Annex F

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

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1. OPENING REMARKS, ELECTION OF CHAIR AND APPOINTMENT OF RAPPORTEURS

Walløe welcomed the participants and was elected chair. Brandon, Scordino and Best were appointed to act as rapporteurs.

2. ADOPTION OF THE AGENDA

The adopted agenda is given as Appendix 1.

3. REVIEW OF AVAILABLE DOCUMENTS

The documents available for discussion by the subcommittee included SC/61/BRG1-13, 15-27, 30-31, O8, AWMP1-3, ForInfo1, 12, 15, 22, 40.

4. GRAY WHALES

4.1 Western North Pacific gray whales

4.1.1 New scientific information

SC/61/BRG24 reported the results of field studies, during 2004-08, on the distribution and abundance of benthic prey distribution patterns on two feeding grounds off the Northeast coast of Sakhalin Island: the shallow Piltun feeding area (PFA) off Piltun Bay; and the deeper (>20m) Offshore feeding areas (OFA). Independent distribution and photo-ID studies have indicated changes in whale abundance in these feeding areas during this time period (Vladimirov *et al.*, 2007, 2008; Yakovlev *et al.*, 2007, 2009). Therefore, the analyses in this report investigated potential correlations in the variability of benthic prey (amphipods and sand lance) and the observed spatial distribution patterns of whales.

Sand lance abundance in the north of the PFA has shown an apparent decline in recent years, but this potential prey source is only available sporadically when compared to the consistent, rich amphipod complex that provides the main food source of western gray whales. Conversely, benthic food biomass in the deep-water OFA was stable during 2004-08. Likewise, whales were observed on those feeding grounds during all years in a zone of high abundance of ampeliscid amphipods (in a depth range of 41-53 m). The greatest changes in benthic abundance and distribution were observed in the shallow PFA; the most notable decrease in the abundance and spatial distribution of the dominant amphipod (*Monoporeia affinis*) occurred in 2006 when sea ice persisted later in the summer season and lower bottom waters temperatures were observed.

In discussion, it was suggested that future analyses would benefit from considering comparative studies of the benthos in the Bering and Chukchi Seas (e.g., Coyle *et al*., 2007; Griebmeir *et al.*, 2006), which could shed light on differences and similarities between the feeding habitats of western and eastern North Pacific gray whales. There was also discussion regarding the extent of direct predation (if any) by western gray whales on sand lance aggregations in deeper water. It was concluded that quantitative analyses of predation were challenging given the available information. Nonetheless, studies such as that reported in SC/61/BRG24 are important for monitoring potential habitat changes and prey availability, and should therefore continue in the future.

SC/61/BRG25 provided results of vessel-based transect surveys and shore-based surveys performed in the summer-autumn season of 2008 in the shelf waters of northeast Sakhalin, within the framework of the Russian program of western gray whale monitoring. Similar to previous years, two main areas were used by gray whales during the feeding season in these waters: the near-shore Piltun and Offshore areas. The overwhelming majority of whales in the Piltun area (97-98%) were distributed at a distance less than 5km from the coast in waters shallower than 20m. In the Offshore area, gray whales stayed within a distance of 35-50km from the Sakhalin Island coast, in waters 35-60m deep. The maximum number of gray whales registered in the Piltun feeding area in 2008 was 47, compared to 73 in 2007 and was accompanied by an approximately two-fold decrease in whale presence in the northern and southern parts of the area. However, in its central part, around the mouth of Piltun Bay, their average seasonal number (20.6) remained similar to that in 2004-07 (19.9) and, on the whole, about 60% of the whales in the Piltun feeding area stayed around the mouth of the Bay during August-September, 2008. The decreasing number of gray whales in the Piltun area coincided with a concurrent increase in recorded whale abundance in the offshore area, where the maximum count was 82 in 2008 compared to 36 in 2007. Likewise, the increase in numbers was accompanied by an increased spatial extent of animals in this area. The total number of observed gray whales in the northeast Sakhalin feeding range in 2008 was 98 individuals. For comparison, the estimate from the same time period in 2007 was 101, which indicated stable abundance in Sakhalin waters during the last two years. Observed inter- and intra-annual changes in the western gray whale distribution in the northeast Sakhalin feeding range in 2004-08 and increasing numbers of the whales off east Kamchatka are possibly caused by fluctuations in available food resources due to environmental variability (SC/61/BRG24). Further investigations and data analysis under the Russian Gray Whale Monitoring Program will provide more detailed insight into the status of the western gray whale population, its distribution and use of foraging habitats.

In discussion, it was noted that industrial activities including pile-driving and a seismic survey occurred during parts of the study period. However, it was not clear if, or how, these activities might have affected the behaviour or distribution of the observed animals.

SC/61/BRG26 provided a summary of 2008 photo-ID studies conducted in the two Sakhalin feeding areas and in Olga Bay, located on the southeast coast of the Kamchatka Peninsula. Photo-ID studies of gray whales conducted in the Piltun and offshore feeding areas during the period 2002-08 confirmed the exchange of individuals between the two areas between and within feeding seasons. During the seven years of photo-ID effort, use of the offshore feeding area by gray whales varied in intensity. The 2002-08 catalogue of photo-identified western gray whales off Sakhalin Island currently includes 165 fully identified, individual whales.

Over the past few decades, researchers have become aware of the presence of gray whales in the coastal waters off southeast Kamchatka during summer-autumn and the early winter months. Photo-ID studies conducted off Kamchatka in 2004 and 2006-08 substantiate these observations. Results from these studies demonstrate that the western gray whale population is not confined to their feeding grounds off Sakhalin during their summer-to-autumn feeding season. At present (as of 2008), the Kamchatka gray whale catalogue contains a total of 78 whales; 39 of these whales are also listed in the Sakhalin catalogue. A total of 50 gray whales were seen off southeast Kamchatka in 2008, including 25 that had not been observed previously off Sakhalin and therefore are not recorded in the Sakhalin catalogue. It is currently unclear if these whales belong to the western or eastern population.

Results from the 2008 photo-ID effort show that 97 individuals from the Sakhalin catalogue were seen only off Sakhalin, 24 were seen only off Kamchatka and one was seen at both locations; thus, a total of 122 whales from the Sakhalin catalogue were observed in 2008. For the first time, one cow-calf pair was recorded in the shallow waters of Olga Bay in 2008. Previously the mother had been recorded off Sakhalin in 2002-06 and in Olga Bay in 2007; she also had been seen with calf off Sakhalin in 2003.

The sub-committee thanked the authors for submitting the results of their important work. It was suggested that interpretation of the sightings data would be facilitated by a measure of the amount of survey effort (spatially and temporally). Effort has been variable from year to year due to weather and logistical difficulties at certain times but it was anticipated that this information will be available in a future report. Future surveys could include biopsy sampling to help to resolve stock status for previously unidentified individuals sighted off the southeast Kamchatka Peninsula. However, permits for biopsy sampling have not been requested and thus there are no plans to include biopsy sampling. No attempt has yet been made to correlate the observations of emaciated whales in SC/61/BRG26 with the data on calving intervals (e.g. SC/61/BRG10) from the Piltun area photo-ID catalogue; however the data are available to undertake this.

SC/61/BRG8 reviewed the findings from the 2008 collaborative Russia-US research programme on western gray whales summering off northeastern Sakhalin Island, Russia. This research programme has been ongoing since 1995 and has produced important new information on the present day conservation status of this critically endangered population. Results from previous years, including an opportunistic survey in 1994, were incorporated in the analyses. It was noted that 2008 represents the first year that the field component of this joint Russia-US project was carried out by a team of all Russian scientists, many of whom are veteran members of the 1997 to 2007 research team; it was expected that this will also be true in 2009 and beyond.

Photo-identification research conducted in the nearshore feeding area off Sakhalin Island in 2008 resulted in the identification of 45 whales, including three calves. Of the 42 non-calves identified, all (100%) had sightings in previous years. One new reproductive female was recorded in 2008, resulting in a minimum of 25 reproductive females observed since 1995. When results from 2008 are combined with data from 1994-2007, a catalogue of 172 photo-identified individuals has been compiled. Not all of these 172 whales (including the 25 reproductive females) can be assumed to be alive, however.

Overall, the pattern of whales photo-identified in 2008 was quite different from previous years in that: (1) 45 is the lowest number of whales identified since 1997 when the research programme was started; (2) three is the lowest number of calves observed since 2000; and (3) never before have no new non-calves have been identified in a given year. These findings are of concern with regards to the status of the population but are presently poorly understood. It is possible that the observed patterns in 2008 are anomalous and simply attributable to natural variation in behaviour. It is also plausible, however, that this change reflects whales being displaced from the feeding area or, worse, indicates partial abandonment of what has traditionally been a critical feeding habitat (especially for mother-calf pairs) for the population. While natural variation in food resources are being investigated by industry-sponsored research (SC/61/BRG24), other investigations need to also be undertaken to examine the possible contributions of cumulative impacts from years of ongoing oil and gas development and production activities. Recent activities in this category include pile driving work and a seismic survey in 2008, which occurred on or in close proximity to the nearshore Sakhalin feeding ground.

The sub-committee recognised that net entrapment of western gray whales is a range-wide issue and that coastal net fisheries outside of Japan must also be considered as potential sources of mortality. Further, it was noted that Japan (as does Korea) reports annual bycatch summaries to the SC in their national progress reports.

No net-related mortality of western gray whales has been documented since January 2007. With this in mind, a question arose regarding the current relevancy of projections from a recent population assessment (Cooke *et al*. 2008) showing that there is a high probability the population will decline to extinction if levels of net-related mortality (1.67 females/year), as based on the scale of those reported from Japan between 2005 and 2007, were to continue. The sub-committee welcomed the information of no reported gray whale net-related mortalities off Japan since 2007. It also noted that the projections used levels of additional female mortality calculated from data from Japan for 2005 to 2007, but that these projections do not assume that all of this mortality was necessarily attributable to Japan, but rather that it was applicable at a range-wide level (i.e. 1.67 females/year anywhere within the range).

SC/61/BRG8 commented that poaching of western gray whales was a potential threat in the waters of range states in the central portion of its range. The sub-committee was informed that poaching was impossible to hide in Japan given the coverage of the mass media.

