Annex D1

Report of the Working Group on the *Pre-Implementation Assessment* of Western North Pacific Common Minke Whales

Members: Hammond (Convenor), Allison, An, Baba, Baker, Borodin, Bravington, Brockington, Brownell, Butterworth, Campbell, Castellote, Childerhouse, Chilvers, Choi, Cipriano, Clapham, Cooke, de Moor, Deimer-Schuette, Donovan, Fujise, Funahashi, Gaggiotti, Gedamke, Goodman, Gunnlaugsson, Hakamada, Hatanaka, Hoelzel, Iñíguez, Jaramillo Legorreta, Kanda, Kasuya, Kato, Kelly, Kitakado, Leaper, Lyrholm, Matsuoka, Miyashita, Morishita, Murase, Okada, Okamura, Palka, Palsbøll, Pamoulie, Pastene, Perrin, Punt, Sekiguchi, Uoya, Uozumi, Víkingsson, Wade, Walløe, Waples, Yamakage, Yasokawa, Yoshida.

1. CONVENOR'S OPENING COMMENTS

Hammond welcomed participants to the meeting, which had commenced as a two day pre-meeting that continued into the main meeting of the Committee.

In 2009, the Commission had agreed that the Scientific Committee should follow the option in its report (IWC, 2010b) that specifies completing a full *Implementation Review* as soon as possible, ideally by the 2012 meeting. This timeline will be possible if the *pre-Implementation assessment* can be completed this year. The Convenor reminded the Working Group that the Committee was undertaking a *pre-Implementation assessment*, rather than immediately commencing an *Implementation Review*, because the 2003 *Implementation* had been conducted before the existing guidelines for *Implementations* had been developed and had focussed primarily on 'O' stock. He drew the attention of participants to Committee guidelines for *Implementations* relevant to *pre-Implementation assessments* (IWC, 2005a). In particular, he stressed that the main focus is: '…the establishment of plausible stock hypotheses consistent with the data that are inclusive enough that it is deemed unlikely that the collection of new data during the *Implementation* process will suggest a major novel hypothesis (e.g. a different number of stocks) not already specified in the basic *Implementation Simulation Trial* structure'.

Additional foci are examination of available abundance estimates and information on the geographical and temporal nature of 'likely' whaling operations and future levels of anthropogenic removals other than due to commercial whaling.

The aim was to complete the *pre-Implementation assessment* at this meeting so that the *Implementation Review* could be completed at the 2012 meeting. However, the guidelines do not put a limit on the time that should be taken to complete the *pre-Implementation assessment*.

2. ELECTION OF CHAIR AND APPOINTMENT OF RAPPORTEURS

Hammond was elected Chair. Waples and Punt were appointed as rapporteurs.

3. ADOPTION OF AGENDA

The adopted Agenda is given in Appendix 1.

4. REVIEW OF DOCUMENTS

Relevant documents available to the Working Group were: SC/62/NPM1-30 and Hatanaka and Miyashita (1997).

An issue was raised concerning paper SC/62/NPM11, which included the instruction 'Do not cite without written permission from the authors'. Committee guidelines (IWC, 2003, p.87) state that documents submitted to the Committee are considered part of the public domain in line with the Rules of Procedure of the Commission. It is the policy of the *Journal* that if authors specify that the paper should not be cited without permission that must be respected. However, Committee guidelines also state that if a paper is to form the major basis for a recommendation by the Committee, it is not acceptable for such a strong restriction on citation to be placed. The authors of SC/62/NPM11 indicated that the paper could be cited in the context of IWC business. Some members believed that all papers submitted to the Committee should be freely citable. This is a general issue and was referred to the full Committee for further consideration.

5. STOCK STRUCTURE

The Chair clarified that the goals for this meeting were not to assess relative plausibility of alternative hypotheses regarding stock structure, but rather: (1) to agree to a set of inclusive plausible hypotheses consistent with the data; and (2) to assemble the types of information that will be considered when evaluating relative plausibility at the First Annual Meeting. The RMP *Implementation* process explicitly takes uncertainty into account by considering alternative stock structure hypotheses. Some discussion ensued regarding the minimum standard for plausibility. Donovan clarified that the IWC has no firm guidelines on this issue. One suggestion was that a single statistical test indicating heterogeneity in a metric directly related to stock structure should be sufficient to establish 'plausibility.' Others felt that it was also important to establish that the test result was not an artefact related to inadequate sampling or other irregularities and that there is reason to believe that differences detected by the test are biologically meaningful. The latter point implies some consideration of effect size in addition to statistical significance. The Working Group **agreed**, as the Committee has in the past, that the most reasonable approach is to use best professional judgment, laced with common sense, after considering all relevant information.

5.1 Brief overview of past discussions

Donovan briefly reviewed previous work on stock structure for western North Pacific common minke whales. Creation of sub-areas allowed for geographic specificity of the stock structure hypotheses. During the previous *Implementation*, the Committee adopted the following stock structure scenarios (IWC, 2004).

(1) Baseline A: a three-stock scenario (J, O, W) with the W-stock found only in part of sub-area 9 and only sporadically.
(2) Baseline B: a two-stock scenario (J and O) with no W-stock.
(3) Baseline C: a four-stock scenario, with J to the west, and O_W, O_E, and W to the east of Japan. Boundaries are fixed at 147°E and 157°E and there is no mixing between the stocks.
(4) Baseline D: a three-stock scenario (J, O, W), with O dominant in the west and W dominant in the east but mixing across 147°E and 162°E.

All of these hypotheses except C involved stock mixing in some areas, and all assumed a single 'J' stock to the west of Japan.

An additional set of hypotheses dealt with potential heterogeneity in the 'J' stock. As summarised in IWC (2010b), these were (in each case, in addition to one or more 'O'-like stocks to the east of Japan):

(5) One stock, J, that migrates to Yellow Sea, Sea of Japan, and the Pacific coast of Japan.
(6) Two stocks, J and Y; J migrates along both coasts of Japan, and Y migrates along the Korean coast.
(7) Two stocks, J and Y; J migrates through the Sea of Japan and Pacific coast of Japan, and Y migrates up to the Yellow Sea.
(8) Two stocks, J and Y; both stocks migrate through the Yellow Sea and Sea of Japan at different times of year.
(9) Three stocks, J, K, and Y; J migrates along both coasts of Japan, K along the Korean coast, and Y up to Yellow Sea.
(10) Three stocks, JE, JW, and Y; JE migrates along the Pacific coast of Japan, JW through the Sea of Japan, and Y up to Yellow Sea.
(11) Three stocks, JE, JW, and Y; JE migrates along the Pacific coast of Japan, JW along the west coast of Japan, and Y migrates along the Korean coast including Yellow Sea.

Only hypotheses (1)–(4) had been agreed by the Working Group last year.

Stock structure evaluations are particularly challenging for North Pacific minke whales because the breeding grounds (presumably to the south of 35°N) have not been identified, let alone sampled, and the primary feeding grounds (in the Sea of Okhotsk) are in Russian territorial waters and present considerable difficulties for sampling. Therefore, available samples are primarily from migrating individuals. Furthermore, migration routes can vary substantially by sex and age, so a sample of individuals collected at a certain time and place might represent a mixture of two or more stocks and/or a non-representative sample from a portion of a single stock. Most population genetic analyses assume that each sample is drawn randomly from a single population, and those analyses that deal explicitly with population mixtures generally require 'baseline' samples from stocks that potentially contribute to the mixture.

Genetic analyses of North Pacific minke whales generally have dealt with these difficulties in one of two ways, both of which have advantages and disadvantages. One approach is to group individuals into geographic collections representing potential stocks and analyse allele or genotypic frequencies using standard population genetic methods and a hypothesis testing framework. The advantage of this approach is that it allows use of well-developed theory and a wide variety of analytical methods, including statistical tests of heterogeneity. The main disadvantages are that the initial grouping of the samples might require rather arbitrary decisions, and results can be ambiguous or misleading if some samples include individuals from more than one population. The other approach has been to use Bayesian clustering methods (specifically, the program STRUCTURE) to partition the entire collection of samples into component gene pools or stocks. The advantage of this approach (which can be considerable for situations such as that for the North Pacific minke whales) is that it does not require one to make *a priori* assumptions about how to put individuals into groups to be compared. The main disadvantages are that the method for inferring the number of gene pools is *ad hoc* and not statistically rigorous, and it has been demonstrated empirically that the power of the method to resolve mixtures of closely related populations is limited. IWC (2010b) has a more detailed discussion of these issues with respect to previous genetic analyses of North Pacific minke whales. IWC (2007) describes related discussions for North Pacific bowhead whales.

5.2 Summary of available genetic and non-genetic data

The Chair emphasised the importance of creating a document that lists the various datasets and other information that were available for the *pre-Implementation assessment*. This would be a living document, at least until a deadline is established for consideration of data for the *Implementation Review*. Kanda, An, Miyashita and Baker constructed a data table, given in Appendix 2.

5.3 Consideration of new information/analyses

The Working Group first considered papers providing non-genetic information.

SC/62/NMP22 provided results of a biopsy skin-sampling survey of common minke whales conducted from 18 July to 31 August 2009 in the Okhotsk Sea by the research vessel *Shonan-maru No.2.* The research area (north of 46°N, south of 57°N, and west of 152°E) included areas within the Russian 200 n.mile EEZ and involved 11 tracklines totalling 2,219.9 n.miles. Weather conditions were generally good, but dense fog sometimes interfered with survey activities. 1,662.6 n.miles were searched in primary searching mode and 447 cetacean groups were sighted. Common minke whale schools were encountered on 46 occasions (48 total individuals), mainly in shallow coastal waters of around 200m depth. Eighteen schools (19 animals) were approached for biopsy sampling and biopsy samples were collected from five individuals, after 18 darts were launched at 9 animals using two Larsen biopsy guns. Unfortunately, none of the biopsy samples could be removed from Russian waters because of CITES-related restrictions. A high-resolution digital camera was used to record scars of cookie-cutter shark bites on 22 common minke whales, all of which exhibited scars on their dorsal and/or lateral aspects. Other large cetaceans encountered were fin, North Pacific right and sperm whales.

In discussion, Miyashita explained that although some permit issues remained unresolved at the start of the cruise, the crew took five biopsy samples in the hope that the permits would be forthcoming. When they learned that it would be impossible to return the biopsies to Japan, the material was disposed of. For subsequent cruises, Japanese scientists plan to conduct some analyses onboard to ensure that at least some information is obtained from the samples (see discussion of SC/62/NPM23 under Item 7.6). It was suggested that other countries are able to import CITES-restricted material from Russia and that in the future the samples might be left with a Russian colleague who could subsequently arrange transfer through another country. This had been explored, but was also found to be unfeasible. In spite of these disappointments, the Working Group was pleased that this research had been conducted within the Russian EEZ, and had been able to collect biopsy samples from minke whales on the feeding grounds. The Working Group therefore **encouraged** future collaborations. Furthermore, the cruise produced valuable new observations on incidence of cookie-cutter shark marks on minke whales and sighting and photographic information on right whales.

SC/62/NPM10 estimated the mixing proportion of 'O' and 'J' stocks in the Sea of Okhotsk using cookie-cutter shark scars from 22 animals. Based on previous research in sub-area 11 in 1996 and 1999, the maximum likelihood estimate for the proportion of 'J' stock in sub-area 12 was 0.

The Working Group welcomed this valuable new information, but **agreed** that the method used to estimate mixing proportions needed some refinement. The baseline data used for incidence of scars on 'J' and 'O' stock were discussed. A question arose as to how long scars from cookie-cutter shark bites remain visible, which determines the time frame over which the observations provide information related to distribution. Although information on scar duration in common minke whales was not readily available, it was noted that some scars are clearly new, others appear to be healing, and others are completely healed and perhaps beginning to fade. Longitudinal studies of individual killer whales indicate that cookie-cutter shark scars can persist for multiple years. Collectively, these results suggest that some caution is needed in interpreting observations of juveniles, which have not had many years to accumulate scars and thus might be misidentified as belonging to a stock that does not frequently enter waters where cookie-cutter sharks occur.

It was suggested that additional data on cookie-cutter scars might be found associated with the JARPN and JARPN II programmes.

SC/62/NPM13 reviewed non-genetic biological information relevant to the stock structure of minke whales in the Yellow Sea, Sea of Japan (East Sea), and western Pacific Ocean. The review was structured to examine four key comparisons between: (1) the Yellow Sea and the Korean coast of the Sea of Japan; (2) the Korean and Japanese coasts in the Sea of Japan; (3) the Sea of Japan and Pacific coasts of Japan; and (4) coastal and offshore areas of the Pacific Ocean. The authors noted that examining minke whale stock structure was made difficult because there are no data from the breeding grounds and there are few data from mature females on the feeding grounds, as sampling has been limited to the mid-latitudes (mostly between 35° and 45°N). A few types of biological data were found to be particularly informative, including conception dates and flipper colour types. An examination of migration patterns, whale distribution, and historical whaling areas on feeding grounds, in concert with observations of immature/mature ratios and sex ratios also provided information to help fully describe possible stock structure hypotheses. Several lines of evidence point to the existence of a separate stock of minke whales in the Yellow Sea. In particular mature females with newborn calves are there in summer, and whales from the Yellow Sea only have dates of conception in autumn (July–September), in contrast to other areas which have winter conception (February–March) dates or a mix of autumn and winter conception dates. There is less information to determine whether two stocks exist on either side of the Sea of Japan. A small sample from the Sea of Japan shows a mixture of autumn and winter conception dates and of type III and type IV flipper colour types, which could be indicative of a mixture of two stocks, but can also be explained by whales from the Sea of Okhotsk moving into the northeastern Sea of Japan. Comparisons between the west and east coasts of Japan (Sea of Japan versus Pacific coast) are complex due to the possibility of certain areas having a mix of multiple stocks or undescribed distinct stocks. Pacific coastal data from Sanriku and east of Hokkaido have only winter conception dates and the type IV flipper colour pattern, whereas the small sample from Sea of Japan has a mix of fall and winter conception dates and type III and IV flipper patterns. It was noted that comparisons between coastal and offshore Pacific areas are complicated because sub-areas 8 and 9 are dominated by immature males whereas coastal sub-area 7 has a majority of females and a higher proportion of mature animals. Whale densities were also much higher along the coast than offshore, suggesting the possibility of a coastal stock, and differences were found between the amount of body scars from cookie-cutter sharks and in the concentrations of some contaminants. Again, the observation of only winter conception dates and the type IV flipper colour patterns from Sanriku and east of Hokkaido are not consistent with the hypothesis that coastal sub-area 7 has a mixture of two stocks. The authors concluded it was plausible there were stock differences between all four comparisons that were made.

The Working Group welcomed this attempt to synthesise diverse types of non-genetic information that potentially can inform discussions of stock structure. The Working Group found the idea of orienting the analyses around four key questions useful. The authors of SC/62/NPM13 acknowledged that although they had attempted to be exhaustive, they might have missed some relevant biological information, particularly if it was reported outside the IWC context, and requested that any such information be forwarded to them. The Working Group in particular supported the collation of the information in table 3 of SC/62/NPM13 and **encouraged** members to work together to complete this and provide it to the First Intersessional Workshop of the *Implementation Review*.

Information about conception dates presented in SC/62/NPM13 was discussed. It was pointed out that the same data are shown in table 1 (as counts) and fig. 6 (as proportions) in the paper, and the latter can be misleading when they are based on a small amount of data. It was also noted that some recent conceptions might be difficult to detect because the foetus is small, and this could potentially lead to bias in estimated conception dates if samples are taken primarily in certain seasons. Several members questioned the proposal, based on a sample size of only eight animals, that minke whales in the Sea of Japan have a bimodal distribution of conception dates. It was pointed out that these data, apparently based on Kato (1992), should not be considered as a single spatial unit because they were derived from two different surveys – three animals with October conception dates were taken off the east coast of Korea in 1972–73 (*Miwa-maru* operation using a self-factory catcher boat), while the other five were from small, coastal-based commercial whaling operations off the west coast of Hokkaido. Wade noted that the samples had been combined to represent samples from the Sea of Japan, which was still the case after the clarification of the exact location of the samples, so the conclusions of SC/62/NPM13 were still valid. It was pointed out that the data on flipper colouration based on Kato *et al*. (1992) were from the *Miwa-maru* operation, which never operated in the neritic zone; these data were therefore not comparable to those considered in SC/62/NPM1 in evaluating migration scenarios (see below). Wade clarified that those data had been used in SC/62/NPM13 to evaluate stock structure scenarios for the Sea of Japan, not migration scenarios, so samples would not need to be restricted to the neritic zone.

