have included mixtures of sei and Bryde's whales.

The Soviet catch data are still incomplete for the North Pacific. The only data sources known to the Secretariat are the official statistics submitted to BIWS and some alternative summary data by Doroshenko (2000). With this information, the best that can probably be done is to place reasonable bounds on the total sei/Bryde's catch (for a low and high catch series) and use the Japanese pelagic catch data to determine the areas and seasons of sei/Bryde's occurrence. If overlap is limited the apportionment may be unproblematic, but the totals remain uncertain.

1.2 Abundance, distribution and trends

1.2.1 SIGHTINGS DATA: JAPAN

- Commercial scouting vessel data 1965-75
- Chartered JSV data 1976-82
- Dedicated surveys from 1983 onwards
- JARPN II surveys 2002-07 (W 170°E, N of 35°N)

The data to 1990 are summarised by 5° square by Miyashita *et al*. (1995). The data prior to 1982 can probably only be used as relative indices of abundance and distribution. Data from 1983 onwards are in principle suitable for absolute abundance estimation (as has been performed for the JARPN II data in SC/J09/JR15), but the variable geographical and seasonal coverage over much of the period will probably necessitate the use of spatial models (see, for example, SC/J09/JR19), with the added complexity of modelling the shifts in distribution over time.

1.2.2 SIGHTINGS DATA: USA

Since the regime shift in the mid-1970's sei whales seem to have become rare in the USA continental EEZ and there have been few sightings in recent surveys (Barlow and Forney 2007). Surveys of southwest Alaska and the Aleutians also failed to yield sufficient sei whale sightings for abundance estimation (Zerbini *et al.* 2006). The coverage of USA surveys during 1986-2006 is available from NOAA SWFSC [map=SCWP2].

1.2.3 SIGHTINGS DATA: BRITISH COLUMBIA

The inshore waters (out to the Queen Charlotte chain) were surveyed in 2004-05 but resulted only in a single sei whale sighting (Williams and Thomas 2007). There appears to have been no survey of the full B.C. EEZ out to 200nm.

1.2.4 SIGHTINGS DATA: GAPS AND NEGATIVE INFORMATION

The offshore parts of the central and eastern North Pacific appear not have been surveyed in recent times.

If abundance data are to be extrapolated beyond surveyed areas using spatial models, then it is important that negative information (surveys with zero or very few sightings) be taken into account. This is a potential concern with respect to analyses such as that in SC/J09/JR36.

A rough quantification of the negative information could be obtained by using a more frequently sighted species, such as fin whales, to provide a (potentially positively biased) estimate of the effective search area.

An alternative is not to extrapolate beyond surveyed areas, and to treat area with negative information (effort and no sightings) as having zero abundance. It would probably be inappropriate to extrapolate densities into areas of no information (no effort) adjacent to areas of negative information (effort with no sightings) without incorporating the negative information.

1.3 Stock structure

1.3.1 JARPN II

mtDNA and microsatellite analyses from 489 whales were collected during JARPN II in western North Pacific (SC/J09/JR32).

1.3.2 JAPANESE COMMERCIAL CATCH

mtDNA and microsatellite analyses from 301 whales were collected during 1972-73 commercial catches in central and eastern North Pacific JARPN II in western North Pacific (SC/J09/JR32).

1.3.3 USA COMMERCIAL CATCH

From Californian land stations operating during 1959-70, samples from 184(?) whales are held in the USA but have not yet been analysed (Rice 1977).

1.3.4 CANADIAN COMMERCIAL CATCH

4,000 sei whales were taken from land stations in British Columbia, mainly in the 1960s, but no samples are known to exist (Gregr *et al*. 2000).

1.4 Biological parameters (age and reproductive data)

Age and reproductive samples have been obtained from 489 sei whales collected under JARPN II during 2002-07 but these have not yet been worked up and presented (SC/J09/JR1).

Analyses of Japanese and American historical data are published by Masaki (1976) and Rice (1977). More detailed data may be available in Masaki's 1975 thesis (in Japanese).

2. Proposed Work Plan

The first phase of the in-depth assessment could start at the 2010 Scientific Committee annual meeting and based on the above data sources could focus on abundance and distribution (present and past), and stock structure.

The in-depth assessment should initially address the entire North Pacific. Subdivision of the region may be possible later depending on progress with stock structure.

Biological parameters should be considered after the first phase has been completed, if new information becomes available.

2.1 Tasks to be completed before the start of the first stage

1. Construction of an inventory of existing data holdings
2. Quantify search effort from USA surveys for use as negative information.
3. Genetic analysis of a subset of the historical Californian samples.
4. Preliminary analyses of the historical sightings data, treating them in a way appropriate to the nature of the data.
5. Complete the catch history, using best approximations for the Soviet component as suggested above.

2.2 Agenda items for first meeting

1. Stock structure (historic and current)

   (Existing and new genetic analyses would be presented and discussed in detail).

2. Abundance and distribution data
   a. Recent dedicated surveys (detailed review of existing and new analyses).
   b. Analyses of historic sightings data, with a view to understanding relative ocean-wide distribution and shifts over time
3. Review and adopt catch history (an upper and lower bound if appropriate).

Each of the above discussions may result in recommendations for further work.

2.3 Data availability

Members wishing to pursue analyses should request access to data under the terms of the Data Availability Agreement. If it is later decided to proceed with an RMP Implementation, the data to be used for the implementation would then have to be submitted to the Secretariat.

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