The sub-committee discussed concerns relating to anthropogenic sound sources including pile driving and seismic operations. These may have been contributing factors to the low number of Western Gray Whales in the Piltun Feeding Area observed in 2008. Melton reported that Exxon Neftegas Ltd. had conducted pile-driving and installation activities at an onshore drilling location along the Piltun spit in 2008. Pile installation activity was not conducted after July 4 until it restarted on September 10 (per pile driving logs). It was noted that while whale density in the Piltun Feeding Area was low throughout the 2008 season, whales from the Sakhalin catalogue off Kamchatka were photographed in August, before the resumption of pile installation on September 10. Information was provided on sound levels in waters offshore from the ENL pile installation location in September. The sound pressure levels measured in the feeding area were highest at the locations perpendicular to the coast (125dB re 1μPa^2 at the 10m isobath, 131dB at the 20m isobath) and fell off to levels below ~100dB and 110dB at locations to the south (11 km) and north (7 km) of the pile installation site, respectively. Sound levels were at background noise levels 17 km to the south of the site. Measured sound levels from the pile installation activity within the feeding area were below levels (>163dB rms from a seismic survey) reported to have caused major behavioural reactions (ceasing feeding and moving rapidly away from the vessel) in 10% of feeding gray whales (Malme *et al*. 1988). Potential behavioural reactions to lower sound levels, however, are not well studied. The sub-committee thanked Melton for providing this information.

Paper SC/61/BRG9 presented results from a preliminary analysis assessing the incidence of killer whale tooth rakes on western gray whales identified off Sakhalin Island between 1995 and 2007 by the Russia-US research programme. Of the 169 photo-identified individuals examined, 74 whales (43.8%; 39 males, 26 females, 9 unknown sex) were found to have survived at least one killer whale encounter based on the presence of visible scarring. At least 22 (29.7%; 14 males, 6 females, 2 unknown sex) of the 74 whales observed with rake marks had evidence of being attacked during the course of the study. Both calves and non-calves were attacked, although relatively few attacks on calves were identified (suggesting that attacks on calves may often be fatal). While varying methodological approaches have been used to examine the incidence of killer whale rakes on other baleen whales, the 43.8% incidence on western gray whales is exceptionally high. The western gray whale population is critically endangered and at such low numbers that even low levels of mortality related to killer whale attacks could hinder its recovery.

The sub-committee welcomed this new information and acknowledged the depth of the photographic assessment at the individual level. In discussion the sub-committee noted that that the incidence rate is high when compared to many observations for humpbacks and other whales. However, behavioural differences between species (e.g. humpbacks fluke more regularly) as well as differences in analysis approaches make it hard to compare available observations of killer whale tooth marks on western gray whales with those from other species. Further, for humpbacks it has been shown that incident rates are highly variable between populations. There was some discussion with respect to the question of where killer whales were most likely being encountered. Most of the tooth marks observed were not fresh, suggesting that most (if not all) attacks are occurring in areas other than on the summer grounds off Sakhalin Island. The possibility of estimating mortality from the incident rates was assessed in SC/61/BRG9, but was found to be unlikely to produce quantifiable results given the type of information available for analysis (i.e. gray whales with killer whale tooth scars are the survivors of attacks).

SC/61/BRG10 presented a preliminary analysis examining birth-intervals and sex composition of western gray whales summering off northeastern Sakhalin Island between 1995 and 2007. Based on sightings and/or genetic evidence, 63 calves were linked to 24 mothers during the study. The number of calves counted on an annual basis ranged from 2 to 11, and the number of calves observed with a given mother ranged from 1 to 5. A total of 39 birth-intervals for 20 (83.3%) of the 24 reproductive females were documented. The number of intervals available to be calculated per female ranged from 0 (for females that were sighted with only a single calf) to 4 (for females that were observed with five calves). Of the observed birth-intervals, 51.3% (n = 20) were two years, 33.3% (n = 13) three years, 10.3% (n = 4) four years and the remainder represented by one interval of five years and one of six years. For the subset of 12 females in which more than one birth-interval could be calculated, the interval remained stable for six (50%), decreased for five (41.7%) and increased for one (8.3%). In general, most females appeared to be maintaining stable intervals of 2 years (n = 5) or 3 years (n = 1) or have experienced a shortening of the birth-interval (n = 5).

Of the 169 whales identified between 1995 and 2007, 142 (84%) have been biopsy sampled. From these samples an overall male-biased sex ratio of 58.5% male and 41.5% female was documented. When the subset of whales sampled as calves (n = 62) was examined, 66.1% were male and 33.9% female. The sex ratio of calves as a function of year was also biased. That is, in 9 (75%) of 12 years there was a male bias in the calf sample. In comparison, in only 2 (16.7%) years was there a female bias and in 1 year (8.3%) was there an even sex ratio. The sex ratio of calves born to the 18 reproductive females that produced at least two calves of known sex during the study varied. Ten (55.6%) of these 18 females had a male calf bias, including five individuals that produced only male offspring. In comparison, 3 reproductive females (16.7%) had a female calf bias, including two individuals that produced only female offspring. Finally, 5 females (27.8%) had an unbiased (i.e. equal) male to female calf ratio. Further, catch records from the early 20th century are also consistent with a persistent male bias in the western gray whale population sex ratio through time (Andrews, 1914; Mizue, 1951). While the mechanisms resulting in the current bias are not understood, the consequences of such may nevertheless be a contributing factor in the lack of population recovery.

In discussion, the sub-committee encouraged further analysis of the sex-ratio data in order to take into account the role of individual maternal influence (e.g. one female had been observed to have had 5 calves, all male). For example, it would be interesting to re-analyse the data, e.g. using boot-strapping, to determine how influential certain females are with respect to the estimated sex-ratio of the population.

SC/61/BRG22 presented the hypothesis that there has never been an isolated 'western' gray whale population. Available evidence with respect to the assumption of separate stocks was reviewed, including: the growth and expansion of the nominal 'eastern' population, observations of animals killed as bycatch off Japan and recent photo-ID data collected in the northern segment of the Sea of Okhotsk, near the Northern Kuril Islands, the eastern coast of Kamchatka, the Kommander and Karaginsky Islands. Photo-ID data from the Kamchatka Peninsula during the feeding season identified a total of 78 whales, 50% of which had been earlier identified near Sakhalin. It was concluded that this indicates an active inter-mixture of the animals between eastern and western feeding areas and also between the Sakhalin and Kamchatka feeding areas. It was hypothesised that as the eastern population has been recovering from commercial whaling (possibly even exceeding pre-exploitation abundance) during recent decades, it has also started reinhabiting old western habitats, via a recovered migration route from Baja California along the southern coasts of the Aleutian chain to Kamchatka and further down to the Sea of Okhotsk. Satellite tagging in Kamchatka feeding areas and hydroacoustic surveys (between the Kamchatka Peninsula and Kuril Islands) were suggested by the author to test this hypothesis.

SC/61/BRG30 offered a rebuttal to SC/61/BRG22. A partial review of information, gained from sightings and genetic data, supporting the idea of differentiation between eastern and western gray whales was presented. The evidence provided in SC/61/BRG30 included: (1) catches off Korea continued through the 1960s, confirming the existence of the population; (2) recent comparisons of microsatellite allele frequencies confirmed that eastern and western populations are genetically distinct; (3) a whale entrapped in a set net in Yoshihama Bay, Japan, in 2007 was photographically matched to an animal first identified as a calf off Sakhalin in 2006, providing a confirmed link between the Sakhalin feeding ground and a migratory corridor off Japan; (4) the limited amount of photo-identification effort off Kamchatka until recent years makes it difficult to assess whether use of this area by Sakhalin gray whales is a new phenomenon or simply was previously undiscovered; and (5) 12 gray whales taken in the hunt off Chukotka in 1994 all had mtDNA haplotypes either found only among the eastern gray whale samples or found in higher frequencies in the eastern sample set. Assignment tests group all of these Chukotka animals with the eastern cluster (although one animal's assignment is somewhat equivocal). It was noted that SC/61/BRG22 does not offer any data or references to support the conclusions drawn, nor does the paper take into account the rather substantial body of work comparing eastern and western gray whales using both mtDNA and microsatellite makers (LeDuc *et al*., 2002; Lang *et al*., 2008a, 2008b). Similarly, the extensive discussions regarding this topic, as reported in numerous reports of the IWC SC and IUCN, have also been ignored in SC/61/BRG22. Based upon the available scientific data, the authors of SC/61/BRG30 concluded that neither the 'new scenario' nor the 'scenario of natural recovery' hypotheses presented in SC/61/BRG22 are plausible.

Recommendations for future work to be done regarding the topic of eastern and western gray whale differentiation included: satellite tagging of western gray whales off Sakhalin Island and Kamchatka; photo-identification comparisons of western gray whale catalogues with those maintained for eastern gray whales; genetic sampling of animals feeding in areas potentially used by both eastern and western animals (e.g. eastern Kamchatka); and genetic analysis of samples (including historic bone or baleen) obtained from animals entrapped, stranded, or sighted in areas other than Sakhalin and Kamchatka (e.g. Japan). Finally, it was recommended that a review of genetic studies on western and eastern gray whales be presented to the BRG sub-committee at the 2010 Annual Meeting.

SC/61/O8 reported that neither stranding nor entanglement of gray whale was reported in Japan from May 2008 to April 2009. Japan reported that in August 2008, the Fisheries Agency, Ministry of Agriculture, Forestry and Fisheries, hosted a meeting (as its follow-up action to the discussion at the 60th Annual Meeting) to ensure that fishermen take appropriate actions when a gray whale is found. The meeting was held with the participation of officials from all prefectural governments, and representatives from set-net fishermen and fisheries cooperative associations. At the meeting, three issues were discussed: (1) current status of the western gray whale population and the discussion at the 60th Annual Meeting; (2) related regulations under the Fisheries Resources Protection Act that entered into force on 1 January 2008, by which catch, sale and possession of the gray whale is prohibited; and (3) actions necessary to be taken when a gray whale is found. In addition, the report noted that the last animal entrapped was in January 2007. The government of Japan will continue to make every practicable effort to reduce anthropogenic mortality of the population.

The Scientific Committee has established a co-ordination group with respect to western gray whale telemetry, in particular to ensure that any programme meets the scientific, conservation and welfare standards set by the IWC Scientific Committee and the IUCN Western Gray Whale Advisory Committee. The report from that group, SC/61/BRG31, outlined a satellite tagging research programme to obtain vital information on the migration route(s) and wintering ground(s) of western gray whales, to enable the development of essential mitigation measures including a comprehensive set of safeguards. A detailed summary of the report of that group is given as Appendix 2. The full rationale for the conservation benefits is given under Item 4.1.2 below. The following summarises the extensive general safeguards developed by the IWC Scientific Committee and the WGWAP (more detailed specifications of these for 2010 are given in Appendix 2):

(1) the work should be carried out by experienced investigators using tested techniques following the guidelines used by the Society for Marine Mammalogy with regard to the treatment of marine mammals in field research;

(2) tag design and deployment methodology should be of best-practice standard, including (a) tag length being the minimum possible to achieve a pre-determined attachment duration and (b) use of sterile techniques to minimise infection;

(3) no more than 12 tags be deployed on known males in good body condition and identified in 'real time' (i.e. in the field while tagging is being attempted by the recognised expert in identification in the field) from previous photo-id and genetic studies;

(4) field protocols to minimise risks and limit the time spent with individuals should be developed and presented for review by the co-ordination group in advance of fieldwork;

(5) follow-up work on the potential effects of tagging should be a key part of any programme, and in particular every effort should be made to resight tagged whales during the period of the study; and

(6) tracking data should be available to the IWC in as near 'real time' as possible.