Table 1

List of sighting surveys and sightings of common minke whales.

Season	Period	Sub-area	Research vessel*	Research distance (n.miles)	No. primary sightings	
					Schools	Animals
Japanese surveys						
1989	13/07–25/08	12	KY1	1,263	25	30
1990	01/08–29/09	8	T25	789	2	2
1990	01/08–29/09	9	T25	2,716	10	10
1990	25/07–21/09	11	KY1	202	10	14
1991	26/07–19/09	7	KY1	1,900	10	13
1991	10/08–17/09	7	SHU	1,990	14	16
1992	29/07–23/09	6	T18	2,387	11	14
1992	01/08–20/09	7	SHU	2,786	8	8
1992	29/07–23/09	10	T18	1,094	8	9
1992	03/08–27/09	12	KY1	2,215	29	32
1994	05/07–07/09	9	T18,T25	3,981	20	21
1995	13/06–22/08	9	KY1,T18, T25	9,686	80	81
2002	10/04–09/05	6	KSK	390	5	7
2002	13/05–01/07	6, 10	SM2	2,162	33	34
2002	05/06–08/09	7, 8, 9	KS2	3,535	3	6
2003	11/04–10/05	6	KSK	716	3	3
2003	12/05–30/06	6, 10	SM2	1,878	27	31
2003	22/07–19/09	11, 12	SM2	1,598	60	67
2003	22/07–19/09	12	SM1	902	12	12
2003	14/05–05/09	7, 8, 9	KS2	4,934	66	73
2004	11/05–29/06	6, 10	SM2	1,898	14	14
2004	14/05–23/08	7, 8, 9	KS2	3,852	29	33
2005	12/05–30/06	10	SM2	841	11	12
2005	29/07–20/09	8, 9, 12	SM2	868	4	4
2005	29/07–20/09	9	SM1	996	6	6
2005	15/05–24/08	8, 9	KS2	4,975	14	15
2006	18/05–28/06	10	KKM	1,852	51	55
2006	17/05–26/08	7, 8, 9	KS2	5,413	45	53
2007	18/05–28/06	10, 11	SM2	1,599	39	47
2007	16/05–30/07	7, 8, 9	KS2	3,776	6	6
Korean surveys						
2000	Early May–early Jun.	6	TG3	709	25	28
2001	Mid Apr.–late May	5	TG3	811	28	30
2002	Mid May–early Jun.	6	TG3	1,169	30	32
2003	Mid Apr.–late May	6	TG3	1,082	16	18
2004	Mid Apr.–late May	5	TG3	1,787	18	20
2005	Mid Apr.–late May	6	TG3	1,145	28	32
2006	Mid Apr.–late May	6	TG3	1,070	20	25
2007	Mid Apr.–late May	6	TG3	1,043	21	25
2008	Mid Apr.–late May	5	TG3	1,384	18	18
2009	Mid Apr.–late May	6	TG3	1,144	36	40

*KKM = *Kaikomaru*; KSK = *Kurosaki*; KS2 = *Kyoshinmaru No.2*; KY1 = *Kyomaru No.1*; SHU = *Shunyomaru;* SM1 = *Shonan-maru*; SM2 = *Shonan-maru No.2*; T18 = *Toshimaru No.18*; T25 = *Toshimaru No.25*; TG3 = *Tamgu No.3.*

SC/62/NPM28 provided alternative interpretations of data discussed in SC/62/NPM13 and argued that the usefulness of SC/62/NPM13 is limited by the failure to interpret the biological information in the context of the available genetic data. Other major points in SC/62/NPM28 were: (a) the existence of different feeding grounds (Yellow Sea vs Sea of Japan) is not sufficient to define independent populations; (b) available biological data do not support division into three populations (Korean, west and east coasts of Japan); (c) different conception dates between west and east coasts of Japan (winter only in the Sanriku area) can be explained by assuming that juvenile 'J' stock animals intrude into this area (pregnant females of 'J' stock seldom enter this area); (d) sex-ratio differences between coastal and offshore whales can be explained by noting that juveniles (both male and female) feed in coastal areas, while offshore areas are occupied mainly by adult males (Hatanaka and Miyashita, 1997; Zenitani *et al.*, 2000); (e) differences in cookie-cutter shark scars can be explained by juveniles (fewer scars) being abundant in coastal areas and 'J' stock animals (fewer scars) being sometimes in coastal areas while adult males (more scars) are distributed in offshore areas.

Additional points made in discussion of SC/62/NPM13 and SC/62/NPM28 included that the results are generally consistent with existing O+J hypotheses based on how animals migrate in the vicinity of Hokkaido/Sakhalin Island. Animals bycaught around Japan were reported to be mostly juveniles, although these catches generally were not examined for maturity or pregnancy. Additional data might be found in IWC (1997). In Wada (1991), 'Sea of Japan' samples were taken from only a small section off the west coast of Hokkaido so are not representative of the entire Sea of Japan (Wada, 1991). Some types of information (e.g. sex ratio and percent sexually mature) may simply reflect demographics within a population and are of uncertain use for comparisons among stocks. Regarding the last point, Wade largely agreed but felt that, nevertheless, in some circumstances this type of information can be a useful indicator of migration patterns or mixing rates of components of a population.

SC/62/NPM1 evaluated the recent hypothesis regarding migration of 'J' stock animals (IWC, 2010b) in the context of available information on mixing patterns between 'O' and 'J' stocks, distribution of sightings, sea ice condition, and bycatch by coastal fishing gear. Collectively, this information agreed well with the following aspects of the hypothesised migrations of 'J' stock: (a) northward (feeding) migration begins in January–February; (b) pregnant females migrate into the southern part of Okhotsk Sea in April following the retreat of sea ice; (c) the main feeding season is April–June; (d) southward (breeding) migration starts in July; and (e) segregation by sex and maturity occurs, with pregnant females migrating to the northernmost distribution area, adult animals migrating and distributing in offshore waters in the Sea of Japan, and juveniles staying close to the coasts of Japan and Korea for most of the year, following a migration pattern that is different from adults.

The Working Group welcomed this paper. The caveats noted above for SC/62/NPM10 regarding estimates of mixing proportions in sub-area 12 also apply here. In addition, the small sample sizes for late summer limit the strength of conclusions that can be drawn. The question of whether juvenile 'J' stock animals did not go to the Sea of Okhotsk was raised. This was acknowledged to be a difficult question, with insufficient data. SC/62/NPM5 addressed whether 'J' stock went into sub-area 12 perhaps early in the year but that later in the year the whales were returning to their breeding grounds so fewer 'J' stock individuals were seen. Juveniles are bycaught as they migrate into sub-area 11, but the fraction of the population that this represents is uncertain.

Considering juvenile 'J' stock in sub-area 12, no data are available from the Russian EEZ. It is possible that whales might go into sub-area 12 as water temperature warms and ice recedes (see fig. 4 of SC/62/NPM1). In Japan and Korea, juveniles tend to be more coastal, so they are not likely to spread widely across sub-area 12. Although no data exist on prey availability, this area is one of most productive areas in eastern Asia, so it should be a good feeding ground. So, the hypothesis that the whales leave by mid-summer is not for lack of prey, but rather reflects the necessity of leaving early enough to arrive at the breeding grounds in time for autumn breeding (as indicated by conception date estimates). In response to a question, Hatanaka acknowledged that direct evidence that the southward migration begins as proposed is lacking, but the hypothesis is consistent with available information about sightings of migrating individuals (see fig. 8 of SC/62/NPM1). An unresolved question is whether changes in the fraction of 'J' stock individuals in the Sea of Okhotsk are due to outward migration of 'J' stock or more 'O' stock whales entering the area.

The Working Group reconsidered Hatanaka and Miyashita (1997) that investigated feeding migration based on length data. It was pointed out that these data are consistent with the generic concept of an 'O' stock, and that the length data might be useful for mature/immature determinations to condition different migration patterns for one or more 'O' stocks. The Working Group **agreed** to include these data in Appendix 2.

SC/62/NPM11 had two major objectives: (1) to determine the status of whales that could not be identified reliably to 'O' or 'J' stock based on analyses described in Kanda *et al*. (2009); and (2) to examine stock structure of the 'J' stock in the Sea of Japan and Yellow Sea. Data used included genetic variation at 16 microsatellite DNA markers analysed from samples collected during JARPN and JARPN II from 1994 to 2007. Previous analyses using the program STRUCTURE (Kanda *et al.*, 2009) classified 91% of sampled whales to either of two populations (assumed to be 'J' and 'O' stocks). It was argued in SC/62/NPM11 that the analysis could have overlooked additional, but weakly differentiated, stocks. An alternative explanation is that only two stocks exist and levels of differentiation are too small to provide 100% resolution. Additional STRUCTURE runs that focused on unassigned individuals and putative 'O' stock individuals failed to find any evidence of additional stock structure. Principal Component Analysis showed that unassigned individuals tended to occupy a multidimensional space that is intermediate to the centres of distribution of 'O' and 'J' stock individuals – a result that is consistent with what would be expected if the unassigned individuals actually come from either 'O' or 'J' stock. Regarding the second objective, SC/62/NPM11 analysed Korean genetic data for bycaught minke whales from 1999 to 2007 in combination with the Japanese genetic data used above. Samples from Korea from 2005–07 were not used in the previous papers. Analyses using STRUCTURE did not show evidence of more than a single population, while conventional hypothesis testing detected only very weak genetic differences among some of the Korean samples, as well as between the Korean and Japanese samples. The genetic differences between the Korean and Japanese samples could be due to a sub-stock (Y stock) that mainly occupies the Yellow Sea but sometimes migrates north along the Korean coast. Results of SC/62/NPM11 thus support the previous view that 'J' and 'O' are the main stocks inhabiting Korean and Japanese waters. In addition, a Y sub-stock might occupy the Yellow Sea, but further analyses with more samples from the Yellow Sea will be needed to reach a final conclusion.

The Working Group appreciated the efforts of the authors to respond to some of the suggestions for additional analyses made last year. Some discussion ensued on two data quality issues that were unclear in the paper. Park stated that the Korean laboratory followed the protocols described in the paper. Kanda explained that PCR products of 16 microsatellites amplified from five reference individuals were analysed in each laboratory for standardisation of microsatellite scores between the Korean and Japanese laboratories. Kanda also noted that genotypes at each of the loci were compared to see the differences in allelic sizes caused from using different platforms. For the current project, the Korean dataset was standardised to the Japanese set by deleting/adding base pairs to alleles at each of the loci, based on differences obtained from analysing the reference individuals. Kanda further explained that at the inter-lab coordination step, 6 loci were excluded because they had a wide range of allele sizes and/or many minor alleles that were difficult to score. Other members noted that it is not uncommon for different laboratories to be unable to achieve consistent scoring of a subset of loci. It was pointed out that data in table 5 of SC/62/NPM11 show that the Korean laboratory consistently reported higher numbers of alleles than the Japanese laboratory. At least two factors could explain this result: firstly, inconsistencies in scoring methods between the laboratories; and secondly different mixtures of stocks analysed by the two laboratories. It was suggested that comparison of winter samples only (when intrusion of putative Y-stock individuals is rare or absent) might help distinguish these two hypotheses. Kanda and Park performed a comparison for sub-area 6, which still showed the same pattern; at most loci, a larger number of alleles were found in samples from Korea that were analysed in the Korean laboratory.

Some members disagreed with the conclusion of SC/62/NPM11 that these results supported the view that 'J' and 'O' stock are the main stocks inhabiting Korean and Japanese waters. These members noted that the PCA showed a uniform distribution across the primary axis without obvious clustering, consistent with an effect of isolation by distance rather than discrete breeding stocks. There were also a large number of samples that appeared counter-assigned, i.e. samples assigned by STRUCTURE as 'O' stock were found on both sides of the principle component axis.

A question arose as to which information provided insights into a possible Y-stock. Kanda responded that this was inferred from differences between Korean areas of sub-area 5 (K5) and sub-area 6 (K6) – row 3 of table 7 of SC/62/NPM11. Sub-area K5 presumably includes only Y-stock, while sub-area K6 includes 'J' stock as well as seasonal intrusions of Y-stock. It was also noted that the comparison across both sides of the Sea of Japan (row 4 in table 7 of SC/62/NPM11) was also significant, although the F_{ST} value (0.0004) was very low. In response to a question, Kanda confirmed that the significance levels indicated in this Table reflected the Bonferroni correction for multiple testing. Results therefore suggest significant genetic differences for samples taken east and west of Korea, as well as between the Korean and Japanese coasts. It was suggested that fig. 5 of SC/62/NPM11, which showed that the fraction of individuals that are unassigned by the program STRUCTURE is roughly constant across all sample areas, might be useful for testing alternative stock-structure hypotheses. For example, the hypothesis that unassigned individuals represent a distinct stock would not be expected to produce this pattern. Another suggestion was to plot the third axis for figs 3 and 4 of

SC/62/NPM11. Hatanaka suggested that those proposing more analyses could undertake them by taking advantage of the Data Availability Agreement.

Two papers presented new analyses of mtDNA data. Paper SC/62/NPM21 examined genetic variation at the mtDNA control region to evaluate the plausibility of proposed stock structure scenarios for the 'J' and 'O' stocks. Analyses were based on samples collected during JARPN and JARPN II surveys from 1994 to 2007 in the area from the Japanese coast to offshore waters (to 170°E) on the Pacific side, and from by-catches around Japan and the Korean Peninsula. Analyses were conducted using updated databases (which included corrected versions of the mtDNA data) for both Korean and Japanese common minke whale mtDNA. Scientific Committee quality control guidelines were followed as far as possible. Samples were first separated into 'J' and 'O' stocks according to the results of the microsatellite analysis (SC/62/NPM11), and subsequent mtDNA heterogeneity tests were conducted for different categories of grouping (total samples, 'pure' 'O' or 'J+' unassigned samples and 'pure' 'J' or 'O' only). Heterogeneity tests were based on the randomised chi-square test and the F_{st} values were calculated to obtain an idea of the effect sizes of the groups compared. For comparisons involving 'pure' 'J' stock samples: (a) no seasonal significant differences were found in either the Sea of Japan or the Pacific side of Japan; (b) no significant differences were found between whales to the east and west of Japan; (c) a significant difference was found between Japanese and Korean samples, but the test became insignificant when whales in the Yellow Sea were excluded. F_{st} values in all these comparisons were very small. Tests for examining sub-stock structure in the 'O' stocks followed the four stock structure hypotheses adopted at the final stage of the *Implementation* in 2003. No significant heterogeneity was found when the samples were grouped and tested according to the geographical boundaries of the stock scenarios A, C and D and 'pure' 'O+' unassigned animals were used. The F_{st} values were very small in all comparisons. Therefore the present results provide no support for the occurrence of sub-structure within the 'O' stock. In general, the results of these mtDNA analyses, which were based on a substantial number of samples, supported the previous view of two stocks of common minke whale in the western North Pacific, the 'J' and 'O' stocks. The possibility of a different stock in the Yellow Sea should be further investigated in the future.

Some members expressed a general concern with the approach used to 'filter' 'O' and 'J' stock individuals based on the STRUCTURE assignment prior to use of the mtDNA in hypothesis testing.

SC/62/NPM20 reported on differences in mtDNA sequences and sex ratios in western North Pacific minke whales by combining information from samples collected in Korean market surveys (Korean 'bycatch', $n = 237$) with three datasets made available courtesy of the Institute for Cetacean Research (ICR) through the IWC Data Availability Group on 8 January 2010 (version 1.0): Japanese 'bycatch' ($n = 832$), 'coastal whaling' ($n = 481$) and 'offshore whaling' ($n = 1,238$). Because the initial dataset included a number of sequencing errors and errors in computing distance from shore, these analyses collapsed haplotypes into four haplogroups, previously considered to be informative (although not diagnostic) of the 'J' and 'O' stocks. The 'O' and 'J' types defined by the four mtDNA haplogroups showed a 93% concordance with samples assigned to the 'O' and 'J' clusters in the STRUCTURE analysis of microsatellite loci (Kanda *et al.*, 2009). Using the information on haplogroups and sex, SC/62/NPM20 reported on numerous pairwise differences for various strata, including sub-areas, source (bycatch, coastal whaling, offshore whaling), latitude (1 degree increments) and season (autumn/winter and spring/summer). Significant differences were found for either haplogroup frequencies, sex ratios or both, for almost all comparisons. A notable exception was the Korean bycatch (market individuals) vs. sub-area 6 bycatch (Japanese coast of Sea of Japan), which did not show significant differences in haplogroup frequencies, but did show a difference in sex ratios and in the haplogroups-by-sex effect. Analyses then focused on sub-areas 2 and 7W to investigate the potential for one or more coastal stocks along eastern Japan. Haplogroup frequencies of bycatch showed a pronounced change at 33–34°N, suggesting this might be a more natural division than the current subarea boundary at 35°N. Within sub-area 7W, comparisons showed differences in haplogroup frequencies and/or sex ratios for most strata, including 'bycatch (BC)', 'coastal Sanriku (CS)', 'coastal Kushiro (CK)' and 'offshore' hunting. As a qualitative investigation of 'J' stock distribution in sub-area 7W, the location of the four haplogroups were plotted according to latitude and longitude. At a qualitative level, these plots show no clear demarcation of haplogroups by latitude or distance from coastline within the range of the 'coastal' whaling operations at Sanriku and Kushiro.

Paper SC/62/NPM20 had the following conclusions regarding plausible stock structure hypotheses.

(1) CK and BC (sub-area 6) are similar in haplogroup frequencies, consistent with a primary influence of one stock, presumably the 'core' 'J' stock, present year-round in the Sea of Japan. In BC (Korea), however, the male-biased sex ratio and the haplogroup-by-sex differences could reflect migratory mixing (or mixing in the market) of a second stock, perhaps from the Yellow Sea. Although the majority of Korean bycatch is reported from the Sea of Japan (East Sea), some proportion of the whales killed in the Yellow Sea are probably transported for sale to Busan, Ulsan and Pohang, where the samples used in SC/62/NPM20 were collected. No sex bias or haplogroup-by-sex differences were found for BC (sub-area 6), suggesting a year-round presence of a non-migratory coastal stock.
(2) BC (sub-area 2) differs from BCK and BC (sub-area 6), and from BC (sub-area 7), suggesting the potential for an eastern coastal stock (J_E) with characteristics of the 'core' 'J' stock in the Sea of Japan (J_W).
(3) BC (sub-area 7), CS and CK differ from 'offshore' hunting, particularly in sub-areas 8 and 9, suggesting the potential for a second coastal stock (O_W) along eastern Japan, with some (perhaps seasonal) mixing of J_E and O_E. Stocks characterised by intermediate haplotype frequencies are well described in humpback whales, where stock divisions are supported by multiple lines of evidence (e.g. photo-id records).
(4) Although it is possible that the haplotype frequencies of sub-area 7W could be explained by a complex seasonal, sex- and age-biased mixing of two stocks, e.g. a 'core J' and a 'core O', this is not consistent with much of the available data including the observed absence of a haplogroup-by-sex effect in BC (sub-area 7), CS and CK.

The authors of SC/62/NPM20 would have liked to analyse the Korean bycatch data but did not have time to work through the data sharing agreement. SC/62/NPM21 noted that the Korean dataset as originally submitted included a number of sequencing errors, which have now been corrected.

Paper SC/62/NPM27 commented on the analyses conducted in SC/62/NPM20. Major points included: (a) interpretation of results of market samples is difficult, as the origin of the samples is unknown, and the dynamics of whale products in the market is undocumented; (b) quality control of market DNA samples followed protocols of Morin *et al*. (2009) rather than the guidelines agreed by the Scientific Committee; (c) haplogroup AA (informative of the 'J' stock according to the authors of SC/62/NPM20) occurs in higher frequencies in samples of the 'O' stock in coastal and offshore samples; and (d) several statistical comparisons were made for strata where 'J' and 'O' stock animals mix in different proportions. It is therefore not surprising that significant differences are found when these strata are compared. For example, the mixing fractions of 'J' and 'O' stocks are different among areas BC (sub-area 7), 7W and 7E. Consequently, haplogroup composition changes leading to the significant differences. Similarly, it is not surprising that no significant differences are found in comparisons among strata where only one stock is suspected (e.g. between sub-areas 8 and 9 and between BC (sub-area 6) and Korean market). SC/62/NPM27 provided two explanations for their results for the Pacific side of Japan: (i) complex seasonal mixing of 'O' and 'J' stock animals; and (ii) whales in sub-area 7W represent a third stock (e.g. O_w). They considered explanation (ii) more plausible, but did not provide any evidence for assigning plausibility. Results of statistical testing of strata including both 'J' and 'O' stock in different proportions are misleading.

Baker contested statements in SC/62/NPM27 because: quality control protocols as discussed in Morin *et al*. (2009) include and extend those considered by the Committee, and SC/62/NPM27 concludes that the hypothesis of multiple stocks is 'more parsimonious' (rather than more plausible) than a complex age-sex, latitudinal-longitudinal, migratory mix of two breeding stocks, which have no defined breeding grounds.

In discussion, it was clarified that although SC/62/NPM20 and SC/62/NPM27 largely considered the same group of samples, there were two important differences: (1) SC/62/NPM20 used market samples for Korean samples, while SC/62/NPM21 used bycatch; and (2) SC/62/NPM21 used mtDNA data that had been error-corrected subsequently due to time constraints and the agreed deadlines for *pre-Implementation assessment*, while SC/62/NPM20 used the original data and grouped haplotypes into haplogroups to minimise influence of the sequencing errors. Members noted some differences between results for mtDNA and microsatellites and suggested that it would be useful to combine results for the two marker types into a single analysis. Some argued that any deviations from the standard two stock (O+J) hypothesis could be explained by occasional intrusions of Y- or W-stocks. Others believed that the results supported separate 'J' stocks on either side of Japan, or more complex stock structure hypotheses.

The Working Group discussed standards for establishing/rejecting hypotheses, which the Committee had previously discussed on a number of occasions but has been unable to establish any guidelines or criteria. The Working Group **agreed** that it is important to try to find a balance between two potential errors: (1) interpreting minor differences that might be artefacts or not biologically meaningful as evidence for separate stocks; and (2) failing to recognise true stock structure because power to resolve closely related populations is low. Finding the appropriate balance, however, is challenging. One suggestion was to use a weight-of-evidence approach, combined with the expectation that a clear explanation is required if statistically significant results do not result in a new hypothesis.

Discussion of SC/62/NPM20 and SC/62/NPM27 also highlighted divergent opinions within the Working Group regarding how best to deal with the inability to sample pure populations on their breeding grounds. In one view, the best way to approach this problem is to utilise results of the program STRUCTURE, which is designed to deal with situations in which there are no reliable *a priori* ways of grouping individuals into putative populations. If the program works as intended, selective removal of individuals believed to be from different populations could facilitate more meaningful analyses of the data using traditional methods. Others argued that this approach has elements of circularity and can result in a false sense of confidence in model results. In addition, published papers document the inability of STRUCTURE to produce reliable results when dealing with mixtures of closely related populations or systems that are characterised by isolation-by-distance. In this view, relying on imperfect STRUCTURE classifications to adjust datasets runs too high a risk of masking true signals of subtle population sub-division. These same issues have arisen previously regarding earlier versions of the genetic data analyses for North Pacific minke whales (IWC, 2010a; 2010b). The Working Group **agreed** on the potential value of trying to collect at least some samples in areas where a single stock is believed to occur, but it is harder to agree on where such areas occur. There was little disagreement that only 'O' stock occurs in sub-area 8, as discussed in previous years. However, it was pointed out that it is possible for a sample to be 'pure' (in the sense that it includes only a single stock) but nevertheless not representative. This might occur, for example, if a stock is not completely homogeneous, but rather exhibits isolation by distance (individuals that occur closer together are more closely related). It is also problematic that mature females are largely absent from the whales killed in sub-area 9, and thus the available samples are not representative of a true population.

Paper SC/62/NPM30 was a direct response to a request by the Committee for repeating (using updated datasets) two types of analyses that were instrumental in erecting some of the existing stock-structure hypotheses: Boundary Rank (BR – see Taylor and Martien, 2003) and empirical Bayesian estimates of migration rates that are consistent with the genetic data (Taylor and Martien, 2004). An *ad hoc* e-mail group was assembled to help direct the analyses in the most productive way. Principal component analysis (PCA) was used to visualise geographically contiguous patterns of genetic variation because the initial configuration of samples for the original BR analyses could not be recreated. PCA does not group individuals into discrete populations; it outputs each individual's coordinates along axes of variation. However, it is possible to represent each individual PCA score for each axis of variation on a map, which allows regions that are genetically homogenous to be identified. These patterns, together with geographic boundaries of sub-areas specified in previous stock structure hypotheses, were used to group the >2,000 individual whales into 12 collections for use in the BR analyses. As the focus here was on possible heterogeneity within 'O' stock, the BR analyses considered four scenarios with increasing levels of the removal of individuals suspected of belonging to 'J' stock:

(1) all individuals included; (2) removing only individuals considered 'J' stock based on mtDNA haplotypes; (3) removing only individuals having a high assignment index for 'J' stock based on the program STRUCTURE; and (4) including only individuals having a high assignment index for 'O' stock based on the program STRUCTURE.

Although the PCA was only used for defining the initial configuration for the BR analyses, the results were discussed in some detail. Waples and Gaggiotti summarised the main results of SC/62/NPM30 as follows.

PCA. The analysis of Scenario 1 using the mtDNA data showed that the first three axes were statistically significant. A graphical representation is shown in fig. 1 of SC/62/NPM30. Axis 1 demonstrated heterogeneity within each of sub-areas 7, 8, 9. Axis 2 primarily contrasts southern regions of sub-areas 7, 8W, 9E with the rest of the sub-areas. PCAs under Scenarios 2–4 showed statistical significance of the first two axes, but no maps showing the spatial pattern were produced. A PCA of both mtDNA and microsatellite data show the same two axes, as well as a third significant axis that reflects variation in the microsatellite data. There was generally little heterogeneity for this third axis, except in the far northeast corner of sub-area 9. This persisted even under Scenario 4.

Boundary Rank Analyses. The first step repeated the BR analyses using mtDNA data for the 559 individuals included in the original (2003) analysis and led to a signal roughly consistent with Baseline C. The next step considered all the new mtDNA data and the four scenarios described above. None of these analyses supported Baseline C. Under Scenario 1, two BR steps were significant: Group 1 joining Groups 2–5, and Groups 1–5 joining Groups 6–12. Under Scenarios 2 and 3, no geographically separate clusters were found. These analyses proceeded by gradually adding individual groups to an increasingly large main cluster and the only significant test was the last step of adding Group 1 (animals just to the east of Hokkaido) to the remaining clusters. Under Scenario 4, none of the groupings were statistically significant. In this case, Group 1 is no longer distinctive and clusters with Group 4 early in the process. When the constraint against lumping samples that are not geographically contiguous was relaxed, results changed markedly. BR analyses were also performed using all available microsatellite data. Under Scenario 1, two statistically significant steps were found: Group 1 joining several others, and Group 3 joining Group 1 and the remaining sub-areas. No significant steps were found in Scenarios 2–4 with microsatellite data.

Migration rate simulations. A rigorous evaluation of this topic would have required updated estimates of abundance as well as detailed information about effect size, neither of which was available. Accordingly, a wide range of scenarios were considered, but results were not particularly useful as it appears that a very wide range of migration rates is consistent with the empirical data.

Discussion focused on whether, given results of these analyses, it is necessary to postulate more than one stock to the east of Japan. It was acknowledged that BR might not be designed to deal with situations like this, particularly because of uncertainties about how best to impose geographic constraints on grouping samples. During the discussion it was mentioned that the major results of the analyses could be summarised as follows: (1) BR of mtDNA found that the only genetically distinctive area was off the east coast of Hokkaido in the west part of sub-area 7; this pattern was seen in Scenarios 1–3 but disappeared under Scenario 4; (2) evidence for heterogeneity within O-type individuals depends largely on results of PCA analyses, which show residual heterogeneity in areas well to the east of the coastal areas (where 'J' stock mixing is likely). However, the information on stock structure provided by the PCA analyses is more qualitative than quantitative, and these results are not easily translated into specific stock-structure hypotheses; and (3) the PCA for microsatellite data identified a group of distinctive individuals in the far northeast corner of sub-area 9, which could be interpreted as support for intrusion of a different stock (perhaps the so-called W stock). Gaggiotti clarified that SC/62/NPM30 was completed well before the errors in mtDNA data were discovered. Therefore, the BR analyses were not performed with the error-corrected data. However, a reanalysis of the corrected mtDNA data using PCA produced results that were very similar to those of the uncorrected data set.

5.4 Stock-structure hypotheses

The Working Group reviewed and discussed two independent attempts to generate plausible stock-structure hypotheses that synthesised both genetic and non-genetic information.

SC/62/NPM12 examined recent progress in the development of stock structure hypotheses for western North Pacific common minke whales ('O' and 'J' stocks), and conducted a preliminary evaluation of these hypotheses in the context of the available scientific information, mainly genetics, presented and discussed by the Committee in recent years. The aim was to identify stock structure scenarios that are consistent with the data. The authors of SC/62/NPM12 considered that the best available scientific evidence is consistent with the hypothesis that there is a single 'J' stock distributed in the Yellow Sea, Sea of Japan and Pacific side of Japan and a single 'O' stock in sub-areas 7, 8 and 9. They considered this hypothesis the most plausible. It is consistent with the pattern of mixing between 'J' and 'O' stocks along the Japanese coast as proposed by Kanda *et al*. (2009), the migration patterns of adult and juvenile 'J' stock whales as suggested by SC/62/NPM1, and the migration of 'O' stock whales as suggested by Hatanaka and Miyashita (1997). SC/62/NPM12 postulated three less plausible hypotheses which modify the most plausible scenario as follows: (1) a W-stock sporadically intrudes into sub-area 9; (2) a different stock (Y-stock) resides in the Yellow Sea and overlaps with 'J' stock in the southern part of sub-area 6; and (3) a W-stock sporadically intrudes into sub-area 9 and a Y-stock resides in the Yellow Sea, and overlaps with 'J' stock in the southern part of sub-area 6. These four hypotheses are further described and shown graphically in Appendix 3.

The authors of SC/62/NPM15 reviewed genetic and non-genetic data regarding stock structure and summarised their conclusions in the context of addressing four key questions, as follows.

(1) Are whales in the Yellow Sea part of a population that migrates into the Sea of Japan? SC/62/NPM15 summarised that migration north into the Yellow Sea, the presence of mature whales and cow/calf pairs there, and the fact that Yellow Sea whales have only autumn conception dates (n = 124), provides evidence that a separate stock exists there. The Korean coast of the Sea of Japan showed some evidence for a mixture of two stocks, and microsatellite DNA showed seasonal differences that might be explained by a Yellow Sea stock moving along the Korean coast only in summer. In summary, the available data suggest that Yellow Sea whales may not be a part of the Sea of Japan stock.

(2) Are whales along the Korean coast part of the same population as whales along the western Japanese coast? SC/62/NPM15 summarised that there is no obvious hiatus in distribution between the two coasts, and that genetic analyses showed mixed results (haplogroup and STRUCTURE found no difference, pair-wise mtDNA and microsatellite DNA found differences). A small sample (*n* = 8) from the Sea of Japan showed a bimodal distribution of conception dates and a larger sample (*n* = 63) showed two different flipper colour patterns, but these data could be explained by a mixture of whales coming into the northeast Sea of Japan from the Sea of Okhotsk. No sex bias or haplogroup-by-sex differences were found for Japanese Sea of Japan bycatch, suggesting a possible year-round presence of a non-migratory coastal stock. In summary, it is plausible there are different stocks on either side of the Sea of Japan, but the data are somewhat contradictory or are lacking in sufficient resolution or spatial extent to make definitive conclusions. Some genetic evidence suggesting a second stock could be most simply explained by whales from a Yellow Sea stock appearing along the coast of Korea in summer.