There was extended discussion of this paper within the sub-committee, particularly with respect to details of the safeguards and the value of the research for the conservation of this critically endangered population. The sub-committee's recommendations regarding telemetry are given under Item 4.1.2.

In these discussions, the sub-committee also recognised the value of tagging whales off Kamchatka (see discussion above) in the future to provide additional information on the stock affinities of these whales (eastern or western), their migratory paths and possible additional feeding areas in order to better inform conservation and management strategies. A detailed proposal for such work, taking account of the 2010 programme off Sakhalin, would be welcomed by the sub-committee for review.

The sub-committee also concurred with the view of the co-ordination group (and the IUCN range wide workshop, see below) of the value of testing new and emerging tags that are potentially less invasive and/or may have longer duration on eastern gray whales as soon as possible, including in the 2009 field season, whilst stressing that this should not further delay efforts to tag western gray whales with existing (proven) tags. A candidate population would be the well-studied Pacific coast feeding aggregation off Washington and Oregon, USA and British Columbia, Canada, in which inter- and intra-annual resightings of the same individuals are frequent, making follow up studies possible. Such techniques, once tested and proven, may then be candidates for use in future tagging studies on western gray whales.

Gedamke acknowledged the high conservation value and urgency in undertaking this research. He expressed his concern though, over conducting this study before a successful study monitoring potential impacts can be completed on feeding Eastern North Pacific gray whales. He also noted the importance of undertaking in-field verification of whale identification (i.e. photo i.d.) prior to tagging WNP gray whales.

Scordino noted that researchers of the southern feeding aggregations of the eastern North Pacific gray whales have permits to conduct satellite tagging studies, but lack funds to conduct the study. In consideration of the direct relevance of understanding and improving the efficacy of tagging gray whales on their feeding grounds, the sub-committee recommended that every effort be made to obtain immediate funding for this tagging study.

The sub-committee stressed the importance of ensuring that all necessary permits for telemetry work on gray whales are applied for in a timely fashion and requested relevant national authorities to facilitate the authorisation of permits.

As a conclusion to the discussions of new information and an introduction to the discussions of conservation and management advice, Larsen presented the report of the Western Gray Whale Range Wide Workshop held by IUCN in September 2008 in Tokyo, Japan (SC/61/ForInfo 40). This represents the most comprehensive recent overview of knowledge and conservation issues related to western gray whales. The workshop was organised as a step towards development of a comprehensive, range wide strategy, as anticipated by the IWC Ulsan workshop in 2002 (IWC, 2004) and the IUCN International Scientific Review Panel in 2005 (Reeves *et al.* 2005). Most attention focussed on areas of the western gray whales' range outside the Sakhalin shelf area given the extensive work of the Western Gray Whale Advisory Panel on that region. The workshop was attended by 26 scientists, including from all the presumed range states except the Democratic People's Republic of Korea. A total of 22 primary documents were discussed at the workshop, the majority of them providing reviews of existing information on western gray whales, but some including new information and results. In the following summary only new information will be highlighted.

Section 2 of the report provides a review of western gray whale population biology including population structure, distribution, feeding, natural mortality, abundance and trends. New here is the considerable amount of information on western gray whales at Kamchatka and on the links between the known and suspected feeding areas (document RW2008-22). The Workshop identified major information gaps with regard to the population biology of western gray whales and the need for improved information on:

(a) migration routes and timing, including movements of the animals within a season and between feeding areas;

(b) population status in addition to the current estimates of abundance and trend;

(c) calving history of individual females in relation to their health status, which is probably affected by environmental factors, both natural and anthropogenic; and

(d) health status from necropsy of stranded or bycaught animals.

Section 3 of the workshop report identifies and quantifies to the extent possible actual and potential threats to the population including both direct and indirect human-caused mortality as well as changes in environmental conditions. New information on direct human-caused mortality includes results on the magnitude of anthropogenic interactions as inferred from the types and incidence of scars on western gray whales (RW2008-15), and information on an initial evaluation of the magnitude of the threat of ship strikes on western gray whales in Japanese waters (RW2008-16). New information was also received on examination of body condition of western gray whales in relation to environmental change in the North Pacific (RW2008-15). The Workshop identified major information gaps with regard to actual and potential threats to the western gray whale population (in addition to those identified above) and the need for improved information on:

(a) where and when the occurrence of western gray whales coincides with a high density of threat factors;

(b) vessel activity, fishing and other anthropogenic factors that could put gray whales at risk in China, Korea and Russia;

(c) effects (preferably dose-based) of noise on gray whales as well as the thresholds of responsiveness;

(d) the 'skinny whale' phenomenon; and

(e) potentially harmful activities in areas where gray whales are present obtained in a timely manner.

Section 4 of the workshop report deals with threat elimination and mitigation. Prioritisation of actual and potential threats identified in section 3 of the report is given in Table 1, which lists the known and potential threats to western gray whales and assigns priority for action. Highest priority is given to entrapment in set nets, entanglement in other types of fishing gear and noise in feeding areas.

Table 1

Known and potential threats to western gray whales, with priority levels for action (taken from SC/61/For Info 40). Key: evidence - S = strong, M = moderate (circumstantial), W = weak; Priority for action – H = high, M = moderate, L = low.

Actual/potential threat	Activity	Evidence	Possible impact	Priority
Directly lethal threats				
Entrapment in set nets	Set-net fishing	S	Mortality, especially of adult females	H
Entanglement in other types of fishing gear	Fishing with gillnets (set or drifting), gear that includes lines in the water column (*e.g.* crustacean traps)	M	Mortality, serious injury, impairment of ability to feed efficiently or to undertake other vital processes	H
Ship strikes	Ship traffic, particularly at speeds higher than 10 knots	M	Mortality, serious injury	M
Sub-lethal threats				
Noise in feeding areas	Offshore construction (*e.g.* oil platforms, pipeline burial), seismic surveys	S	Impaired efficiency of feeding, leading to compromised health. Possible abandonment of feeding area	M-H
Contamination of prey	Offshore oil and gas production, oil transport	W or M	Reduced food availability, leading to compromised health	L
Noise in migratory routes	Shipping primarily	W	Whales forced to change routes, increasing their energy needs or forcing them into high-risk areas	L
Physical disturbance of prey	Offshore construction that mobilises sediment, onshore construction or development that increases runoff or discharge	W	Reduced quantity or quality of feeding habitat	L
Physical modification of coastal zone	Urban development (*e.g.* land reclamation), bridge, causeway or dam construction	W	Degradation or elimination of habitat for key life functions	L

Discussion of actual and potential mitigation measures centred primarily on fishing-related mortality. The workshop agreed that in general:

- mitigation through prevention is preferable to mitigation through disentanglement, so in the case of set nets, the goal should be to prevent whales from entering in the first place;
- disentanglement teams should consists of trained individuals who have access to specially designed equipment;
- because a single wrap of line can kill a whale, it is wrong to assume that releasing a whale with 'only a little gear left on it' can be considered a successful rescue.

The workshop was pleased to learn that three rescue (response) teams had been established in the Republic of Korea and that these teams are designated to release any marine animals, including gray whales, either live-stranded or accidentally caught in fishing gear. The workshop identified the need for a better basis for assessing the nature and degree to which chemical contaminants other than oil represent a threat to western gray whales as a major information gap with regard to threat elimination and mitigation (in addition to those identified above).

Section 5 of the workshop report deals with the structure and components of a range wide conservation plan for western gray whales. The workshop agreed that such a plan should be developed under the auspices of the IUCN Global Marine Programme following the guidelines provided by Donovan *et al.* (2008) and as outlined in Annex D of the workshop report.

The initial draft of the plan will:

(1) include a clear explanation of why the conservation plan is needed and a statement of its goals and objectives;

(2) incorporate assistance from the relevant programme(s) within IUCN with respect to the 'legal framework' portion of the plan;

(3) accompany any references to 'hunting' by a clear explanation (possibly in the form of footnotes) of the legal status, recognising that all range states, with the possible exception of the Democratic People's Republic of Korea have complete prohibitions against the direct, intentional taking of western gray whales;

(4) include examples of mitigation measures taken elsewhere in the world to protect whales (regardless of species) from the same or similar threats;

(5) include a separate section, in addition to specific actions, devoted to public awareness and education.

Larsen noted that the workshop developed a number of recommendations under each section of its report and commended these to the sub-committee.

4.1.2 Recommendations and conservation advice

As it had done last year, the sub-committee acknowledged the important work of the IUCN WGWAP and welcomed this year's update on the panel's activities (given in Appendix 3).

The sub-committee welcomed the report of the IUCN range wide workshop and thanked Larsen and IUCN for their hard work in ensuring that this happened; it agreed that the workshop represented an important updating of the 2002 IWC workshop and formed a strong basis for conservation and management action. The sub-committee endorsed the report and its recommendations and the full recommendations are given in Appendix 4 with some clarifications made during sub-committee discussions.

In particular, the sub-committee endorsed the development of a 'Conservation Plan for Western North Pacific Gray Whales' following the process outlined in Donovan *et al.* (2008) and in Annex D of SC/61/ForInfo 40, which was the overarching recommendation of the workshop. This is in accord with the Committee's discussions of conservation plans last year (IWC, 2009). Donovan reported on the current status of the plan. The core of the plan is to reduce anthropogenic mortality towards zero as soon as possible. This reiterates the view of the Scientific Committee for a number of years of the urgent need to reduce anthropogenic mortality to zero. An initial drafting group (including scientists from several range states) has been established and considerable work is underway (one drafting meeting has been held) although the draft is not yet ready for circulation. The recommendations of the range wide workshop will form the basis of draft 'actions' to be included in the plan that will be developed over the coming year and submitted to IWC for consideration. Involvement of stakeholders in the development and implementation of the plan is a key component of the work.

The sub-committee then considered the main recommendations and conclusions of the workshop report. These cover three broad areas: status and monitoring, threats and improved mitigation, and improved information outside the feeding grounds.