(3) Are so-called 'J' type whales on the east coast of Japan the same population as on the west coast of Japan? The majority of whales bycaught on the southern Pacific coast of Japan (sub-area 2) are assigned to be 'J' type and so are either part of a Sea of Japan stock or are a coastal stock separate from a Pacific Ocean ('O') stock. Whales caught in the Pacific Ocean, even from sub-area 7 coastal areas, only have winter conception dates (*n* = 68) and a single flipper colour type (*n* = 77); if coastal sub-area 7 had a mixture of stocks there should be fall conception dates and a mixture of flipper colour types. There are differences in microsatellite DNA and mtDNA between the two coasts of Japan when all samples are used. Additionally, the southern Pacific coast bycatch (sub-area 2) is genetically different from bycatch along the northern Pacific coast of Japan (sub-area 7), suggesting a Pacific coastal stock might be distributed only in the Kuroshio current, and not further north in the Oyashio current. In summary, it is plausible that there are different coastal stocks on either coast of Japan, and/or longitudinally along the Pacific coast.

(4) Is there a coastal population in sub-area 7 (east of Hokkaido and northern Honshu) that is different from offshore minke whales in the Pacific Ocean, even after accounting for Sea of Japan whales that might migrate into this area? One hypothesis is that there is a 'pure' Sea of Japan stock ('J' type whales) and Pacific Ocean stock (O-type whales). Under that hypothesis, genetic differences between Pacific coastal waters (sub-area 7W) and other areas have been interpreted to be a mixture of these two stocks. An alternate hypothesis is that this area contains a distinct stock characterised by intermediate haplotype frequencies, as seen in humpback whales, for example. Again, the lack of evidence of fall conception dates (*n* = 68) and a mixture of flipper colour types (*n* = 77) in the Pacific Ocean argues against there being a mixture of stocks in coastal Pacific areas. Although it is possible that the haplotype frequencies of sub-area 7W could be explained by a complex seasonal, sex- and age-biased mixing of two stocks, e.g. a 'core J' and a 'core O', it is not as parsimonious as the hypothesis of a distinct stock with intermediate haplogroup frequencies. The absence of a strong haplogroup-by-sex interaction in coastal waters is inconsistent with the prediction of a sex-biased mixing of two stocks. SC/62/NPM30 concluded there was genetic heterogeneity in the Pacific Ocean, with a strong signal in the coastal area east of Hokkaido. In summary, the authors of SC/62/NPM15 thought it was plausible that the unique genetic signals seen in coastal waters of the Pacific coast of Japan are due to the existence of a distinct coastal stock or stocks, rather than a mixture of a 'pure J' and a 'pure O' stock.

Baker and Wade later generated a single additional stock-structure hypothesis from consideration of the four questions posed above. This hypothesis postulates six stocks (Y, J_W, J_E, O_W, O_E and W) and is described and shown graphically in Appendix 4.

In discussion, there was general agreement on two of the key questions posed by SC/62/NPM15: (1) a separate 'J' like stock (denoted Y-stock) occurs in the Yellow Sea and in at least some years some Y-stock whales are found in the Sea of Japan; and (2) minke whales on the east coast of Korea and on the west coast of Japan are generally part of a single stock.

In contrast, substantial disagreements remained about answers to the other two questions. These disagreements centred on how to interpret results of statistical tests showing heterogeneity of allele frequencies. In one view, the results can be explained by overlapping distributions of 'O' and 'J' stock, which leads to different mixing proportions (and hence different allele and haplotypic frequencies) in different geographic areas. Under this hypothesis, it would not be surprising that comparisons of samples from areas having different fractions of the two stocks often produce statistically significant results. An alternative view, as articulated in SC/62/NPM15 and SC/62/NPM20, is that an explanation that requires complex mixing patterns is less parsimonious than the hypothesis that the statistically significant differences reflect a distinct stock with intermediate gene frequencies.

Appendix 5 presented three new lines of evidence to support the mixing hypothesis from data for whales sampled from the coastal portion of sub-area 7W: (1) individuals assigned by STRUCTURE to 'O' stock tend to be larger than those assigned to 'J' stock – this is consistent with mixing but would not be expected if whales in this area represent a distinct stock; (2) as expected under the mixing hypothesis, the proportion of individuals assigned to 'O' stock increases with distance from the coast; and (3) four loci (and all loci overall) show highly significant deficiencies of heterozygotes in whales from this sub-area, which is a well known result when genetically divergent populations mix.

It was suggested that two additional types of information could help resolve whether the Hardy-Weinberg deviations are due to a mixture rather than some other factors that can cause the same result. Hardy-Weinberg departures are expected in a mixture only at loci for which allele frequencies differ substantially between contributing stocks. If it can be shown that the loci with significant departures are ones for which substantial differences are found between 'O' and 'J' stock, the argument would be strengthened. Deficiencies of heterozygotes can be due to a population mixture (as claimed here), but also to certain types of genotyping errors (null alleles or allele dropout). The argument would therefore be stronger if it can be shown that these same loci are in Hardy-Weinberg equilibrium in samples that are believed to come from a single population. It was also noted that none of the loci used in the studies were derived from minke whales, which can result in an increased probability of null alleles, and three of the four loci with deviations were eliminated as problematic in the combined datasets across the Japanese and Korean laboratories. In response, Kanda stated that Hardy-Weinberg deviations are not found for these loci in offshore samples (which presumably include few or no 'J' stock individuals).

Appendix 6 reached a different conclusion from consideration of allozyme data (Wada, 1984; 1991). Wada found deviations from Hardy-Weinberg equilibrium at the allozyme locus ADH-1 and evidence of seasonal mixing in what is now termed sub-area 11 (northeast coast of Hokkaido). However, he found no Hardy-Weinberg deviations in samples from small-type coastal whaling sub-area 7W, despite large samples sizes and various stratifications by year, month, age and sex. In discussion, it was suggested that the lack of Hardy-Weinberg equilibrium in sub-area 7W in Wada's analysis could perhaps be explained by the few commercial catches taken in very coastal waters, where the fraction of 'J' stock animals is high.

Other points raised included the following: (1) some analyses in SC/62/NPM15 (comparing 'J' stock along the east and west coasts of Japan) might have been wrongly extrapolated from bycatch (which includes juveniles) to the entire population; (2) Boundary Rank analyses do not support Baseline C, which is the basis for postulating a coastal stock in sub-area 7W; (3) sex-ratio differences noted by SC/62/NPM15 can be explained by segregation by sex and maturity; and (4) considerable evidence for stock mixing exists and has been presented, while the existence of additional stocks is only an opinion not based on real data.

In conclusion, in spite of disagreements about some specific points, the Working Group **agreed** that the set of stock-structure hypotheses based on the four proposed in SC/62/NPM12 and Appendix 3 and the fifth proposed in Appendix 4 were inclusive and sufficiently plausible to take forward to the next step in the *Implementation* process.

Several members prepared a minority statement, which is given in Appendix 7.

6. CATCHES

6.1 Review of information on any uncertainties in commercial catch reports

The Working Group noted that there was information available on the commercial catches for the countries that have taken the largest catches of western North Pacific minke whales. There are, however, limited data on catches for the People's Republic of China and no catch data for North Korea (if North Korea has taken western North Pacific minke whales).

6.2 Review information regarding incidental catches

Several sources of information regarding incidental catches were available.

SC/62/NPM4 provided information on incidental catches of common minke whales off Japan and Korea. Some suggestions were made on how plausible estimates of future incidental catches can be made, as well as to how past series, now considered erroneous, can be constructed. An annual trend of bycatch-per-unit effort (BPUE) was estimated. The annual incidental catches for 1995 to 2000, years for which incidental catches are believed to be underreported, were estimated using this BPUE trend estimate. It was suggested that these estimates are more plausible than assuming an annual incidental catch of 100 animals during this period.

The methods used in this paper were discussed under item 9.4 of Annex J. The Working Group noted that it would be useful if estimates were presented to the Preparatory Meeting for the First Intersessional Workshop of the *Implementation Review* (see Item 11.2).

SC/62/NPM19 provided information on bycatch of minke whales in Korean waters from 1996 to 2008. The authors collected bycatch data from the 14 local branch offices of the Korea Coast Guard which investigates the bycatch of cetaceans. A total of 1,156 minke whales were bycaught of which 83.7% were bycaught in the East Sea. Animals were entangled or trapped by set nets (n = 363), entangled by fish pots (n = 316) and gillnets (n = 303), respectively. Bycatch peaked in May–June and December–January. The average length of bycaught minke whales was 5.05m (range 2.7 to 9.0m). Minke whales were bycaught in a narrow band on the continental shelf of the East Sea while bycatch was scattered widely all over the shallow basins of the Yellow Sea and the Korea Strait. Bottom topography and oceanic conditions in the Yellow Sea reduces the incidence of bycatch even though there are minke whales there year round. Canonical Correspondence Analysis was applied to explain the characteristics of bycatch based on categorical variables such as area, fishing gear and size. Younger animals appear to be trapped in set nets in the southern part of the East Sea in spring. On the other hand, larger whales were bycaught by various fishing gears in the Yellow Sea from summer to winter and middle-sized animals were entangled year round by fish pots and gillnets in the northern part of the East Sea and the Korea Strait.

In discussion, concerning estimates of bycatches by fishing gear, the Working Group was informed that the large majority of the incidental catch off Japan was taken in set nets. Miyashita reported that 119 common minke whales were bycaught in set nets and one animal in a gillnet during 2009 (SC/62/ProgRep Japan).

The Working Group noted that SC/62/NPM26 provided information on incidental catches off Korea based on DNA profiling of market products. This paper was discussed under Item 9.4 of Annex J.

The Working Group **recommended** that available data on incidental catches and the associated effort should be analysed to develop CPUE series for possible use during the *Implementation Review*.

6.3 Development of a set of hypotheses for alternative removal series for use when conditioning trials

The Working Group **agreed** that sufficient information is available that alternative hypotheses regarding time-series of historical commercial and incidental catches could be developed during the *Implementation Review*.

6.4 Spatial and temporal disaggregation of removals

The Working Group **agreed** that there is sufficient information to disaggregate the historical commercial and incidental catches to sub-areas and periods during the year during the *Implementation Review*.

6.5 Areas and timing for future harvesting

SC/62/NPM3 and SC/62/NPM18 provided information on likely future whaling operations for minke whales in the western North Pacific. Japan aims to conduct land-based and pelagic whaling. Land-based whaling will be restricted to close to Japan while pelagic whaling will occur mainly in offshore areas. Temporal and spatial restrictions will be imposed on both types of whaling to try to reduce catching 'J' type animals. Korea intends to conduct land-based whaling to the east and west of Korea from March to November. These whaling plans will need to be elaborated further during the First Intersessional Workshop of the *Implementation Review*. Paper SC/62/NPM5, which describes sub-areas for use in the *Implementation*, was not discussed here and will be presented to the First Intersessional Workshop.

6.6 Future work

The work that needs to be completed prior to the Preparatory Meeting for the First Intersessional Workshop of the *Implementation Review* related to catches is:

(1) construction and GLM standardisation of CPUE series using the incidental catches and the associated fishing effort (see also Item 8.3);
(2) development of a format for reporting incidental catches by Japanese and Korean scientists and the Secretariat and the provision of these data in the agreed format to the Secretariat; and
(3) development of alternative hypotheses regarding time-series of past and future commercial and incidental catches.

7. ABUNDANCE ESTIMATES

7.1 Summary of available information and past discussions

SC/62/NPM2 provided estimates of abundance for the JARPN II survey area (sub-areas 7, 8 and 9, excluding the Russian EEZ) for the early (May and June) and late (July and August) seasons for 2006 and 2007. The data were stratified taking into account migration patterns suggested from sighting surveys during the 1994–2007 JARPN and JARPN II surveys. The abundance estimate for sub-area 7 was divided by 0.854 to account for incomplete coverage. Total abundance in the JARPN II area was 6,395 (CV = 0.717) and 2,872 (CV = 0.458) in the early and late seasons, respectively, assuming $g(0) = 0.798$ (SE = 0.134). The estimated numbers of common minke whales in the survey area during the late season was less than that during the early season. This can be interpreted by most minke whales migrating further north of the JARPN II survey area to regions such as the Sea of Okhotsk and the waters east of the Kamchatka Peninsula and the Kuril Islands. The estimate of 2,872 for the late season represents a part of the whole population and needs to be added to abundance estimates for the main distribution area of minke whales during the late season for *Implementation Simulation Trials.*

SC/62/NPM7 summarised the sighting surveys for minke whales in the western North Pacific conducted by Japan and Korea since 2000. The survey period for 'J' stock was April–June, and that for 'O' stock July–September. The areas covered were the Korean EEZ in sub-areas 5 and 6, the Japanese EEZ in sub-areas 6 and 10, the Russian EEZ in sub-area 10, the Sea of Okhotsk (sub-areas 11 and 12) and east of the Kuril archipelago and Kamchatka (sub-areas 8, 9 and 12), including the Russian EEZ. A total of 505 minke whale schools (560 animals) were sighted on 27,045 n.miles on primary search effort in 22 cruises.

SC/62/NPM16 analysed sightings data from recent surveys conducted by Korea in the Yellow Sea (sub-area 5) and the East Sea (sub-area 6) to estimate the abundance of minke whales. The covariates 'year', 'area' and 'wind' were considered and $g(0)$ was assumed to be 1. The hazard-rate and half-Normal models were considered as detection functions and the hazard-rate model was chosen using AIC. Two coastal and one offshore block for the Yellow Sea and three coastal and two offshore blocks for the East Sea were selected based on area coverage. The abundance in the Yellow Sea was estimated to be 1,534 (CV = 0.523) for 2001, 799 (CV = 0.321) for 2004 and 680 (CV = 0.372) for 2008. The abundance estimates for the East Sea were 549 (CV = 0.419) for 2000, 391 (CV = 0.614) for 2002, 485 (CV = 0.343) for 2003, 336 (CV = 0.317) for 2005, 459 (CV = 0.516) for 2006, 574 (CV = 0.437) for 2007, and 884 (CV = 0.286) for 2009. These may, however, be underestimates because $g(0)$ is assumed to be 1 and some effort and sightings were omitted to allow estimates to be computed for the same area in each year.

SC/62/NPM24 reported on a sighting survey for minke whales and other cetaceans in the East Sea from 21 April to 30 May 2009. The survey area consisted of one offshore block and four coastal blocks. The sightings were made by naked eye, with optional use of binoculars and performed in closing mode for species identification, school size estimation, and taking photographs and videos. The observers were trained to estimate distance and angle during the survey and tested. The research vessel covered 1,143.9 n.miles, and 40 minke whales in 36 primary sightings were observed. Common dolphins, Risso's dolphins, Dall's porpoises and finless porpoises were also sighted during the survey. An provided oversight on behalf of the Scientific Committee. The plan had been presented to the 2008 Annual Meeting (Choi *et al.*, 2008) and was endorsed by the Committee. The sighting survey was carried out under the guidelines for conducting surveys and completed the predetermined transect lines.

The Working Group expressed its appreciation to the Government of Korea for its continued commitment to surveys for minke whales in Korean waters, and to An for his role of oversight on behalf of the Committee. The Working Group **recommends** that the 2009 survey off Korea be adopted for use in the RMP.

SC/62/NPM8 updated the integrated abundance estimates for common minke whales in sub-areas 5, 6 and 10 using new information on abundance and $g(0)$ (Miyashita *et al.*, 2009; SC/62/NPM7 and SC/62/NPM16). Japan and Korea have conducted a series of sighting surveys during April–June in these sub-areas that are one of main habitats of the 'J' stock of common minke whales. Although parts of sub-areas 5 and 6 were not covered during the surveys because of the inability to cover the territorial waters of other countries, information on abundance from sightings data from Japanese and Korean surveys in the rest of the sub-areas can be integrated to obtain better estimates of the abundance of 'J' stock animals. A log-linear model with fixed year and survey block effects and random effects for the process error was employed. Estimates of $g(0)$ and their uncertainties were also taken into account. The extent of the process error was estimated through an integrated likelihood function, and other fixed effects were estimated using linear predictors. The predicted abundance estimates by block and sub-area, and for all three sub-areas together were produced for a reference year (2009), with and without a year trend in abundance. The results showed that the annual trend was not significant. Under the assumption of no annual trend, a spatially-extrapolated estimate for sub-areas 5, 6 and 10 combined was 16,162 (CV = 0.277). It should be noted that 'J' stock animals are also found in the East China Sea, Pacific coast of Japan and the Sea of Okhotsk, and this fact should be taken account of when estimates of abundance for the 'J' stock are used for management purposes.

The Working Group **endorsed** the method used to combine sightings data over time to estimate the extent of additional variance, but not necessarily the methods proposed for dealing with abundance across spatial areas in this case because of concerns over migration during the survey and extrapolation (see also Item 7.3). The Working Group did not review the abundance estimates in SC/62/NPM8 *inter alia* because it is unclear whether the sub-areas used for reporting abundance estimates in SC/62/NPM8 will be used in the *Implementation Simulation Trials* developed during the First Intersessional Workshop of the *Implementation Review*. It was noted that although models can be used to interpolate abundance for unsurveyed regions, if a region has never been surveyed, the abundance estimate for that region should be set to zero when calculating catch limits under the RMP.

7.2 General issues

The Working Group noted that sufficient information needs to be provided for the surveys to enable final decisions regarding whether the resulting abundance estimates can be used for conditioning and in the *CLA*. Specifically, it was noted that some of the surveys had taken place in the same direction as the expected migration of whales and information on why this does not lead to bias needs to be provided.

7.3 Selection of the years and areas for which abundance estimates will be available for use in conditioning of trials

SC/62/NPM14 reviewed the proposed method in SC/62/NPM8 for integrating surveys for use in the *Implementation Simulation Trials*. SC/62/NPM14 found there was a substantial seasonal trend in timing between the southern surveys and the northern surveys. The surveys in the Yellow Sea and the southern part of the East Sea/Sea of Japan occurred from mid- or late-April until late-May or early-June. The surveys of the northern part of the Sea of Japan occurred from mid- or late-May until mid- or late-June, meaning there is an approximate one month lag in the start of the surveys to the north, in the direction the minke whales are thought to be migrating. Therefore, there is the possibility of double-counting if abundance estimates from these two regions are added together, as has been proposed in SC/62/NPM8. Telemetry data on humpback whale migration shows they can travel 60–100km per day. The only telemetry data from minke whales is consistent with this; two minke whales on feeding grounds off northern Norway moved an average of 53 and 66km between daily positions (Heide-Jørgensen *et al.*, 2001). Using the 60–100km a day range one would expect it to take 16–27 days for a minke whale to travel from the southern tip of Honshu to west of Hokkaido (~1,600km), and 22–38 days from the southern tip of Honshu to the northern part of sub-area 10 (~2,250km). Given there is about a 20–30 day lag between the start of surveys in sub-areas 5 and 6-south, and the start of the surveys in sub-areas 6-north and 10, it is clear there is a strong likelihood of double-counting, so those sets of surveys should not be added together to get abundance for the population. SC/62/NPM14 recommended that the early surveys could be added together (survey areas 5E, 6WS and 6ES) for an abundance for that early period in those areas, and the later surveys could be added together (survey areas 6EN, 10E and 10W) for a later period. If the operating model used in the assessment has sufficient resolution (both temporally and spatially), the model could be fitted to both abundance estimates. However, given the migration of minke whales over the survey period it would be inappropriate to use the sum of the two numbers as an abundance estimate for the number of minke whales in the entire study area. SC/62/NPM14 also recommended against the proposal in SC/62/NPM8 to extrapolate average density from surveyed areas into large un-surveyed areas. This is not permitted under the RMP and the Committee has, in the past, also considered this inappropriate for *Implementation Simulation Trials*. This issue is not trivial; for example, an estimate of 1,029 in sub-area 5E is extrapolated to an abundance of 7,897 for the entire Yellow Sea in SC/62/NPM8.

Miyashita stated that SC/62/NPM14 referred to changes in the peak in the catch as evidence for seasonal northward migration (Omura and Sakiura, 1956), but it was necessary to take into account weather condition differences in the same month for different localities affecting the small-type whaling operation. The weather conditions may affect the putative peaks in the catch, which do not represent the migration of common minke whales. It was also stated that segregation by sex and maturity should be taken into account when considering migration. SC/62/NPM1 concluded that the feeding migration for 'J' stocks starts in January and February, the main feeding season for 'J' stock is April to June, and the southward migration starts in July. This means that 'J' stock animals in the Sea of Japan have already finished their northward feeding migration during the present survey period (April–June), and there are no double counting problems in the integrated abundance estimate in SC/62/NPM8.

The Working Group discussed possible migration patterns of 'J' stock minke whales in the Sea of Japan, as well as whether some component of the 'J' stock may not migrate to a substantial extent, in relation to how abundance estimates are computed and used in *Implementation Simulation Trials* and when applying the *CLA*. The Working Group **agreed** that care needed to be taken to avoid double-counting animals when computing abundance estimates. In relation to animals in the Sea of Japan and the Yellow Sea, the Working Group **agreed** that the *Implementation Simulation Trials* would capture hypotheses regarding the migration patterns of western North Pacific minke whales and that the models underlying these trials would be specified accordingly. The abundance estimates used for conditioning will be allocated to the appropriate time periods to avoid double counting.

The Working Group **agreed** that there are several abundance estimates for possible use when conditioning trials. Table 1 provides a summary of the sightings surveys for the sub-areas used in the last set of *Implementation Simulation Trials* and those conducted since. The Working Group did not discuss the acceptability or otherwise of the use of these surveys for conditioning the *Implementation Simulation Trials.* Table 1 provides an overview of where and for which months abundance estimates can be computed as required.

7.4 Selection of the years and areas for which abundance estimates will be available for use in *CLA* in trials

The Working Group noted that it was not necessary to select the abundance estimates for use in the *CLA* at the present meeting; this selection will take place during the First Intersessional Workshop of the *Implementation Review*. The selection of abundance estimates for use in *CLA* will need to take account of whether the surveys and their analysis followed the Requirements and Guidelines for Conducting Surveys and Analysing Data within the RMP (IWC, 2005b) [see also Item 7.2]. Some of these surveys (e.g. those from JARPN II) have not been reviewed by the Committee for use in the RMP.

7.5 Plausible range for *g*(0)

SC/62/NPM9 provided revised estimates of *g*(0) and abundance for western North Pacific common minke whales. The main changes from the previous analyses were the addition of new data, particularly for the Okhotsk Sea for 2003 and 2005. The model used to estimate *g*(0) is based on that used for Antarctic minke whales, although it is simpler because school size is usually one. The model without weather condition covariates had a lower AIC than the model with weather condition covariates, and the resultant abundance estimates were insensitive to whether the weather condition was included in the analysis or not. Thus, the final analysis did not include the weather condition. The resultant estimates of *g*(0) were 0.716 (SE = 0.16) for the Top barrel, 0.617 (SE = 0.19) for the IO platform, 0.505 (SE = 0.21) for the upper bridge, 0.798 (SE = 0.13) for the Top barrel and upper bridge, and 0.859 (SE = 0.10) for the Top barrel, IO platform, and upper bridge.

The Working Group welcomed SC/62/RMP9 which substantially reduced the previous range for *g*(0). There was insufficient time for an in-depth review of SC/62/NPM9. The Working Group **agreed** to review the method used to estimate *g*(0) and the resultant estimates further at the First Intersessional Workshop.

7.6 Plans for future surveys

SC/62/NPM17 and SC/62/NPM4 outlined the plans for future sighting surveys by Korea and Japan. Japan noted that it was not currently planning to conduct surveys in sub-areas 6 and 10, but may revise that decision in future. It was noted that the results of the *Implementation Simulation Trials* may provide information on which programme of surveys will lead to the best performance of the RMP, and that Japan and Korea may wish to modify their survey plans once the results of initial trials become available.

SC/62/NPM25 described plans for a sighting survey in the Yellow Sea, for April–May 2011, in IO passing mode using the research vessel *Tamgu 3*. The objective of the survey is to obtain information on the distribution and abundance of minke whales. The research area includes coastal and offshore waters in the Yellow Sea bounded by 123°24’E, 126°00’E, 33°00’N and 37°18’N. The survey area is divided into six blocks (three inshore and three offshore). The starting points for each block are set randomly and the total transect length is 1,534.2 n.miles, although several transect lines will be cut by the EEZ between Korea and China. The survey will start in the southern coastal block and move north. Once the coastal blocks are surveyed, the survey will cover the offshore block from north to south. Training and testing of distance and angle measurement will be conducted at the start and end of the survey. Biopsy samples will be attempted using both the Larsen gun and a crossbow. An would be able to provide oversight for the survey on behalf of the Committee. Details of the cruise report and abundance estimation will be presented in 2012.

The Working Group was pleased to see that distance and angle estimation will be tested and **requested** that the results of analyses of these and previous data be presented to future meetings. It was noted that the survey could be conducted to eliminate the possible implications of migration during the survey. The Working Group appointed An to provide oversight on behalf of the Committee.

SC/62/NPM23 described plans for a sighting and biopsy sampling survey for common minke whales in the Okhotsk Sea during summer 2010. The aim of the survey is to collect sightings data and information on stock identification. Biopsy sampling using Larsen guns and observations of cookie-cutter shark scars on whale bodies are planned. The research area is north of 46°N, south of 57°N and west of 152°E in the Okhotsk Sea, including the Russian EEZ and 12 tracklines totalling 2,110.0 n.miles are specified. The research vessel *Shonan-maru No.2* will conduct the survey from 13 July to 26 August 2010, and two Japanese scientists and a Russian observer will be onboard. As noted in SC/62/NPM22, all the biopsy samples taken during the last summer survey in the Okhotsk Sea could not be removed from Russian waters because of discrepancies between Russia and Japan as regards the domestic legal status of the common minke whale related to CITES as well as domestic legal systems related to international trade. To overcome this, genetic analysis using biopsied skin samples will be conducted on the research vessel. The RFLP analysis of mtDNA control region will be attempted. The skin samples will not be retained on board after genetic analysis. Photo-identification for large cetaceans such as North Pacific right whales will be also attempted.

The Working Group noted the importance of estimating the proportion of ‘J’ and ‘O’ stock animals in the survey area. It **recommended** that Japan explore ways that are not constrained by CITES to facilitate extracting relevant information from biopsy samples collected from the EEZ of Russia which could be used to explore stock structure and mixing. Specifically, ‘portable PCR’ methods can be used to extract DNA and amplify standard markers. Amplified fragments for sex identification can be visualised in the field with agarose gells. Biotin labelled primer can be used to amplify both microsatellite and mtDNA markers. The amplified fragments can then be bound to streptavidin-coated beads or plates, prior to washing away the native DNA. The streptavidin-bound synthetic DNA is not subject to CITES regulations (Jones, 1994). The Working Group appointed Miyashita to provide oversight on behalf of the Committee.

8. OTHER ISSUES

8.1 Reviewing the information to estimate dispersal rates and mixing proportions

The Working Group noted that SC/62/O30 outlined an approach for estimating mixing rates between stocks using microsatellite data.

8.2 Specification of biological parameters

8.2.1 Biological parameters

Values for the biological parameters for use in *Implementation Simulation Trials* for the western North Pacific minke whales had been assembled for the previous *Implementation* (IWC, 2004).

8.2.2 MSYR

The previous trials were based on values for MSYR(mat) of 1% and 4%. These values should be used in any new trials unless the current review of MSY rates (Annex D, Item 2) leads to a recommendation for a change to this range.

8.3 Other information

The Working Group noted that CPUE data had been assembled and used to compare alternative stock structure hypotheses (Yasunaga *et al.*, 2009, appendix II (Okamura)). The Working Group **recommends** that relevant commercial and incidental catch and effort data, along with the information identified by the 1987 CPUE Workshop (IWC, 1989), should be assembled, GLM standardised where possible, and be available at the First Intersessional Workshop of the *Implementation Review*. Data on flipper colour and conception dates should also be assembled and presented to the Preparatory Meeting of the First Intersessional Workshop of the *Implementation Review*.

9. OTHER BUSINESS

9.1 Review of proposed timetable for future *Implementations* and *Implementation Reviews* (IWC/62/7rev Appendix B, p. 37)

The Working Group **agreed** that it had completed the *pre-Implementation assessment* (see also Item 11.1) and the Committee should be able to complete the *Implementation Review* in 2012. The work plan (Item 11) outlines how the Working Group plans to ensure that it is able to complete the *Implementation Review* as scheduled. This will require adequate resources and planning.

9.2 Review of the Scientific Assessment Report

The Working Group reviewed the IWC Scientific Assessment Group (SAG) deliberations related to western North Pacific common minke whales. It noted that it was not possible to apply the RMP to the data for these minke whales owing to the considerable changes to the understanding of stock structure in recent years. It **agreed** that the present uncertainty precludes giving adequate advice regarding the catches in table 4 of IWC/62/7. The Working Group generally **agreed** with the conclusions of the SAG. A summary of the Working Group conclusions is as follows.

(1) The *Implementation* process should be completed as quickly as possible. Completing the *Implementation Review* will allow advice on catches to be based on the RMP, which has been selected to ensure that catches are sustainable.

(2) A high priority should be accorded to research to determine the proportions of 'O' and 'J' stock in sub-area 12 because the implications of any proposed catches for both 'O' and 'J' stock clearly differ depending on this proportion. In this respect, the Working Group welcomed the survey of sub-area 12 planned for summer 2010 and **emphasised** the importance of collecting as much data as possible to estimate stock proportions in sub-area 12.

(3) The proposed catches by coastal whalers in table 4 of IWC/62/7 may not help to improve the status of 'J' stock compared to current JARPN II catches. The incidence of 'J' stock in the catch decreases with distance offshore. The Working Group received an analysis which estimated the number of 'J' stock animals under catch levels of 150 inshore and 70 offshore (Appendix 8). The Working Group recognised the value of analysis such as those in Appendix 8 and **recommended** that further analyses be conducted using a finer spatial resolution and quantifying the uncertainty associated with the predictions, including the likely level of inter-annual variation in catches of 'J' stock animals.

(4) The Working Group was unable to agree on the impact of the proposed catches on the 'O' stock. However it **agreed** that the risk to the 'O' stock will be minimised if the *Implementation* is completed as soon as possible so that advice can be based on the RMP and hence also **agreed** that catches of 'O' stock should not exceed present levels.

Regarding distance from the coastline, Baker noted that accuracy of these data was particularly important to investigation of the nearshore distribution of 'J' stock, relative to the proposed small-type coastal whaling operation. Pastene responded that, in view of those inconsistencies, the analyses to investigate on 'J' stock the effect of limiting whaling operations to 10 n.miles or more from the coast was repeated using the correct data for distance from coastline. Results were very similar to those found in previous analyses.

The Working Group noted, but did not discuss, SC/62/NPM31 on reconsideration of the population status of the 'J' stock of common minke whales.

10. INITIAL DISCUSSIONS OF FUTURE EXPERIMENTAL AND ANALYTICAL WAYS TO DISTINGUISH AMONG COMPETING HYPOTHESES

Much of the remaining disagreement about competing stock-structure hypotheses centres on the question of whether minke whales in sub-areas 7 and 2 represent a mixture of 'O' and 'J' stock animals or a single stock with intermediate characteristics. Accordingly, the Working Group **agreed** that trying to resolve this issue should be a top priority, using both genetic and non-genetic data. Regarding the latter, under the 'pure' Sea of Japan stock hypothesis, 'J' stock whales are thought to have fall conception dates and a mix of flipper colour morphologies. To date, only winter conception dates and a single flipper colour morphology have been seen in the Pacific Ocean. If the mixture hypothesis is true, a mix of these biological traits should be seen in coastal sub-area 7, so data on these two biological traits from that area would be very useful.

IWC (2010b, p.207) identified a number of additional analyses of genetic data that might be informative regarding stock structure. This list is as follows, with annotations [in brackets] noting accomplishments since last year.

- Identify strata where only one stock occurs, or individuals from other stocks are sufficiently rare that genetic data from these strata can be used to characterise the stock of interest. These analyses might profitably start in sub-areas 7E and 8, where available data suggest that only a single stock occurs [PCA analyses in SC/62/NPM30 touch on this issue; addressed in part in SC/62/NPM20].
- Approach (1) could be performed in a sequential fashion, perhaps progressing from the western to eastern side of Japan [addressed in part in SC/62/NPM20].
- Focus particular attention on JE and O in sub-area 7, where over 1,000 samples have been collected [PCA analyses in SC/62/NPM11 did this; addressed in part in SC/62/NPM20].
- Increase the number of loci so that STRUCTURE can at least reliably separate all 'O' and 'J' stock individuals.
- Evaluate robustness of STRUCTURE results to use of admixture vs no-admixture and correlated vs uncorrelated allele frequency options [this was done intersessionally but not formally reported; according to

Kanda, results were not strongly affected by these variations].