With respect to status and monitoring the sub-committee endorsed the following research recommendations that:

(1) research effort off Sakhalin Island (via photo-ID and biopsy), in support of annual population assessment through modelling, must be continued as the highest-priority monitoring tool for this population (the sub-committee expressed concern that no biopsy samples were collected in 2008);

(2) photo-identification effort be continued or expanded in other areas where western gray whales are known to occur, such as off Kamchatka and Magadan (the sub-committee also encourages that a biopsy component be added to the photo-identification work in these areas);

(3) the importance of continuing efforts to identify additional feeding areas of western gray whales;

(4) all photographs from Kamchatka be compared to the Sakhalin catalogues maintained by the Institute of Marine Biology (IBM) and the Russia-US programme;

(5) in accordance with previous recommendations of the WGWAP and the IWC Scientific Committee, joint analyses of the Russia-US and IBM catalogues are undertaken and that the photographs from Kamchatka and other parts of the population's range be included in any such joint analyses (the sub-committee noted and welcomed the progress already being made in this regard under the auspices of the WGWAP – see Appendix 3).

A primary recommendation related to threats and mitigation was the need for satellite telemetry work. Given the extensive discussion that has occurred within the IWC Scientific Committee and elsewhere regarding this recommendation, the background and rationale is presented here.

A good spatial and temporal understanding of the migratory routes, breeding areas and movements of western gray whales is essential if effective conservation measures are to be developed and implemented to protect them from anthropogenic threats throughout their range, particularly entanglement and entrapment in fishing gear, vessel traffic and industrial activities. At present, there is a severe shortage of such information. The Workshop stresses that the most efficient (and probably only) way to achieve the necessary knowledge is to undertake a carefully planned satellite tagging programme. A successful programme will provide essential insights on threats (e.g. what they are, their spatiotemporal character and severity), reveal new information about the biology and behaviour of the animals to allow the development of effective mitigation measures, and better inform research and conservation planning.

In short, satellite tagging of western gray whales will address the following critical objectives:

(1) Further identification of feeding habitats of western gray whales. This would (a) lead to photographic identifications of whales in feeding areas other than Sakhalin and Kamchatka, allowing improved population assessment, and (b) point to additional areas in need of protection from harmful human activities.

(2) Identification of migratory timing and routes between summer feeding and winter breeding areas to improve assessment of threats along the migration routes and identify where mitigation is most critically needed.

(3) Identification of the winter breeding area(s) so that threats there can be identified and mitigated.

In making the recommendation below the sub-committee reiterated the importance it had attached to the extensive cost-benefit reviews of telemetry studies that have been undertaken in recent years (by the Scientific Committee, the WGWAP, the review commissioned by the US Marine Mammal Commission, the Range Wide Workshop) in addition to its discussions this year with respect to how telemetry can contribute to the conservation of this critically endangered population versus the potential risks of tagging to individual western gray whales. It concurred with the view that initiation of the satellite-tagging programme should not be further delayed, and recommended that every effort be made to attempt tagging on the Sakhalin feeding ground at the end of the 2010 field season. It further reiterated that every safeguard will be undertaken to minimise risks to the health of individual animals and to the population's recovery as summarised above in the discussion of SC/61/BRG31 and in Appendix 2 and that this will be supervised by the co-ordination group established previously. If these criteria are not met to the satisfaction of that group then the effort will not proceed in 2010. The sub-committee also noted its earlier discussions of the value of telemetry studies off Kamchatka as soon as 2011 and the testing of new and emerging technology on eastern gray whales and encouraged the development of plans for such work to be undertaken. The sub-committee also requests national authorities to facilitate the granting of permits for telemetry work recommended by the IWC Scientific Committee.

In terms of taking more immediate action the sub-committee endorsed the recommendations related to the release of entrapped/entangled whales (see Appendix 4) summarised below:

- that every effort be made to release entrapped animals as expeditiously as possible and in this context it encourages relevant authorities to develop carefully considered incentive schemes to encourage live release of gray whales, free of fishing gear;
- encourages the appropriate Japanese authorities to continue a campaign to educate all set-net fishing cooperatives concerning (a) the critically endangered status of western gray whales, (b) the historical role of set nets in bycatches of gray whales and (c) the need to make every effort to release any entrapped or entangled western gray whale.
- encourages authorising agencies to identify appropriate individuals who can make up a rapid-response team to assist fishermen in the event that a badly entangled gray whale is found and specialised assistance is needed to release it alive and encourages communication with experienced response teams elsewhere in the world.
- encourages appropriate authorities in the other range states (e.g., Russia, Democratic People's Republic of Korea, Republic of Korea and China) to initiate educational campaigns specifically targeted at fishermen who use the types of fishing gear that could entrap or entangle western gray whales.

Should carcases be discovered, the sub-committee recommends that facilitation of necropsies be conducted as a priority in all range states, involving all relevant qualified individuals and organizations In this regard the sub-committee welcomes the initiative of IUCN to develop a detailed necropsy protocol, taking due account of experience elsewhere in the world (e.g. with North Atlantic right whales), and distributed widely to maximise the amount of data and information obtained from dead western gray whales.

The sub-committee recommends that reports of any necropsies that occur are provided to the Annual Meetings of the Scientific Committee.

The sub-committee noted that almost all of the new information on western gray whales in recent years has come from the feeding grounds near Sakhalin Island. It therefore endorsed the workshop's recommendation that arrangements for detecting, reporting and investigating occurrences of gray whales, for example through stranding and sighting networks, be enhanced in all range states and particularly in China. This should be accompanied by efforts to improve the capacity and ability of researchers in the range states to investigate and validate reports of gray whales, e.g. through photography or tissue sampling. It reiterates previous Scientific Committee recommendations that any tissue samples should be made available for genotype matching with the biopsy archive of the Russia-US programme.

Recognising the difficulty of detecting individuals away from the known concentrations on the feeding grounds, and given that the total number of animals is so small and information on breeding grounds and migration is so poor, the sub-committee agrees that high priority be given to developing accurate and effective public awareness campaigns in the range states, involving use of *inter alia* the internet, newspapers, radio and, if possible, television. It encourages IUCN and IWC to assist relevant authorities in each of the range states in this regard.

4.2 Eastern North Pacific gray whales

4.2.1 New scientific information

SC/61/BRG5 reported on investigations of eastern gray whales taken in Mechigmensky Bay during 2007/08. Information on eastern gray whale numbers, distribution and behaviour in Mechigmensky Bay were collected, as well as physical information collected from whales that were killed in the subsistence hunt near Lorino. The reported data were categorised as: (1) data from visual and boat-based surveys collected during 2007/08; or (2) physical information. Land-based surveys were conducted in 2007/08 and ship-based surveys were conducted in 2008 only. Gray whale distribution was found to be uneven and varied by month. Numbers appeared to increase during the month of October in both of these years, with incidences of single, large daily counts contributing to these higher sighting values. It was speculated that these increases might be related to the start of the southbound migration. Whales were generally sighted at distances greater than 5-6km offshore and the number of whale sightings was similar between 2007 and 2008. Behaviour was typical of feeding animals, and this area appears to be an important foraging site for these whales.

Data collected on biological parameters included weight, sex, length (and other morphometric measurements), sexual maturity, stomach content, blubber thickness and presence or absence of abnormal smell or taste to the meat. Three whales were weighed. Blubber and skin were found to make up 30% of the total body weight, the skeleton made up 26%, the meat 22% and 22% of the weight was accounted for by the remaining organs. In 2007, the majority of whales taken were female (61%) and of these, 87% were immature. In 2008, 48% of whales taken were females, with only 42% of these immature. This discrepancy was likely due to the selective use of hunting areas, as it has been theorised that immature and mature whales segregate due to preferred prey distribution which is probably related to depth. In 2008, there were more whales with empty or near empty stomachs (43%) when compared to 2007 (3%). Amphipods were the leading prey, both by biomass and frequency of occurrence in the stomachs. Polychaetes were second in occurrence. The authors developed a 'fatness index,' and yearlings were found to be fatter than other age groups. However, no trend was found in yearling fatness over the survey periods (both 2007/08 and historical measurements). This might be indicative of a stable trend in feeding conditions in Chukotkan waters.

In 2007, two stinky whales were killed in the hunt, while this figure jumped to eight in 2008. Of note, in 2008, many of these whales were not stinky in the sense of a bad smell, but were considered inedible because of a bad taste that is normally associated with 'stinky' whales. The cause of the odour/taste remains unknown. It is noted that additional research is needed in this area and samples were collected in this study in anticipation of the cooperative research effort described in SC/61/BRG12.

SC/61/BRG12 summarised the research efforts made in 2008 to investigate the Chukotkan 'stinky whale' phenomenon. Samples were collected from two stinky whales and two normal whales, which were frozen for later analyses. A further five stinky whales samples were collected later in the summer/early autumn. Permitting efforts are underway to split these samples between Russian and US analytical laboratories. The NSB-DWM will support field research efforts in 2009 and funding has been granted for additional Chukotkan marine mammal work in 2010 and 2011. This research will be a collaborative effort between NSB-DWM, ChukotTINRO, ATMMHC, Chukotkan Science Support Group, VNIRO and several local Chukotkan Native groups.

SC/61/BRG27 presented the results of surveys for gray whales that utilise Laguna San Ignacio (LSI), in the west coast of Baja California Peninsula during the winter breeding season. This lagoon has been monitored with standardised boat surveys since 1978, and represents the longest time series of winter breeding lagoon counts for this species. Counts from the most recent surveys (2007-09) were compared with respect to the timing and duration of the occupation of the lagoon by gray whales, the number of adult whales, the number of non-female-calf pairs, and the number of female-calf pairs seen in the lagoon from mid-January to early April. The distribution of gray whales within the lagoon during the winter was compared over three time periods: 1978-1982; 1996-2000; and 2006-09. Counts of the total number of adult whales, female-calf pairs, and single non-calf whales indicate that gray whales began to enter the lagoon in mid-January each year, and maximum counts were obtained the last week in February each year. The percent of the total number of gray whales counted in the lagoon during the mid-February peak of the breeding season increased from 1978 to 2009 in the lower lagoon zone nearest the entrance and in the middle lagoon zones, while the percent of whales occupying the upper lagoon zone furthest from the entrance decreased during this period. This change in the distribution of the whales within the lagoon suggests that fewer whales are utilising the interior of the lagoon and preferring the areas closer to the entrance to the open ocean. The lower lagoon is the zone where whalewatching activities are permitted, while the middle and upper zones are closed to eco-tourism and whalewatching. Comparison of these trends with other breeding lagoons is needed to determine if these trends are representative of gray whales occupying the entire winter range, or unique to Laguna San Ignacio.

In discussion it was noted that changes in the occupancy rates in the lagoons also corresponded to some extent with changes in the migration timing. Additionally, the percentage of cow/calf pairs was believed to be related to water temperature in the lagoons. There was discussion about the 'turn-over' rates in the lagoons, and it was noted that the turn-over rates (how many days spent in a specific lagoon) are much shorter for non-cow/calves.

The sub-committee noted that there are plans for a new marine port to be developed on the south side of Punta Colonet (Baja California, Mexico) approximately 150 miles south of the US-Mexico border. The port is scheduled to be operational by 2014 but this date appears to be uncertain as the project has been postponed because of the current worldwide economic situation. Gray whales pass in close proximity to Punta Colonet during their south and north migration to and from the calving lagoons along the coast of Baja California. In the past the SC has expressed concern about development projects in gray whale critical habitats along the coast of Baja California because of the presence of gray whales (Compean *et al*., 1995). Development has and will continue throughout much of the coastal range of gray whale. For this reason, the sub-committee re-emphasised the statement in the 1994 report of the SC as follows "*to plan development compatible with the conservation of the animals and their critical habitats, the effects of past and current potential impacts of development require study*" (IWC, 45:78). In the case of the port development at Punta Colonet, there is a need to implement an ongoing research and monitoring programme to collect baseline (pre-development) data on how gray whales use the Punta Colonet regions during their south and north bound migration. In addition, it would be important to gain knowledge on the planned routes of maritime traffic that will operate in accordance with the port development, in order to understand potential impacts to other mysticetes distributed in the area. These data will serve to benefit the design of best-practice mitigation measures to minimise potential ship strikes as marine traffic increases in the location when the port becomes operational in 2014.

The sub-committee noted that due to population increases and some environmental changes during the last decade (e.g., retreating sea-ice and a regime shift in the Bering Sea); eastern gray whales have begun foraging much more extensively in the Chukchi Sea. Because this is an area of increased interest for the development of offshore petroleum resources, the SC encourages appropriate resource agencies to pay additional attention to the changing role and habitat use of gray whales in the Arctic.

SC/61/AWMP1 reviewed the 23 shore counts for the Eastern North Pacific (ENP) stock of gray whales, and documented how the counting procedures have changed over time. In attempting to provide a new abundance series it was realised that, due to inconsistencies in the analytical methods that have been used over time, all the correction factors would have to be re-estimated in a more consistent manner. It was not possible to complete this before this year's meeting; however, this analysis should be completed by early autumn 2009. The results of this approach will be better suited to trend analysis.

Counts have typically occurred from 10 December of one year to February or March of the following year. Several improvements in the quality of data collected have occurred through time: 1) sky condition was noted prior to 1978, but visibility has been recorded instead of sky condition since then; 2) prior to 1985/86, observers made non-calibrated estimates of distance to a sighting using predetermined distance intervals (e.g., ¼, ½, ¾ mile) but, observers now use reticle marks in binoculars to obtain fairly precise distance measurements; 3) paired, independent sightings (which allow for the estimation of the probability of pods being missed by an observer) have taken place since 1985/86; before this each observer worked alone without any tests of sighting rates. Only sightings made at visibility codes less than or equal to 4 have been used for abundance estimation (except 1992/93 and 1993/94, when visibility codes less or equal to 3 were used).

Abundance estimates have generally followed the same methodology throughout the 40-year period (1967 to 2007): the observed number of pods (under acceptable visibility conditions) was multiplied by correction factors for: (1) pods passing outside watch periods - f_t; (2) night travel rate -

f_n ; (3) pods missed during watch periods - f_m , and; (4) bias in pod size estimation - f_s . The product of the number of pods and the above correction factors was then multiplied by the mean pod size, $\overline{S}$, to yield an abundance estimate.

Data from 1967/68 – 1979/80 were originally analysed by Reilly *et al.* (1980, 1983) and reanalysed by Buckland and Breiwick (2002). Data from subsequent surveys have not been analysed in a way totally consistent with Reilly *et al*. (1980, 1983). For example, since 1995/96 the correction factor, f_t , for pods passing outside the watch period has been based, not on the number of pods per hour, but on the estimated number of whales per hour to account for differential sightability by pod size and the covariance within the estimated number of whales sighted when corrections are applied to individual sightings of pods. Three of the correction factors, f_n, f_m, and f_s were not estimated in each survey. Corrections for night travel rates were established through thermal imagery in tests conducted from 1994 to 1996; a correction factor for missed pods has been made since 1987/88; and pod size bias corrections were done when an aircraft was available.

SC/61/AWMP1 outlined the following work plan which will be used to revise the time series of abundance estimates for the ENP gray whales:

(1) The data for 23 years of shore-based counts will be reviewed and reformatted. Careful documentation and development of metadata will result in a standalone dataset that will be provided to the IWC with a uniform data analysis program (it was noted that the data have been reformatted and are in two Microsoft Access tables);
(2) Pod size bias correction factors will be revised to reconcile the available tests of observers' pod size estimates;
(3) An analysis including all of the double count data from all years will be conducted to determine a generalised correction method, and this method will be applied to all of the years with data collected at Granite Canyon including the years when there was no paired observational effort;
(4) Hermite polynomials will be applied to whales (pods corrected by pod size bias) per hour for all available years of sighting data;
(5) An empirical approach will be used to scale the earlier estimates to the most recent estimates (*sensu* Buckland *et al*. 1993) if it is not possible to reconcile the differences in data collection methods, and;
(6) Where possible, data from both observers (when paired-observer data is available) will be used to maximise the data value. These data will also be analysed as a single observer data set to determine the risk of bias compared to a single observer.

In discussion it was noted that the CVs of the existing abundance estimates are known to be underestimated, but it was unknown how the re-analysis would affect these CVs, other than ensuring that they will be estimated consistently for the entire time-series during the revised analyses.

SC/61/AWMP2 introduced a stochastic population dynamics modelling framework that incorporated a hypothesised relationship between an environmental variable and process error in life history parameters for a cetacean population. An index of sea-ice in the Bering Sea, which has been hypothesised to pertain to eastern North Pacific gray whale calf production, was integrated into a stock assessment. In addition to stochastic birth rates, the framework also allowed for stochasticity in survival rates, and was fit to an index of strandings to capture the dynamics observed during the mortality event of 1999 and 2000. The results of this framework were compared to those based on a deterministic model that was only fit to the abundance data. These alternatives were each able to fit the abundance data well, but led to different interpretations with regards to current depletion and other quantities of interest. The framework developed could be used as an operating model with which to test the *Gray Whale SLA*, given climate forecasts and hypotheses regarding environmental impacts on population dynamics.

In discussion it was noted that the selectivity patterns assumed in the analyses could be improved upon, for example by subtracting calving females from the recruited population. The importance of considering relevant environmental indices for such analyses was also discussed. In this regard, a positive aspect of the framework developed in SC/61/AWMP2 is that it is flexible in allowing for the substitution of alternative environmental indices (or a weighted average of a set of such indices). It was anticipated that revised versions of the data used in these analyses would be considered within this framework during next year's *Implementation Review*.

SC/61/AWMP3 presented the results of a set of simulation trials used to test the performance of the *Gray Whale SLA*. The operating model was based on the framework presented in SC/61/AWMP2. This allowed future projections to be explicitly conditioned on available information pertaining to the population dynamics of eastern North Pacific gray whales, including survey estimates of 1+ abundance, calf counts, strandings data and the extent of sea-ice in the early season feeding grounds in the Bering Sea. The scenarios considered in the analyses explored the impact of different sources of environmental variation, including scenarios in which future environmental forcing and episodic events are driven by the hypothesised relationship between the extent of sea-ice and deviations in life history parameters. Likewise, scenarios which included future episodic events were based on the estimated magnitude of the 1999 and 2000 unusual mortality event which was determined during the conditioning process (SC/61/AWMP2). A variety of sources of uncertainty were considered, including parameter uncertainty, the uncertainty about the relationship between the extent of sea-ice and population dynamics, the extent and nature of episodic events and observation error. Their impact on the performance of the *Gray Whale SLA* appeared to be small. Further, the performance of the *SLA* was judged to be acceptable (resulting in high final depletion and satisfaction of need) for all scenarios considered in these analyses.

In discussion it was noted that in order to perform future projections of this kind, it is necessary to have an environmental index for which there exist not only observations, but also a relevant forecast from global climate models. Further, not all global climate models perform equally well at capturing different types of observed environmental variability. Therefore, following the approach of SC/61/AWMP3, future analyses along these lines should be based on the output from a subset (or weighted average) of global climate model output from those models for which there is more confidence in predictive ability. It was noted that the analyses were based on extrapolating into the future based on the assumption that the relationship between sea-ice and birth rates was constant, but that this was not necessarily the case. Therefore, future trials should also consider the effect of alternative assumptions with regard to the relationship between environmental variability and population dynamics (e.g., by allowing such relationships to be some function of population depletion).

4.2.2 Catch and stranding information

Borodin summarised catch data for 127 gray whales (63 males, 64 females) taken in the aboriginal hunt in Chukotka waters in 2008. Six males and 3 females were taken in western Bering Sea. Their body length varied from 8.0m to 12.6m (mean 9,45m), and body weight varied from 6.0 to 21.1t (mean 9.58t). The rest of gray whales were harvested in Chukchi Sea. Their body length varied from 8.0m to 14m (mean 10.1m), and body weight varied from 6.0 to 29.3 t (mean 11.33 t). The largest gray whale female was killed near Lorino settlement on October 15, 2008. It was 13.9m long and weighed 28.6 tons. The largest gray whale male was harvested near Lavrentiya settlement on October 17 2008. It was 14.0m long and weighted 29.3 tons. The furthest towing distance to shore was 17.5km, the shortest – 0.3km. 42% of taken gray whales demonstrated aggressive behaviour during the hunt. 14 days (7%) of the 200-days harvest season were dead calm in 2008. Two pregnant females were taken in 2008, and two cases of killer whale attack were observed. 10 individuals of 127 gray whales were considered unfit for consumption in 2008 (samples were taken from 7 animals only). In total, biological sampling was conducted on 44 gray whales; 3 gray whales were struck and lost. All aboriginal whaling data were presented through the Department of Industrial and Agricultural Policy of the Chukotka Autonomous Region. Harvest of gray and bowhead whales was supervised by The Association of Indigenous Small Peoples of the North in 2008. The Fisheries Council of the government of Chukotka autonomous region distributed quotas among hunters on April 18 2008. There was a need in quick regulation and redistributing of quotas during the harvest season, and all redistributions were approved by the Council.

In discussion, it was noted that sex ratios in the aboriginal hunt in Chukotkan waters have historically been skewed towards more females. But, currently this sex ratio is more even. One reason for this difference is that the selectivity of the hunt changed after the early 1990's, when the harvest transitioned from using a catcher ship to shore based small boats.