- Do some new STRUCTURE runs that focus on unassigned individuals and/or 'O' plus unassigned individuals [SC/62/NPM11 did this].
- Use mtDNA haplotypes to verify STRUCTURE results and produce more robust population assignments. This would require concerted efforts to update the mitochondrial and nuclear DNA baselines with Korean data [Integration of Korean data is discussed in SC/62/NPM11 and SC/62/NPM21. SC/62/NPM20 shows results using the mtDNA haplogroup assignments].
- The program IM or a similar program could be used to test whether existing data are more compatible with an equilibrium model with migration or an isolation model.
- Consider feasibility of using the program GeneLand, which is similar to STRUCTURE but allows the inclusion of spatially-explicit data for each individual [this was done in conjunction with work reported in SC/62/NPM30. The program TESS was applied to the data but no meaningful results were obtained (O. Gaggiotti, pers. comm.)].
- Re-do the Boundary Rank analyses using new data [completed in SC/62/NPM30].
- Examine geographic and temporal patterns of occurrence of close kin [not done, but proposed again in SC/62/NPM29].
- Update the study of Taylor and Martien (2004) that used simulations to evaluate distribution of dispersal estimates that are compatible with existing mtDNA data [done in SC/62/NPM30].

In addition, four new items were suggested:

(1) Expanding the principal components analysis in SC/62/NPM30 to include multiple regression of additional factors (such as distance from shore and collection month and year) that might help explain patterns in the genetic data.
(2) Produce a more detailed description of methods for data quality assurance and efforts to standardise scoring between laboratories.
(3) Provide more detail about results of PCA analyses (described in SC/62/NPM30) under purging scenarios 2–4. In particular, what patterns of heterogeneity are seen and how do they differ from results under Scenario 1.
(4) Repeat SC/62/NPM20 using corrected haplotypes and Korean samples (subject to DAA).

11. RECOMMENDATIONS TO THE SCIENTIFIC COMMITTEE

11.1 Progress on the *pre-Implementation assessment*

The Working group **agreed** that it had successfully addressed all of the items required for a *pre-Implementation assessment* and therefore **agreed** that the *pre-Implementation assessment* was completed.

11.2 Other

The Working Group **recognised** that there is a considerable amount of work that needs to be done to complete the *Implementation Review*. Specifically, there is a need: (a) to assemble the data so that they can be used when conditioning the operating models on which the *Implementation Simulation Trials* are based; (b) to specify and code the operating models themselves; and (c) to fit the operating models to the agreed data sets (conditioning). The Working Group **agreed** that it would be infeasible to conduct all of the work in a single meeting (i.e. the First Intersessional Workshop). Rather, it **agreed** that the probability of completing the work during the first year of the *Implementation Review* would be maximised if two meetings were to take place. The main objective of the first meeting (the Preparatory Meeting) would be to determine the structure (time-steps, sub-areas and population components) of the operating models so that all relevant data can be assembled at the appropriate spatial and temporal resolutions in time for the First Intersessional Workshop, and to start to specify the operating models and how they will be conditioned. Appendix 9 outlines the work plan in more detail, including tentative dates for deadlines and for holding the Preparatory Meeting and the First Intersessional Workshop.

The Workshop proposed a Steering Group under Butterworth with members from Allison, An, Baker, Butterworth, de Moor, Donovan, Double, Hammond, Kitakado, Park, Pastene, Punt, Wade and Waples to coordinate any intersessional work and to facilitate holding the Preparatory Meeting and the First Intersessional Workshop.

12. ADOPTION OF REPORT

The report was adopted at 22:36 on 7 June 2010. The Working Group thanked the Chair for guiding them through a very difficult agenda. The Chair thanked the rapporteurs for their work on what was a long and detailed report.

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Appendix 1

AGENDA

1. Convenor's opening comments
2. Election of chair and appointment of rapporteurs
3. Adoption of Agenda
4. Review of documents
5. Stock structure
    - 5.1 Brief overview of past discussions
    - 5.2 Summary of available genetic and non-genetic data
    - 5.3 Consideration of new information/analyses
    - 5.4 Stock-structure hypotheses
6. Catches
    - 6.1 Review of information on any uncertainties in commercial catch reports
    - 6.2 Review information regarding incidental catches
    - 6.3 Development of a set of hypotheses for alternative removal series for use when conditioning trials
    - 6.4 Spatial and temporal disaggregation of removals
    - 6.5 Areas and timing for future harvesting
    - 6.6 Future work
7. Abundance estimates
    - 7.1 Summary of available information and past discussions
    - 7.2 General issues
    - 7.3 Selection of the years and areas for which abundance estimates will be available for use in conditioning of trials
    - 7.4 Selection of the years and areas for which abundance estimates will be available for use in *CLA* in trials
    - 7.5 Plausible range for *g*(0)
    - 7.6 Plans for future surveys
8. Other issues
    - 8.1 Reviewing the information to estimate dispersal rates and mixing proportions
    - 8.2 Specification of biological parameters
        - 8.2.1 Biological parameters
        - 8.2.2 MSYR
    - 8.3 Other information
9. Other business
    - 9.1 Review of proposed timetable for future *Implementations* and *Implementation Reviews* (IWC/62/7rev Appendix B, p.37)
    - 9.2 Review of the Scientific Assessment Report
10. Initial discussions of future experimental and analytical ways to distinguish among competing hypotheses
11. Recommendations to the Scientific Committee
    - 11.1 Progress on the *pre-Implementation assessment*
    - 11.2 Other
12. Adoption of Report

Appendix 2

DATA LIST FOR *PRE-IMPLEMENTATION ASSESSMENT*

N. Kanda, Y.R. An, T. Miyashita and C.S. Baker

Table 1

Data list for Japan.

Details	Raw format	Where held	Analytical methods	Key papers	Comments
Operational data					
Catch and effort					
Japan, coastal whaling CPUE – Searching time, – no catch, vessel tonnage	Electronic	IWC, NRIFSF	Bayesian population model	Kawahara (2003)	
Abundance					
Shipboard					
Japan, dedicated sighting survey – Sea of Japan in 2006 and 2007, – Sea of Okhotsk in 2003, – East of Kuril Islands, – Kamchatka Peninsula – (Russian EEZ in 2005) Sighting, effort and weather data, distance and angle experiment data	Electronic suitable for Distance	NRISFS	IO passing mode line transect survey with $g(0)$ correction	SC/62/NPM7 SC/62/NPM9 SC/62/NPM8	
Japan, dedicated sighting survey – Sea of Japan in 2002–05 Sighting, effort and weather data, distance and angle experiment data	Electronic suitable for Distance	NRISFS	Normal closing mode line transect survey without $g(0)$ corrections	SC/62/NPM7 SC/62/NPM8	
Japanese Scouting Vessel sighting data (1965–88) Noon positions, research distance, no. sightings (schools and animals), weather conditions (water temperature, wind speed, wind direction, water colour)	Electronic form	IWC	Density index (no. animals/research distance)	Miyashita *et al.* (1994)	
Angle and distance experiment data	Electronic	ICR, IWC		JARPN/JARPN II review*	1994–2007
Sighting data	Electronic	ICR, IWC		JARPN/JARPN II review*; SC/62/NPM2	1994–2007
Effort and weather data	Electronic	ICR, IWC		JARPN/JARPN II review*; SC/62/NPM2	1994–2007
Stock structure and dispersal rates					
Catch history					
Japan, coastal whaling biological data: date, time, position, length, sex., foetus length, stomach contents (species, quantity, size), foetus (number, sex, size), blubber thickness, testis weight, no. corpus luteum, no. corpus albicans, age.	Electronic? Data sheets	IWC, NRIFSF		Kato *et al*. (1992)	Conception date has been estimated from the foetus growth curve, and used in Kato *et al*. (1992)
Biological					
Sex	Electronic	ICR, IWC		JARPN/JARPN II review*	1994–2007
Body weight	Electronic	ICR, IWC		JARPN/JARPN II review*	1994–2007
Organ weight	Electronic	ICR, IWC		JARPN/JARPN II review*	1994–2007
Maurity stage	Electronic	ICR, IWC		JARPN/JARPN II review*	1994–2007
Corpora albicantia and lutea (number)	Electronic	ICR, IWC		JARPN/JARPN II review*	1994–2007
Lactation condition	Electronic	ICR, IWC		JARPN/JARPN II review*	1994–2007
Testis weight	Electronic	ICR, IWC		JARPN/JARPN II review*	1994–2007
Foetus, number	Electronic	ICR, IWC		JARPN/JARPN II review*	1994–2007
Foetus sex	Electronic	ICR, IWC		JARPN/JARPN II review*	1994–2007
Foetus, body length	Electronic	ICR, IWC		JARPN/JARPN II review*	1994–2007: Conception date can be estimated from the foetus growth curve, but the number of foetus data was 39 from JARPN II (IWC, 2010, pp.441–45).
Foetus, body weight	Electronic	ICR, IWC		JARPN/JARPN II review*	1994–2007
Ecological					
Parasites (external)	Electronic	ICR, IWC		JARPN/JARPN II review*	1994–2007
Parasite (internal)	Electronic	ICR, IWC		JARPN/JARPN II review*	1994–2007, offshore
Blubber thickness	Electronic	ICR, IWC		JARPN/JARPN II review*	1994–2007
Girth	Electronic	ICR, IWC		JARPN/JARPN II review*	1994–2007
Stomach contents (IWC format)	Electronic	ICR, IWC		JARPN/JARPN II review*	1994–2007
Stomach contents weights	Electronic	ICR, IWC		JARPN/JARPN II review*	1994–2007
Main prey species in stomach contents	Electronic	ICR, IWC		JARPN/JARPN II review*	1994–2007

Cont.

Details	Raw format	Where held	Analytical methods	Key papers	Comments
Ecological cont.					
Freshness of stomach contents	Electronic	ICR, IWC		JARPN/JARPN II review*	1994–2007
PCB concentrations (blubber)	Electronic	ICR, IWC		JARPN/JARPN II review*	2000–07, offshore
Total Hg levels (liver)	Electronic	ICR, IWC		JARPN/JARPN II review*	1994–2007
Total Hg, methyl Hg and Se levels (liver)	Electronic	ICR, IWC		JARPN II review*	2000–07, offshore
Total Hg, methyl Hg and Se levels (kidney)	Electronic	ICR, IWC		JARPN II review*	2000–07, offshore
Total Hg, methyl Hg and Se levels (muscle)	Electronic	ICR, IWC		JARPN II review*	2000–07, offshore
Cookie cutter shark scars	Electronic	NRIFSF ICR, IWC		SC/62/NPM10 JARPN/JARPN II review*	1994–2007
Genetics					
Allozymes	Electronic	ICR, IWC		JARPN review*	1994–99
Mitochondrial DNA control region sequences	Electronic	ICR, IWC		JARPN/JARPN II review*	1994–2007
	Electronic	OSU, IWC		Lukoschek *et al.* (2005)	1999–2004, market samples
Microsatellites (16 loci)	Electronic	ICR, IWC		JARPN/JARPN II review*	1994–2007
Morphometric					
Body length	Electronic	ICR, IWC		JARPN/JARPN II review*	1994–2007
Body proportion	Electronic	ICR, IWC		JARPN/JARPN II review*	1994–2007
Skull (length and breadth)	Electronic	ICR, IWC		JARPN/JARPN II review*	1994–2007

*For more details see JARPN review report (IWC, 2001) and JARPN II review report (IWC, 2010) or references therein.

Table 2
Data list for Korea.

Details	Raw format	Where held	Analytical methods	Key papers	Comments
Operational data					
Catch and effort					
Korea, coastal whaling CPUE – Searching time, no. of catch, vessel tonnage	Printed document	IWC, CRI	Bayesian population model	Gong and Hwang (1984)	
Abundance					
Shipboard					
Korea, dedicated sighting survey East Sea in 2000, 2002–03, 2005–07 and 2009 Yellow Sea in 2001, 2004 and 2008	Electronic suitable for Distance	CRI mode	Normal closing line transect survey without $g(0)$ corrections	SC/62/NPM16 SC/62/NPM7 SC/62/NPM8	
Angle and distance experiment data East Sea in 2000, 2002–03, 2005–07 and 2009 Yellow Sea in 2001, 2004 and 2008	Electronic	CRI			
Sighting data	Electronic	CRI			
Effort data	Electronic	CRI			
Stock structure and dispersal rates					
Biological					
Sex	Electronic	CRI			1999–2009 bycatch
Ecological					
Main prey species in stomach contents	Electronic	CRI			2007–09 bycatch
POPs (persistent organic pollutants) levels (muscle, liver)	Electronic	CRI		Moon *et al.* (2009)	2006 bycatch
PFCs (perfluorinated compounds) levels (liver)	Electronic	CRI		Moon *et al.* (2009)	2006 bycatch
Heavy metal (As, Cd, Cu, Hg, Pb and Zn) levels (muscle, liver)	Electronic	CRI		Kim *et al.* (2005)	2004 bycatch
Genetics					
Mitochondrial DNA control region sequences	Electronic	CRI		SC/62/NPM21	1999–2009 bycatch
	Electronic	OSU, IWC		Baker *et al.* (2007); SC/62/NPM20	1999–2005 market samples
Microsatellites (11 loci)	Electronic	CRI		SC/62/NPM11	1999–2009 bycatch
Morphometric					
Body length	Electronic	CRI			1999–2009 bycatch
Body proportion	Electronic	CRI			2004–09 bycatch

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Appendix 3

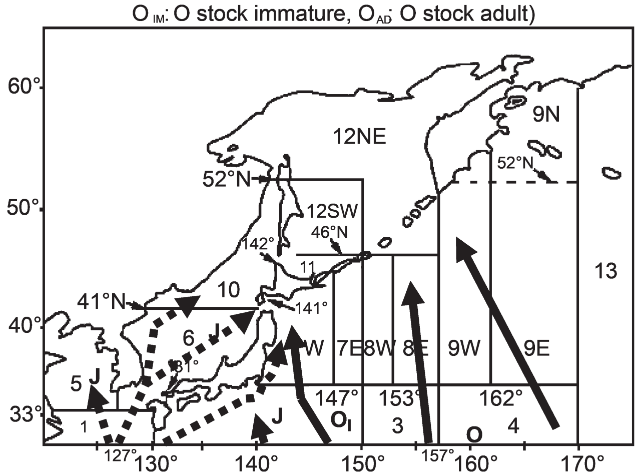
HYPOTHESES ON STOCK STRUCTURE IN WESTERN NORTH PACIFIC COMMON MINKE WHALES

Luis A. Pastene, Mutsuo Goto and Naohisa Kanda

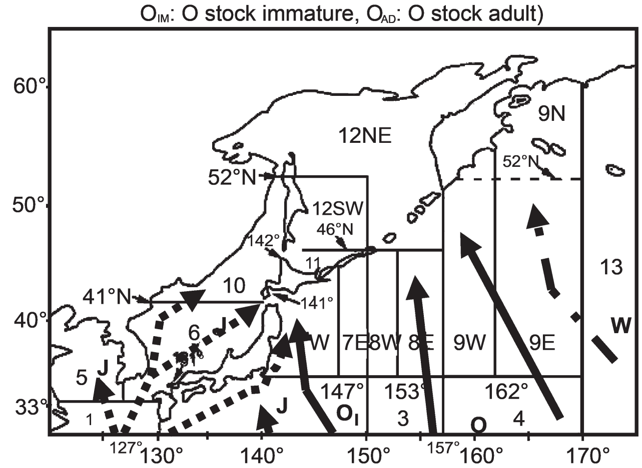
The best available scientific evidence is consistent with the following hypothesis, which is considered the most plausible:

(1) Single 'J' stock distributed in the Yellow Sea, Sea of Japan and Pacific side of Japan (pattern of interaction between 'J' and 'O' stocks along the Japanese coast as proposed by Kanda *et al*., 2009). Migration pattern of adult and juvenile 'J' stock is as suggested by SC/62/NPM1. Single 'O' stock in sub-areas 7, 8 and 9. Migration of 'O' stock is as suggested by Hatanaka and Miyashita (1997).