4.2.3 Preparation for Implementation Review

Brandon and Punt (SC/61/AWMP3) described an operating model and a number of scenarios that might be used for the *Implementation Review* for the gray whale *SLA* to be conducted before or during the 2010 IWC SC meeting. The goal of the *Implementation Review* is to evaluate new information about the ENP gray whale stock that has become available since the *SLA Implementation* to determine whether the new information is outside the realm of plausibility covered by the *Implementation* trials. If so, it may be necessary to conduct further trials incorporating the new information, as envisaged in SC/61/AWMP3.

Data that are to be used in the *Implementation Review* must be made available under data availability Procedure A. Under Procedure A, there are deadlines for papers using those data to be submitted to the Scientific Committee.

Type of paper	Time before meeting
Final datasets available	6 months
Papers using novel methods	3 months
Papers using standard methods	2 months
Papers responding to those above	1 month

From discussions at this meeting it appears that at least the following will be required:

(1) Data used in the revised series of abundance estimates from the 1967/68-2006/07 counts of ENP gray whales on their southern migration past Granite Canyon, CA (Breiwick *et al*., 2009, SC/61/AWMP1). The data from all these surveys is being reformatted as necessary to permit abundance estimates using a uniform methodology that incorporates improvements in survey and estimation techniques that occurred over time. The new abundance time series will be more suitable for trend estimation than earlier estimates.
(2) Data used to produce new estimates of calf production during 1994-2008 from the northbound migration at Point Piedras Blancas, CA (e.g. Perryman *et al.,* 2002).
(3) Data on the number of stranded gray whales on the coast of CA, OR, and WA, 1975-2006 (Brownell *et al*., 2007), updated to include 2007-2009. These data provide information on the mortality event that occurred in 1999-2000.
(4) An index of March and April sea-ice conditions (e.g. HadSST) which covers as much of the assessment period as possible and can be projected into the future (Brandon and Punt, 2009, SC/61/AWMP2). Moore will provide recommendations regarding the characteristics of an appropriate index/ices.
(5) An updated catch series, 1930-2008, that incorporates catches discovered since the catch series used for SC/61/AWMP2 and SC/61/AWMP3 was created. Reeves will assist in updating the catch series. In particular it will need to include the catches by *California* in the 1930s and further consideration of aboriginal/subsistence catches prior to the 1960s.

In addition to these data sources, any information regarding stock (or lack thereof), priors for biological parameters and other relevant data (e.g., that from studies in the Baja lagoons) will need to be considered.

4.2.4 Management advice

The subcommittee reaffirmed its advice from last year that the *Gray Whale SLA* remained the most appropriate tool for providing management advice for this harvest. Use of this confirmed that the current limits will not harm the stock. An *Implementation Review* is scheduled for 2010.

5. BOWHEAD WHALES

5.1 Bering-Chukchi-Beaufort Seas (BCB) stock of bowhead whales

5.1.1 New scientific information

SC/61/BRG1 introduced a probability model for data arising from aerial line transect surveys, with the goal of estimating large- and medium-scale relative animal density for BCB bowhead whales during their autumn migration. This model included consideration of animal clustering and censored observations due to effort truncation and flights with zero animal sightings. Terms were also included for spatio-temporal covariates that affect detection probabilities and animal presence. Approximate model fitting was accomplished using generalised additive modelling techniques for censored data. Estimation of uncertainty relied on bootstrapping. The data regarding autumn BCB bowhead migration were derived from a large 25-year dataset of bowhead whale aerial line transect surveys in the western Arctic. The fitted model in SC/61/BRG1 effectively maps the spatio-temporal pattern of the autumn bowhead migration and is consistent with current scientific understanding and hunters' traditional knowledge. Additional model terms were added to test for potential localised zones of unusual scarcity or abundance such as what could be introduced by avoidance of industrial activities or hunting or by variation in prey availability, whale behaviour or other environmental factors. The analysis shows significant results including a region of lower relative density north of Prudhoe Bay and strong evidence of a region of high density immediately east of this region in an area the whales would pass through before approaching the region of low density. These findings are consistent with the hypothesis of industrial impact. Conversely another model indicates that the region of low density may have persisted since about 1990, which is more consistent with a hypothesis of long-term environmental effects like prey availability. There is no evidence that whale behaviour or swim speed is associated with any of these effects. Thus, the causes of these detected patterns are not well understood.

The BWASP survey protocol may cause fine scale 'holes' in survey density, however an initial investigation of whether model results would be sensitive to such effort variation indicated that there was no significant effect. Further, compared to the region of interest and the smoothness of model terms, the variation in survey effort was small-scale and spatially scattered.

SC/61/BRG3 reported on bowhead whale distributions in the Central Beaufort Sea during late summer and early autumn of 2006-08 during periods with and without seismic exploration. Data came from aerial surveys, vessel-based surveys and acoustic buoys. During some 2007-08 surveys large numbers of feeding bowhead whales were seen in areas where feeding has previously been recorded, but is considered uncommon. Feeding whales appeared to remain in that area for 16 days in 2007 and for 6 days in 2008 while seismic surveys were conducted 10-50km east of them. During feeding and travelling periods, averages of ~2,500 and ~350 bowhead whales were present in the survey area. The mean distance from the centre of the seismic survey area was not significantly different between periods with (51.4km) and without (49.6km) seismic activity during feeding periods, but the mean distance was significantly greater with seismic activity during travelling periods (51.5 vs. 27.3km, respectively). During feeding periods, the highest sighting rates were recorded in the West sub-area in areas where seismic sounds were estimated to have been ≥120dB re 1µPa (rms). During the travelling period, sighting rates in the sub-area that included the seismic operation declined as exposure increased, suggesting localised avoidance of seismic operations, but sighting rates were not significantly different among the East, Central and West sub-areas. Based on aerial sightings and observations from vessels, feeding bowhead whales appeared to tolerate seismic sounds until levels approached ~160dB but some appeared to tolerate higher levels. These levels are higher than the 120-30dB threshold for avoidance by migrating bowhead whales observed during seismic operations near the same location in 1996-98. Detections of bowhead whale calls via acoustic recorders and sightings during aerial surveys had generally similar distribution patterns during seismic and non-seismic periods, suggesting that whales did not divert 50-75km around seismic operations. The latter distances correspond to the ~120dB distances from the two seismic survey areas. Thus, it appears that bowhead whales may tolerate higher levels of seismic sounds when feeding than when travelling. Similar tolerance to seismic activity has been seen in the summer feeding areas in Canadian waters.

In discussion it was pointed out that previous IWC publications have noted that the Central Beaufort Sea is a regularly used feeding area.

SC/61/BRG3 provided an update on SC/60/E14, which included only the 2007 data. Concern was expressed at SC60 and at this meeting that whales motivated by a feeding opportunity might not avoid seismic sounds and lack of avoidance does not necessarily mean there was no impact. Additional data are needed to understand impacts of different levels of sound exposure on the behaviour and hearing of cetaceans. The results of the study and the concerns have not changed substantially since 2008.

The sub-committee received new information on how operators of seismic surveys mitigate for potential impacts on marine mammals. Sound levels emitted from seismic operations were measured at distances up to ~80km from the airgun sources and equations fitted to the measurements. These distances included measurements at presumed distances where marine mammals could undergo potential temporary threshold shifts and permanent threshold shifts. Support vessels were employed ahead of source vessels to detect whales before they enter presumed radii where TTS might occur and airgun operations were modified if whales were present in those areas. Industry also moved operations this year when a large aggregation of feeding bowhead whales was found near their operation even though whales were well outside of the presumed TTS zone; seismic efforts in that area resumed later in the season.

SC/61/BRG4 presented results on numbers and distributions of cetacean species from aerial and vessel-based data collected during the summer and autumn of 2006-08 in the eastern Chukchi Sea. Most vessel-based data were collected from industry vessels engaged in seismic and related support activities in offshore (>37km from shore) but only data collected in the absence of seismic activity were used. Aerial survey data were collected from a fixed-wing aircraft in the nearshore region (0-37km from shore) from Pt. Hope to Barrow using a randomised line-transect methodology. Distribution and relative abundance of species observed were similar to previous studies, allowing for annual variation and population increases of some species. Small numbers of bowhead whales were seen during the summer period; bowhead sightings did not become common until the autumn migration began. Gray whales were the most abundant species and distribution changed between years, which seemed to correspond to changes in feeding areas used. In 2006 gray whales fed in more southerly coastal environments and in 2007-08 gray whales fed further north and further offshore.

Effort during seismic operations, and for the two hours following seismic activity, was not included in the analysis as sightings were reduced by seismic activity. Sighting rates were believed to return to normal after about two hours, especially when the survey vessel was moving away from the earlier seismic sound source.

A question was raised that referred to a comment made by the author in an earlier E session, regarding the detection of 'about 100' whale carcasses sighted during the 2006 surveys. The author was asked for his ideas on why so many more dead whales than live whales were seen on transect. The author responded that while there were many dead whales, most were gray whales with only one identifiable as a bowhead, and that some were definitely resightings, as the ability to mark counted carcasses did not exist. The author noted that since a large number of carcasses were sighted early in the season, they likely died prior to the 2006 seismic surveys. The SWG expressed concern about the number of dead whale sightings noted during the 2006 survey[1].

The sub-committee noted that the history of surveys in the eastern Chukchi Sea was not correctly portrayed in the report, including the sightings of several fin whales in the 1980s.

SC/61/BRG13 reported on efforts of NSB-DWM to increase baseline knowledge of sensory systems in bowhead whales. The NSB-DWM has developed a program to investigate hearing, sight, smell and taste in the bowhead whale that involves the removal of ears, brains, eyes and other tissues from subsistence-killed whales in Barrow, Alaska for anatomical and genetic studies. The work began in autumn 2008 and includes auditory work focused on investigating the basic anatomy of the mysticete ear via gross and histological anatomy. Fixed tissues will be assessed histologically for information on baseline histological appearance and for the presence of pathologic changes compatible with acute or chronic auditory damage. The olfactory research includes general anatomical investigations and histology of the olfactory epithelium of the olfactory passages in the nasal cavity and the olfactory bulb, as well as genomic work. The taste and vision studies focus on taste buds and stereoscopic vision/corneal structure. These studies will provide a better understanding of the sensory world of the bowhead whale and the potential for impacts from sound, waste and other industrial discharges.

The sub-committee looks forward to receiving the results of the work presented in SC/61/BRG13. In discussion it was noted that research on whale sensory organs, particularly hearing, is also being conducted by Ketten *et al.* However, its scope and success is uncertain.

SC/61/BRG7 discussed methods to estimate site specific rates of mutation in the mitochondrial control region (HVRI) using more conservative protein coding genes for character weighting and to identify sites of recurrent substitutions or homoplasy. Recurrent substitutions are a major source of noise and limit the ability of mtDNA analyses to accurately resolve population genetic, evolutionary and demographic parameters. A recently developed procedure called tree-weighting and character mapping was used to obtain fully resolved phylogenies for concatenated HVRI-Cytochrome b-ND1 sequences of Steller sea lions and bowhead whales. In contrast, the excision of hypervariable sites, while increasing resolution of the haplotype network, reduces the number of haplotypes and thus lowers the resolving power of the dataset overall. The simple addition of sequence also increases the resolution of haplotype networks but it does not fully resolve them. Application of the method to Steller sea lions and bowhead whales revealed the two species to possess markedly different evolutionary patterns including time to most recent common ancestor (360,000 years for Steller sea lions and 1.2 million years for bowhead whales). These divergent patterns of evolutionary history translate into markedly different estimates of long-term effective population size. Bayesian skyline plots of Θ, which is proportional to effective population size and mutation rate, show both species have undergone an historic population increase to current levels but bowhead whales are nearly an order of magnitude greater than sea lions for Θ. Future studies, including a nested clade analysis, are expected for bowhead whales.

The authors noted that average age of reproductive females was used as the generation time. The sub-committee was pleased to see the fully resolved haplotype network for HVR1 for bowhead whales.

The Bayesian methods for calculating the effective population size of bowhead whales showed that it has fluctuated over time by approximately two orders of magnitude, making the determination of pre-whaling population size difficult. Archaeological material may help refine estimations of effective population size through time.

SC/61/BRG20 investigated whether individual bowhead whales tend to keep their rank in the spring migration past Barrow in Alaska, or whether their time of migration is random relative to that of others. In a series of aerial photographic surveys, 40 individuals were captured in more than one year. To study individual-specific persistency in migratory pattern, the relative ranks of the captures of these whales among all captures that year were analysed. Controlling for body length and the presence of calves, the correlation of relative ranks in individuals captured multiple times was not found to be significantly different from zero (p-value=0.78).

The sub-committee thanked the author for the work, noting that it provided evidence that the timing of large whale migration is actually distributed throughout the entire migratory period, not just towards the end.

SC/61/BRG21 investigated how information builds up in a sequential capture-recapture study. Fisher information is defined as the expected negative curvature of the log likelihood function at its maximum and is essentially the inverse of the variance of the maximum likelihood estimator. Information builds up as effort increases. The expected increase in Fisher information, the information gain, per extra capture in a sequential capture-recapture experiment was found to grow faster than linear in number of captures when the population is closed and homogeneous. A similar pattern was found for open populations, with information gain growing faster to its maximum the shorter the longevity. From simulating annual photographic capture-recapture surveys off Barrow in the spring, from 2008 and with effort as in previous such surveys, the abundance estimate for the BCB bowhead population based on photo-ID data was found to have a CV of approximately 9% in 2022. Since annual photographic surveys are unlikely to be funded the actual time to achieve this reduction in CV will almost certainly be longer.

Schweder *et al*., 2009 [SC/61/ForInfo22] described a model for estimating abundance, mortality and population growth of bowhead whales from systematic photographic surveys conducted during the spring migration when most of the BCB population of bowhead whales migrates past Point Barrow, Alaska. A stringent matching protocol designed to prevent false positive matches of the naturally but variably marked individuals led to 42 resightings between years. The reverse side of this stringency is the presence of false negatives, i.e. some true recaptures are not recognised as such. The problem of false negatives was addressed by modelling the capture process and the matching process. The captures of an individual were assumed to follow a Poisson process with intensity depending stochastically on the individual whale and on the year. The probability of successfully matching a capture to a previous capture was estimated by logistic regression on the degree of marking and image quality. Individuals were recruited by the Pella-Tomlinson population model, assuming a constant mortality rate. An approximate likelihood was maximised. Bias, which was mainly due to false negative matches, was corrected using bootstrapping, and confidence curves in agreement with previous results were obtained for key parameters. The likelihood might be combined with likelihoods based on other relevant data, such as other capture-recapture data, direct count data, and catch data for assessing the BCB bowhead population.

The sub-committee commended the authors for their work. The most recent spring photo-identification surveys have not yet been fully analysed and should narrow confidence intervals when included. Summer sightings of marked whales were not used in the analysis, but if included in the

[1]In Plenary, the authors clarified that this number of carcasses was too high, and that the actual numbers were: 33 cetacean carcass sightings plus 9 unidentified carcasses, some of which may have been cetaceans. There were also 3 sightings of a bowhead carcass.

model they may increase estimate precision. All photographs, despite quality, were included in the analyses. They were not subjected to data screening for photo quality and identifiability of whales as done in previous mark-recapture analyses of photo-identification data, yet this method still found comparable results.

Koski (2009) [SC/61/FI12] provides an abundance estimate for BCB bowheads based on photo-identification data. Specifically, photo-identification data were collected in 2003-05 for use in capture-recapture analyses. A screening procedure was used to define which whales photographed were marked and could be re-identified if photographed on another occasion. Further, an estimate of the number of marked whales was obtained using a closed population model for capture-recapture data. To account for unmarked whales, this estimate was divided by an estimate of the proportion of the bowhead population that was marked based on the 1989-2004 spring photographic surveys near Barrow.

The sub-committee **agreed** that the 2004 abundance estimate of 11,800 (CV 0.255, 95% confidence interval [7,200; 19,300], and 5% lower limit 7,800) from the photo-identification data is an acceptable estimate of the abundance of the BCB stock of bowhead whales. This estimate is suitable for use in the *Bowhead Whale SLA*.

SC/61/BRG23 provided details of a 2009 effort to count BCB bowhead whales near Barrow, Alaska. The last successful on-ice census occurred in 2001; therefore an updated estimate was needed. To determine detection probabilities two observation perches operated independently. Sea ice conditions (i.e. closed leads because of west winds) during the first half of May precluded efforts to update detection probabilities or estimate abundance. Four hydrophones were deployed in early April and will be retrieved in July or August 2009. Data from those instruments will provide information on calling behaviour during migration, including times when visual observers were not able to see whales.

During discussion it was noted that changing ice conditions are increasing the difficulty of on-ice efforts to count bowheads. In 2010, there will likely be another attempt to conduct an on-ice census, including estimation of detection probability via an independent observer experiment. Schweder *et al.* (2009), Koski (2009) and SC/61/BRG21 provided details about using photo identification data to estimate bowhead abundance using capture-recapture techniques. Suydam stated that if funding allows, conducting both an on-ice count and a photographic survey will occur in 2010. Transitioning from on-ice techniques to photographic surveys may be necessary because of changing sea ice due to global warming.

The sub-committee further discussed the potential for abundance estimates in the future being based on photo-identification data from systematic aerial surveys. In Schweder *et al.* (2009) a refinement of the capture-recapture technique for analyzing such data from the spring migration is suggested. A likelihood function summarizing the data from previous systematic photo-surveys is developed. The information gain in data obtained from a new survey, as evaluated from the archive of captures from previous surveys, is discussed in SC/61/BRG21 (Schweder and Sadykova). From the results of that paper, and data on costs, a cost and information-benefit analysis might be worked out. This would provide grounds for deciding how much effort should be allocated to on-ice versus photographic surveys for abundance estimation. The subcommittee would welcome such an analysis.

SC/61/BRG17 presented a stochastic population dynamics modelling framework for BCB bowhead whales which keeps track of females in different reproductive stages (calving, receptive and resting). This model was fitted to a variety of data sources, including estimates of total (1+) abundance, the fraction of calves based on aerial surveys and a potential index of deviations in birth rates (sea-ice on the eastern Beaufort Sea feeding grounds) using penalised maximum likelihood. The results from this extended assessment were compared with analyses which mimic those on which previous assessments have been based. All model configurations fitted the abundance data well. However, only the stochastic models were able to mimic the inter-annual changes in the proportion of calves adequately. Although currently preliminary, this model framework could be extended and used as the basis to evaluate some of the potential impacts of climate change on the dynamics of the BCB bowhead whales, and hence the performance of the Bowhead Whale *SLA*.

In discussion it was noted that the assumption made with respect to environmental variability may model bowhead biology better if it were expanded to examine juvenile survival rate or alternative time lags for calf births.

Suydam reported results of a study by Quakenbush *et al.* that deployed satellite tags to 28 BCB bowhead whales in Alaska and northwestern Canada in 2006-08. The motivation for the project was to provide additional insights into stock structure and potential impacts from oil and gas activities. Fifteen of the tags were deployed in 2008 and 14 of those were deployed by Alaska aboriginal subsistence hunters. Preliminary results show high success and are revealing information on the movements and areas of high use of bowhead whales.

The authors were commended on the success of this new research initiative. The sub-committee expressed interest in the tagging success of the project and in obtaining details on how tags were applied by the hunters. Their techniques could be used for other projects and led to increased success in retention of tags. Possible differences in application of tags by hunters versus scientists include a more vertical angle of insertion, greater use of poles for application, and skill of approaching whales.

The sub-committee looks forward to receiving the results of how these data compare with changes in sea ice distribution in the future. Knowledge on behaviour of whale migrations is very important and is difficult to assess in any other way. This study confirmed the traditional knowledge of Alaskan natives on St. Lawrence Island that bowhead whales primarily migrate on the west side of the Island.

5.1.2 Catch information

SC/61/BRG6 summarised data from the 2008 Alaskan hunt. A total of 50 bowhead whales were struck resulting in 38 animals landed (including an autumn calf, 7.2m in length), similar to the 10-year average of 40.4 (SD=7.1). The efficiency (no. landed/no. struck) of the hunt was 76%, which is higher than the average during 1998-2007 (mean=65%, SD=8%). Challenging sea ice conditions, weather and struck whales diving under the shore-fast or into the pack ice contributed to a lower efficiency (60%) during the spring compared to the autumn (92%). Of the landed whales, 18 were males, 19 were females, and sex was not determined for one animal. Of the 19 females, 6 were presumed mature (based on length >13.4m). Only one was closely examined and she had an active follicle. Biologists were unable to examine the others because they were landed in remote villages or were butchered in the water. Hunters reported that one female was pregnant with a foetus ~3m in length. Hunters mistakenly harvested a calf thinking it was a small independent whale. Autumn calves are close in body length to yearlings and it is difficult to determine their status when swimming alone.

The Russian delegation reported that in 2008, two female bowhead whales were hunted in Chukotka. The whales measured 11.5 and 12.5m and were 44 and 39 tons respectively.

5.1.3 Management advice
The sub-committee reaffirmed its advice from last year that the *Bowhead Whale SLA* remains the most appropriate tool for providing management advice for this harvest. The results from the *SLA* show that the present strike and catch limits are acceptable.