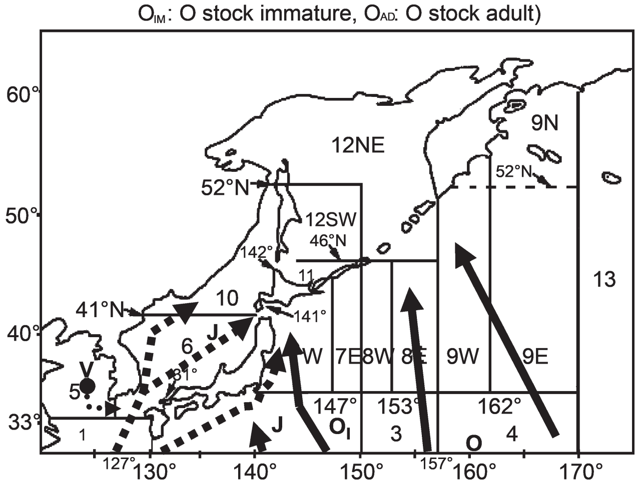
Hypothesis 1: (J/O: mixture of J and O stocks, O_{IM}: O stock immature, O_{AD}: O stock adult)



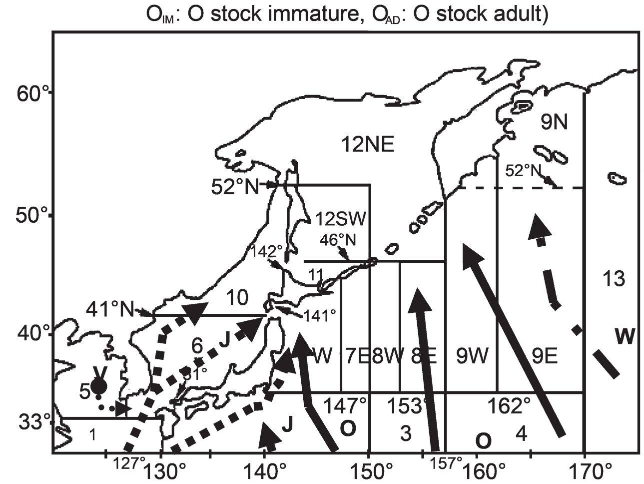
Hypothesis 2: (J/O: mixture of J and O stocks, O_{IM}: O stock immature, O_{AD}: O stock adult)



Hypothesis 3: (J/O: mixture of J and O stocks, O_{IM}: O stock immature, O_{AD}: O stock adult)



Hypothesis 4: (J/O: mixture of J and O stocks, O_{IM}: O stock immature, O_{AD}: O stock adult)



Three less plausible hypotheses are also postulated:

(2) Same as in (1) but W stock sporadically intrudes into sub-area 9.
(3) Same as (1) but a different stock (Y stock) resides in the Yellow Sea and overlaps with the 'J' stock in the south part of sub-area 6.
(4) Same as in (1) but with W stock sporadically intrudes into sub-area 9 and a different stock (Y stock) residing in the Yellow Sea, which overlaps with the 'J' stock in the south part of sub-area 6.

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Appendix 4

A PLAUSIBLE STOCK STRUCTURE HYPOTHESIS FOR WESTERN NORTH PACIFIC MINKE WHALES BASED ON EVIDENCE SUMMARISED IN SC/62/NPM15

C.S. Baker and P. Wade

The review of genetic and biological data from the western North Pacific minke whale provides evidence to address four primary uncertainties (SC/62/NPM15):

(1) Are whales in the Yellow Sea part of the same population that migrates into the Sea of Japan? No, there is genetic and biological evidence of differences. The population may overlap with the population in the Sea of Japan during part of the year.
(2) Are whales along the Korea coast part of the same population that migrates along the Japanese coast of the Sea of Japan? Yes, there is little evidence of differences between these two coasts. The population is at least partly non-migratory, as evidenced by year-round bycatch in sub-area 6.
(3) Are whales along the east coast of Japan part of the same population as those in the Sea of Japan? No, there is genetic and biological evidence of differences between these two coasts. The population is at least partly non-migratory, as evidenced by year-round bycatch in sub-area 2.
(4) Is there a coastal population in sub-area 7 that is different from the offshore population in the Pacific Ocean, even after accounting for some Sea of Japan whales (or other stocks) that might migrate into this area? Yes, there is genetic and biological evidence of differences between whales in near-shore sub-area 7 and those further offshore.

Together, the evidence relating to these four uncertainties is sufficient to propose a plausible hypothesis of 5 stocks, referred to as Y, Jw, Je, Ow and Oe. Finally, there is genetic evidence for heterogeneity to the east of the Oe stock, presumably representing a sixth stock, referred to previously as W.

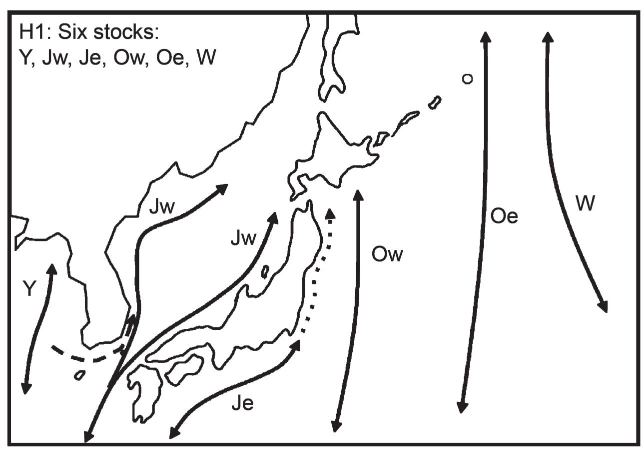


Fig. 1. Six stock hypothesis.

Appendix 5

COMMENTS ON SC/62/NPM15

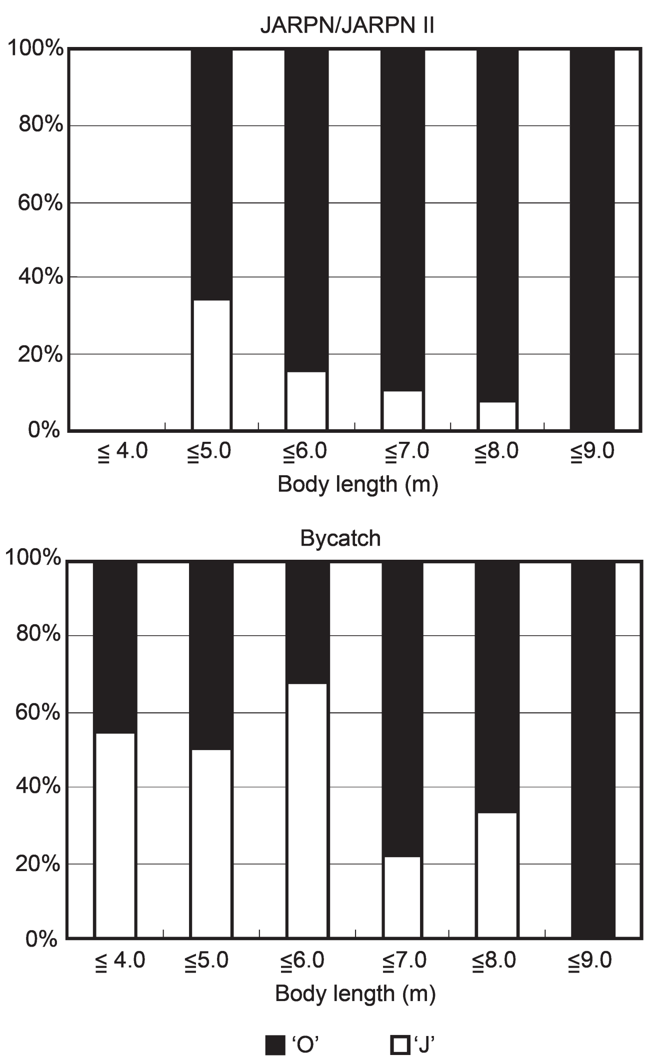
N. Kanda, LA. Pastene and H. Hatanaka

Paper SC/62/NPM15 proposed the existence of a distinct coastal stock in addition to the 'J' and 'O' stocks along the Pacific coast of Japan (sub-area 7W), rather than a mixture of the 'J' and 'O' stocks. Here, we argue against their hypothesis of a distinct coastal stock by presenting some pieces of evidence.

We have shown the results of assignments of the minke whales to the 'J' and 'O' stocks by conducting a STRUCTURE analysis (e.g. SC/62/NPM11). If there is a distinct coastal stock in sub-area 7W as they proposed, it is predicted that proportions of the two identities should be almost the same by: (1) body length; and (2) distance from the coastline. In addition, (3) the sample of all minke whales from sub-area 7W should be under the Hardy-Weinberg expected genotypic proportions.

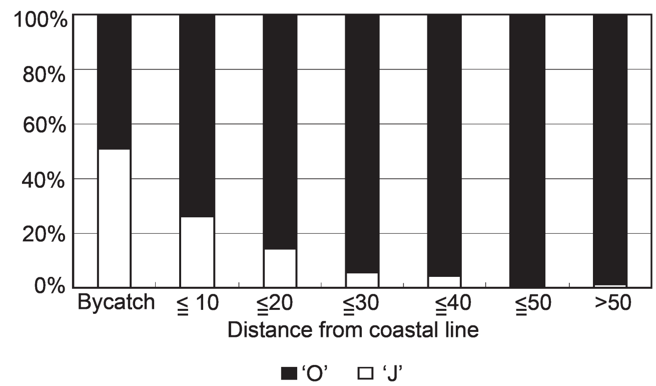
(1) Body length

The histograms below indicate that those assigned to the 'O' stock tend to be larger than those assigned to the 'J' stock.



(2) Distance from the coastline

The figure below shows the proportion of the minke whales assigned to 'J' and 'O' stocks by the distance from the coastline. The proportion of the whales assigned to the 'O' stock increases offshore.



(3) Hardy-Weinberg expected genotypic proportions

The table below shows the result of the tests for deviation from the Hardy-Weinberg expected genotypic proportions at each of the 16 microsatellite loci in the sample of all common minke whales collected from sub-area 7W (i.e. both bycatch and JARPN/JARPN II samples (n = 1,106)). Four of the 17 loci showed significant deviation from the Hardy-Weinberg expected genotypic proportions. All of these significant results were due to the homozygote excess, supporting the mixture of two stocks.

Table 1

Results of tests for deviation from the Hardy-Weinberg expected genotypic proportions in minke whales from sub-area 7W.

Locus	p-value
EV37	0.8778
EV1	0.1290
GT310	0.0000*
GATA28	0.0401
GT575	0.0495
EV94	0.6931
GT23	0.0157
GT509	0.0000*
GATA98	0.4467
GATA417	0.0461
GT211	0.0298
EV21	0.1517
DlrFB14	0.0389
EV14	0.0003*
GT195	0.0000*
TAA31	0.0474
All loci	Highly significant

*Significant after correction for multiple tests.

In conclusion, these results presented here support that the minke whales distributed in sub-area 7W are a mixture of the 'J' and 'O' stocks, rather than a single coastal stock.

Appendix 6

COMMENT ON MIXING IN SUB-AREA 7W: HARDY-WEINBERG IS PLAUSIBLE OR NOT?

C.S. Baker and P. Wade

Wada (1984) provided the first genetic evidence for a distinct stock of minke whales in the Sea of Japan, based on a comparison of allele frequencies of the Adh-1 allozyme locus. Wada (1991) updated this analysis comparing the genotype frequencies of n = 903 whales taken by Japanese small-type coastal whaling in areas A, B, C and D. In area A (now referred to as sub-area 11), the results showed a significantly higher frequency of the Adh-1^D allele and a deviation of genotype frequencies from Hardy-Weinberg (an excess of homozygotes), particularly in the month of April, compared to areas B and C (now referred to a sub-area 7W). Wada (1991) attributed the deviation in sub-area 11 to a mixing of whales from the Sea of Japan, where the frequency of Adh-1^D is nearly fixed (Adh-1^D = 0.93, with whales from the Pacific coast, where Adh-1^D = 0.31. In sub-area 7W, Wada (1991) found no evidence of deviation from Hardy-Weinberg equilibrium in analyses of the total sample, or in stratification by year, month, sex or age class.

Appendix 4 reports deviation from Hardy-Weinberg at 4 of 17 loci for a sample of n = 1,106 minke whales taken as bycatch and in scientific hunting in sub-area 7W. These authors attribute this deviation (an excess of homozygotes) to the mixing of whales from two distinct stocks (e.g. 'J' and 'O') in the near-shore waters of Honshu and Hokkaido.

In summary, the allele frequencies and Hardy-Weinberg equilibrium of the Adh-1 locus in the small-type coastal whaling from sub-area 7W, as reported by Wada (1991), are inconsistent with the simple mixing of two stocks, as proposed in Appendix 4, and with the proposed 'feeding migratory route' of juvenile 'J' stock whales, as proposed by Goto *et al.* (SC/62/NPM1).

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Appendix 7

MINORITY STATEMENT REGARDING PLAUSIBILITY OF STOCK STRUCTURE HYPOTHESES

H. Hatanaka, L.A. Pastene, N. Kanda, T. Gunnlaugsson, J.Y. Park, S.G. Choi and Y.R. Rock

After the deliberations on plausible stock structure hypotheses during the PIA for western North Pacific minke whales, Baker and Wade proposed some hypotheses for the Pacific side of Japan which we believe are not consistent with the current available data. We do not support the hypotheses of J_e and O_w stocks in the Pacific side of Japan because they are not supported by the existing data. However, we did not want to block the consensus which would have stopped the process from moving to the next step. Therefore we reluctantly accepted that the Baker and Wade hypotheses be included on the basis of assurances from both the chair of NMP and the IWC Head of Science that: (a) the *pre-Implementation assessment* requires only an agreement on stock structure hypotheses that meet some minimum standard of plausibility and does not prejudge actual plausibility of hypotheses; (b) there would be opportunities at a later stage of the process to delete hypotheses; and that (c) not all hypotheses included at this point would need to be tested. Again, this does not mean we agree with these hypotheses.

Baker and Wade proposed a coastal 'J' stock in sub-area 2 (J_E) and a coastal 'O' stock in sub-area 7 (O_W). Japanese scientists have demonstrated through the analysis of biological and genetic data that both 'J' and 'O' stocks mix with each other along the Pacific side of Japan. Baker and Wade made use of mixed samples of both stocks in their mtDNA haplogroup analysis to reach their conclusions that there are stocks with intermediate haplotype frequencies. Their analytical approach is contrary to previous recommendations from the Scientific Committee to exclude 'J' stock animals from analysis on stock structure of the 'O' stock. Furthermore an updated Boundary Rank analysis did not support the occurrence of an O_W stock. Previous results from this method had been the only evidence for supporting an O_W stock in the past. Given the results of the updated Boundary Rank analyses their hypothesis should not have been listed as plausible hypotheses at this stage in the process.

The hypothesis they proposed is especially hard to address with additional data. Therefore we consider reasonable that they provide reasonable logic to support their claim of plausibility for this stock structure scenario by the next Scientific Committee meeting. Without the provision of a reasonable logic their hypotheses should be dropped from the list of plausible hypotheses.

Appendix 8

LIMITING WHALING OPERATIONS ON 'O' STOCK COMMON MINKE WHALES TO WATERS 10 NAUTICAL MILES OR MORE FROM THE JAPANESE PACIFIC COAST MINIMISES CATCH OF 'J' STOCK WHALES

N. Kanda, H. Hatanaka and M. Goto

Introduction

Concerns have been expressed that providing a quota for 'O' stock common minke whales to be taken in the Pacific coastal waters of Japan as part of an agreement on the 'future of IWC' will increase the accidental take of 'J' stock animals. In this regard, the report of the Scientific Assessment Group (IWC/M10/SWG6) indicates that introducing a 10 n.mile buffer zone would limit the number of 'J' stock animals accidentally caught in coastal whaling operations to 27 and noted that 'if it is possible for catch effort to be moved further offshore then this is likely to reduce the likelihood of catches of 'J' stock animals'. This Appendix provides more detailed analysis of the effect of introducing a 10 n.mile buffer zone on the number of 'J' stock animals to be accidentally caught based on both past commercial whaling data and data from JARPN and JARPN II. Whaling operations proposed in the agreement will in any event be mostly well beyond a 10 n.mile buffer zone. Japan's proposal for the agreement would change the current research take of 120 coastal and 100 offshore minke whales to a quota of 150 coastal and 70 offshore.

Materials and methods

Sampling of common minke whales during JARPN II coastal component surveys is conducted in coastal waters within 50 n.miles from the whaling ports. Analyses of these whales taken by JARPN II surveys, as well as bycaught whales from set net fisheries (bycatch), indicates that the 'J' stock whales tend to be distributed in the area close to the coast line (10 n.miles or less). Proposed future coastal whaling plans to operate in coastal waters more than 10 n.miles from the coastal line in order to avoid 'J' stock animals. The extent to which such a limit to the operation of future whaling on the 'O' stock minimises the catch of 'J' stock whales is shown below.

Identification of the stocks among the individuals was according to Kanda *et al*. (2009). Microsatellite genetic variation was analyzed using 16 sets of primers in order to obtain genotypic data from coastal and offshore surveys of JARPN and JARPN II from 1994 to 2007 (n = 1711) and bycatches from 2001–07 (n = 831). The Bayesian clustering approach implemented in the computer program STRUCTURE version 2.0 (Pritchard *et al*., 2000) was used to determine the most likely number of genetically distinct stocks present in our samples and stock assignment. Individuals taken by the JARPN and JARPN II surveys from sub-area 7W were used to determine the proportion of 'J' stock individuals by the distance from the coastline. For the calculations, only the stock-determined whales were used.

Results

Fig. 1 shows the sampling locations of the minke whales collected during JARPN/JARPN II surveys in the coastal waters of Japan illustrating that more 'J' stock whales were taken in waters near the coastline than in offshore waters. Table 1 shows the number and proportion of 'J' and 'O' stock whales by survey and distance. Table 2 shows the expected number of 'J' stock whales that would be included in the catch with and without a 10 n.mile limitation on whaling operation. Our estimation shows that the number of the 'J' stock whales' caught would decrease under the 10 n.mile limitation. For a catch of 120 animals the number of 'J' stock whales would decrease from 28.3 to 23.4. Similarly, for a catch of 150 animals the number of 'J' stock whales

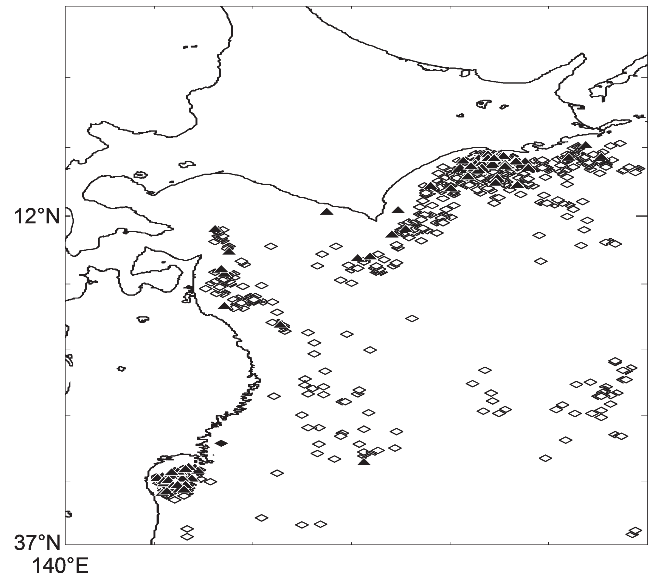

Fig. 1. Sampling locations of the minke whales near the coastline during JARPN/JARPN II. 'O' stock (Diamonds) and 'J' stock (Triangles).

Table 1

The number of 'J' and 'O' stock animals in past JARPN II surveys (2000–07).

	Total		10 n.miles or more	
	'J'	'O'	'J'	'O'
Kushiro	38	190	19	145
Sanriku	41	164	26	110
Coastal	79	354	45	255
	0.182	0.818	0.150	0.850
Offshore*	24	346	19	336
	0.065	0.935	0.054	0.946

*Minke whales collected in sub-area 7W from 1994 to 2007.

Table 2

Expected number of 'J' stock animals accidentally caught in proposed catch limit.

		Include <10 n.miles			Only over 10 n.miles		
Coastal	Offshore	Coastal	Offshore	Total	Coastal	Offshore	Total
n = 120	n = 100	21.8	6.5	28.3	18.0	5.4	23.4
n = 150	n = 70	27.3	4.5	31.8	22.5	3.8	26.3

would decrease from 31.8 to 26.3 animals. These results clearly show that for future coastal whaling operations, implementation of a 10 n.mile buffer zone minimises the catch of 'J' stock animals. When we compare the expected catch of 'J' stock whales between the current coastal operation under JARPN II (120 without a 10 n.mile buffer zone) and the proposed coastal whaling by Japan (150 with a 10 n.mile buffer zone) in combination with estimated catch of 'J' stock animals in offshore operations, the catch of 'J' stock whales would slightly decrease from 28.3 to 26.3 animals.

Figs 2, 3a, and 3b show the catching locations of minke whales from past commercial whaling in the coastal waters of Japan illustrating that most catches were taken well beyond 10 n.miles from shore. In a similar fashion, future coastal whaling operations with no takes within 10 n.mile from shore would be conducted well beyond the 10 n.mile line. This would therefore address the comment from the Scientific Assessment Group that moving the catch effort further offshore would likely reduce the likelihood of catches of 'J' stock animals.

Conclusions

Future coastal whaling operations under a regime that includes a 10 n.mile buffer zone and with actual catches taken further offshore will not increase and in fact will reduce any accidental catch of 'J' stock animals.

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Pritchard, J.K., Stephens, M., and Donnelly, P. 2000. Inference of population structure using multilocus genotype data. *Genetics* 155:945–959.

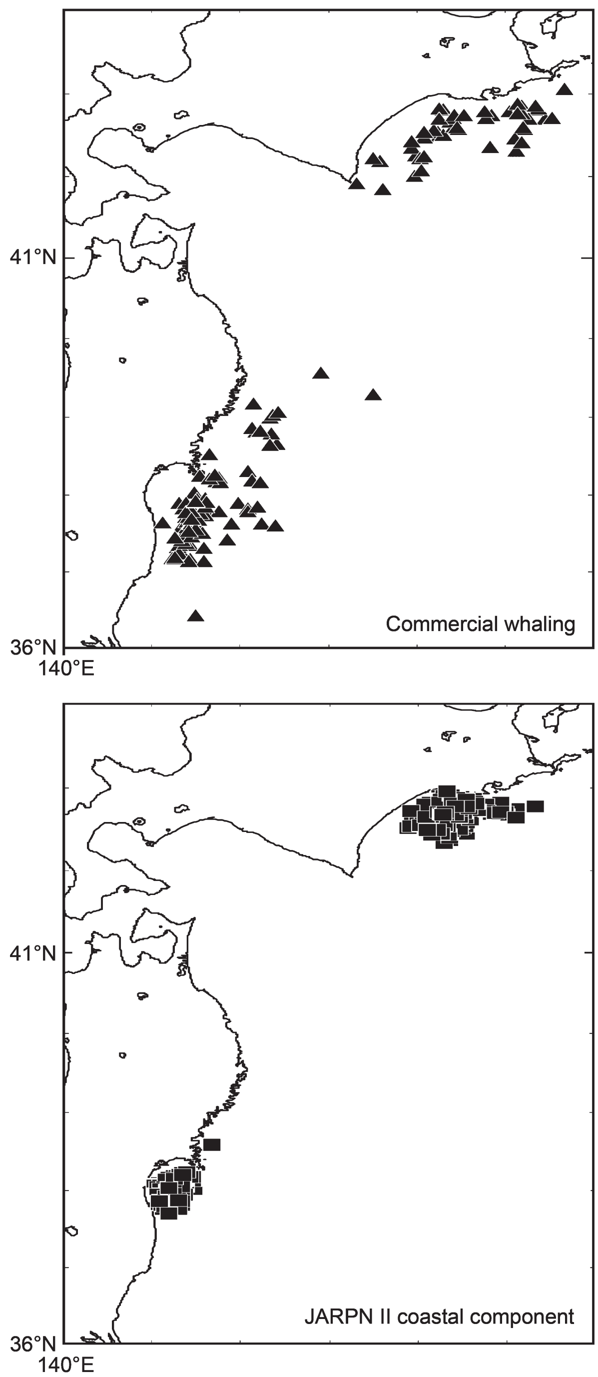

Fig. 2. Sampling locations of commercial whaling (upper) and JARPN II coastal component (lower).

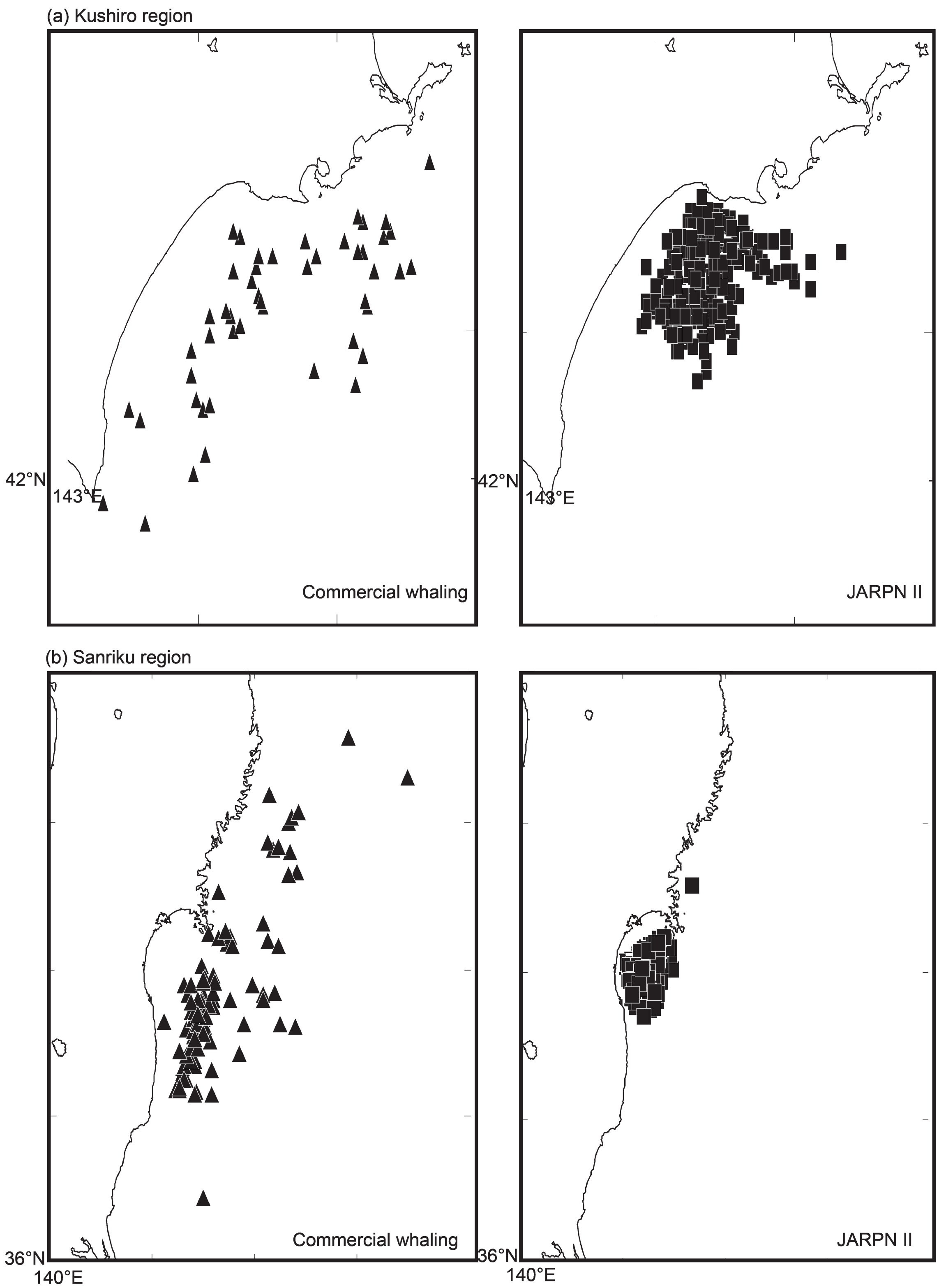

Fig. 3a. Detail of the Kushiro region and Fig. 3b. Detail of the Sanriku region.

Appendix 9

IMPLEMENTATION REVIEW – DRAFT WORKPLAN

The schedule for an *Implementation Review* specifies that between the finalisation of the *pre-Implementation assessment* and the following Annual Meeting of the Scientific Committee, a First Intersessional Workshop shall be held to address at least the following items (IWC, 2005, p.86):

(1) A final review of the plausible hypotheses arising from the *pre-Implementation assessment* (and, if appropriate), elimination of any hypotheses that are inconsistent with the data) – this will take into account the probable management implications of such hypotheses to try to avoid unnecessary work in the precise specifications of hypotheses for which these are very similar.
(2) An examination of more detailed information in expected operations, including whether coastal, pelagic, on migration, on feeding, on breeding or combinations of these. When providing such information, users and scientists may provide options or suggest modifications to the pattern of operations.
(3) The determination of the small geographical areas ('sub-areas') that will be used in specifying the stock structure hypotheses and operational pattern.
(4) The development of (options for) potential *Small Areas* and management variants.
(5) The specification of the data and methods for conditioning the trials that will be carried out before the next Annual Meeting (an e-mail correspondence group will be established to make revisions should any problems arise).
(6) Further consideration of experimental ways to distinguish amongst competing hypotheses.

Because the *pre-Implementation assessment*, though developing the stock structure hypotheses to be considered, did not achieve the level of spatio-temporal detail to allow preparation of data (e.g. sighting survey estimates of abundance) in the form needed for (5) above, it will be necessary to hold a Preparatory Meeting to prepare for the First Intersessional Workshop. The following sets out the associated schedule and requirements.

Work required prior to Preparatory Meeting

(a) The proponents of the two sets of stock structure hypotheses (the Y, J, O and W set, and the Y, J_W, J_E, O_W, O_E and W set) must develop documents setting out these hypotheses in a manner that specifies the areas in which these minke whale stocks (and as pertinent their components: juvenile, adult male, adult female) are to be found by month.
(b) Data for consideration at the Preparatory Meeting must be prepared at the level of detail appropriate to topics for that meeting listed below: commercial and by-catches (by sex where available); catch length and possibly age information (where available); CPUE for both commercial and incidental catch; genetic data; abundance surveys (specifically plots showing survey tracklines with achieved coverage, overall area covered and survey period).

Deadline: Mid-September 2010.

Preparatory Meeting (3–4 days)

This meeting will:

(a) Determine the sub-areas, time steps and population components to be used in *Implementation Simulation Trials* (i.e. complete item (3) above).
(b) Describe fully (though not completely finalise) the specifications of the various stock-structure and associated movement hypotheses (i.e. partially address item (1) above).
(c) Partially address the selection of the data and methods needed for conditioning the *Implementation Simulation Trials*, at least to the extent that the work specified below as needed to be completed before the First Intersessional Workshop can be undertaken, and arrange for persons to undertake that work (i.e. partially address item (5) above).

Deadline: End-September 2010

Further work required before the First Intersessional Workshop

(a) Disaggregate commercial and incidental catches into sub-areas and time steps (and, to the extent that may be necessary, population components) agreed at the pre-meeting.
(b) Similarly develop abundance estimates from surveys (and commercial and incidental catch CPUE, as appropriate) corresponding to these sub-areas and time-steps, together with their variance-covariance matrices.
(c) Evaluate mixing proportions of different stocks in pertinent sub-areas and time steps using genetic (and perhaps other, e.g. flipper colour) data.
(d) Evaluate dispersal rates between stocks using genetic data (this may require iteration after the First Intersessional Workshop).
(e) Preparation of Simple Model Filter software (see below).

Deadline: End November 2010

First Intersessional Workshop (4–5 days)

The Workshop will address and finalise where necessary items (1) to (6) above (excluding (3) which will have been finalised at the Preparatory Meeting). This will include finalisation of items (1) concerning details of hypotheses and item (5) concerning data and methods. In addressing item (1), the Workshop may make use of the Simple Model Filter approach to assess whether some hypotheses may be inconsistent with the data. The workshop will also detail any further work required to facilitate the conditioning of the trials specified in time for the next Annual Meeting.

Deadline: End December 2010

Budgetary implications

Allowance needs to be made for the cost of two intersessional meetings, and the attendance of up to 8 invited participants at each for a total of 8 days of meetings (in additional to national scientists).

REFERENCE

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