5.2 Eastern Arctic bowhead whales

5.2.1 Stock structure
The sub-committee expressed disappointment that no genetic analysis was supplied this year to test the single stock hypothesis as was promised last year. Although the sub-committee agreed at the previous two Annual Meetings to consider a single stock as the working hypothesis, it was acknowledged there is still uncertainty about the population structure of bowhead whales in eastern Canada and Western Greenland. Wade noted that in other sub-committees, notably RMP, it is common to keep several working hypotheses of population structure when uncertainty exists. He acknowledged that tagging data showing movements of individuals completely around Baffin Island have been taken as support for a one-stock hypothesis, but pointed to examples in other baleen whales, in which one stock is thought to migrate through an area occupied by a second stock. He also noted that significant genetic differences between Baffin Bay locations and Hudson Bay/Foxe Basin locations in both mtDNA and microsatellite DNA have previously been presented (SC/57/BRG11) and a consensus tree (from both mtDNA and microsatellites) had all Foxe Basin/Hudson Bay samples on one side and all Baffin Bay samples on the other, consistent with a two-stock hypothesis. Given that no new genetic information has been presented to disprove the two stock hypotheses, he recommended that both one-stock and two-stock hypotheses should be considered working hypotheses by the sub-committee.

The sub-committee agreed that a working hypothesis of one stock implies that alternative hypotheses are still considered and therefore there should be consideration of both one stock and two stock hypotheses. The sub-committee strongly encouraged provision of genetic analysis to evaluate the appropriateness of the hypotheses considered.

5.2.2 Abundance
In 2008, the sub-committee agreed on a negatively biased estimate of 6,344 (95% CI = 3,119-12,906) which pertains to the Baffin Bay-Davis Strait population (IWC 2008 p. 28).

Some members of the sub-committee noted that there was considerable uncertainty associated with the current estimate of the Eastern Canada/Western Greenland Bowhead population size and that it would be difficult to obtain adequate aerial survey coverage of the large and fragmented summer range to provide a more accurate and precise estimate. It is recommended that the possibility of photographic survey be investigated to obtain a capture-recapture estimate, similar to that presented for the BCB stock in SC/61/FI12.

5.2.3 Catch information
Three bowhead whales were harvested under licence in the eastern Canadian Arctic in 2008, two in Nunavut and one in Nunavik (northern Quebec) (Reeves, pers. comm.).

5.2.4 Management advice
In 2007, the Commission agreed to a quota (for the next five years) of two bowhead whales struck annually off West Greenland but the quota for each year shall only become operative when the Commission has received advice from the Scientific Committee that the strikes are unlikely to endanger the stock.

In 2008, the Committee was pleased to have developed an agreed approach for determining interim management advice. The sub-committee agreed that the current catch limit will not harm the stock. It was also aware that catches from the same stock have been taken by a non-member nation, Canada. It noted that should Canadian catches continue at a similar level as in recent years, this would not change the sub-committee's advice with respect to the strike limits agreed for West Greenland.

5.3 Other stocks of bowhead whales
SC/61/FI21 reviewed knowledge concerning the endangered population of bowhead whales in the Okhotsk Sea (OS), about which relatively little is known. This is an update of the report presented last year (SC/60/BRG35). The authors reviewed existing information about this stock, including much previously untranslated material published in Russian. Whaling for OS bowhead whales began in either 1846 or 1847, was pursued intensively for two decades, and continued sporadically until about 1913. Catches resumed in 1967 when the USSR began killing bowhead whales illegally, although the number of whales taken remains unknown. Estimates of the pre-exploitation population size have ranged from 3,000 to 20,000 whales, but all such estimates are based upon incomplete data (primarily from 19th century whaling) and untested assumptions; a better estimate cannot be attempted without further investigations of whaling logbook data to separate bowhead whale catches from those of North Pacific right whales. Information on historical and current distribution comes from whaling records (notably Townsend 1935) and from modern (notably Russian/Soviet) marine mammal surveys. Little is known about winter distribution; however, at least one Russian report suggests that OS bowhead whales can overwinter in pack ice. In spring and summer, bowhead whales spread out over open water, with known concentrations in Shelikhov Bay (northeastern OS) and off the Shantar Archipelago (northwestern OS). Genetic data indicate that the OS stock is a separate stock from the Bering -Chukchi-Beaufort population. There is no historical or current evidence that bowhead whales ever leave the OS. Mark-recapture genotype data give the only current estimate of minimum abundance as 247 whales, though this may relate to the portion of the population that inhabits the Shantar region. Dedicated surveys and other research are required to better assess the status and conservation needs of the OS stock.

SC/61/BRG2 summarised reported sightings of bowhead whales which have taken place in the Svalbard area between 1940 and 2008. The data provided are based on a database of incidental sightings held at the Institute of Marine Research and records of sightings at the Norwegian Polar Institute. The paper summarises 41 observations made during 1940-2008, of which only three were made prior to 1980. Most of the observations have been confirmed, and there has been an increase in number of sightings over the last decade. Looking at the seasonal distribution of the sightings, whales were first seen in the Fram Strait west of Svalbard in early spring, but quite soon thereafter, probably in response to seasonal changes in ice cover and marine productivity, they moved both southwest into the Greenland Sea and eastwards into the Barents Sea.

The sub-committee informed the author that in 1988 scientists from Woods Hole had made acoustic recordings of singing bowhead whales in Fram Strait and suggested future acoustic work to monitor bowhead whales.

6. RIGHT WHALES

6.1 North Atlantic right whales

SC/61/BRG11 provided recent information on North Atlantic right whales for the period November 2007-April 2009, including on-going research and national management actions. The summary was provided by the North Atlantic Right Whale Consortium (NARWC), more than 100 individuals and groups that conduct coordinated research on this population across its known range. The NARWC identified several areas of priority research, including photo-identification and cataloguing efforts, scar-based monitoring and health assessments, necropsy studies and analyses of population structure and dynamics. A shared photographic catalogue was used to produce an estimate of population size of 415 for 2007. This was the number of unique, catalogued individuals that had been seen alive between 2001 and 2007. It did not explicitly account for un-photographed whales in the population and may change slightly as additional data are incorporated into the catalogue. A total of 39 calves have already been documented in 2009. This represents the largest annual calf count on record, and mothers in 2009 had previously given birth 3.9 years ago on average. A total of six right whale mortalities were documented during the report period. Additionally, there were 10 new entanglement cases and five previous entanglement cases that had not yet been resolved. The paper listed a wide range of research being undertaken by NARWC members. It also summarised recently legislated actions in the U.S. and Canada, including several geared toward reducing the frequency of right whale entanglement and ship strike. The author emphasised that further work is particularly required to understand and reduce entanglement, and that funding shortfalls continue to threaten core aspects of research.

Waring *et al*. (2009) provided the most recent US government stock assessment of the North Atlantic right whale. Photo-identification data indicated that a minimum of 345 individuals were alive in 2005, based on individuals seen alive in that year, or both before that year and after. This total may increase as cataloguing efforts continue. There was an increasing trend in the minimum number alive from 1990 through 2004, but significant annual variation was also observed. The mean crude growth rate over the period was 1.9%. Observed calf production from 1993 through 2007 averaged 15.6 per year (95% CI: 13.7-17.7). In addition to the 16 observed calf deaths during the same period, three females died with near term foetuses in 2005. Recent observed mortalities included six mature females, four of which were at the beginning of their reproductive life. Between 2003 and 2007, there were 11 documented ship strikes and 5 entanglements that were known or expected to lead to death. These observed cases exceeded the US management limit of zero human-induced mortality for this stock.

In discussion it was clarified that the estimates of population size in SC/61/BRG11 and Waring *et al*. (2009) are not directly comparable. Rather, they are different types of estimates, calculated over different time periods and for different purposes.

While the sub-committee remained concerned regarding the status of this population and the continued anthropogenic mortality that threatens its recovery, it noted that the relatively high calf counts and the positive growth rates in recent years are encouraging. The sub-committee also commends the recent actions taken to lower the possibility of ship collisions, including movement of shipping lanes in the US and Canada, the establishment of an Area To Be Avoided in Roseway Basin, and speed restrictions on vessels in areas of the eastern coast of the US. The sub-committee also commands the progress made towards reducing risk of entanglements by sinking 'ground line' in fixed gear fisheries, and urges the continuation of the management efforts.

6.2 North Pacific right whales

SC/61/BRG16 summarised a multi-year study of North Pacific right whales in the Bering Sea, conducted by the US National Marine Mammal Laboratory. A short field season in 2007 was followed by more extensive work in the summer of 2008, including both vessel and aerial surveys. Approximately 1200nm (vessel) and 5821nm (aerial) of on-effort track lines were covered throughout the survey. One right whale and 3 humpbacks were satellite tagged during the cruise. The right whale tag remained attached for two months, during which the whale remained in the same area in which it was tagged; this emphasises the importance of this region (which has been designated as Critical Habitat by the US government) as a feeding ground for this population. On Leg 1, extensive oceanographic sampling was conducted throughout the area to characterise the habitat. Acoustic monitoring was conducted 24 hours a day using sonobuoys, and right whale calls were heard on 19 of 33 days. In addition, three autonomous recorders were deployed; these will be retrieved and redeployed in 2009. In total, 9-11 individual right whales were photographically identified. Four whales were seen by both survey platforms, indicating that a small number of individuals occurred in the survey area. Five whales seen in 2008 were also previously photographed in the Bering Sea in 1996-2002, and in 2004.

In discussion some concern was expressed over the potential impact of satellite tagging individuals in such small and endangered populations. Clapham noted this concern but said that the tagged whale will be monitored post-tagging and the state of the tag site examined: he also drew attention to the reports in Mizroch *et al*. (in press) that included resighting records of humpback whales tagged with larger devices more then 30 years after tagging, with no discernible effect on survival or reproduction. There was at least one individual right whale in the photo catalogue that carried scars from entanglement in fishing gear.

Mark-recapture estimates of abundance for Northeast Pacific right whales may be available next year from both genetic and photo-identification data (Wade, pers. comm.).

6.3 Southern right whales

In reviewing recent work as described in the following sections, the sub-committee agreed that continuation of current long-term studies on southern right whales off eastern South America, South Africa, and Australia\New Zealand should be encouraged, particularly as they should provide information on population status in relation to K and annual breeding success in relation to climate change.

6.3.1 Australia and New Zealand

Bannister reported the results of an aerial survey undertaken off southern Western Australia in late August 2008 (Bannister, pers. comm.). Last year the sub-committee reviewed the results of a 15-year series of annual surveys in that area, from which increase rates had been obtained of 6.94% (95% CI 3.37-10.63) for all animals and 8.10% (85% CI 4.48, 11.83) for cow/calf pairs (Bannister, 2008). Those results had excluded data from the final year in the series, 2007, where the counts had been very low and were regarded as outliers. The 2008 survey had resulted in the highest counts recorded, with calculated annual increase rates, 1993-2008, of 6.38% (95% CI 2.88, 10.00) for all animals and 6.61% (95% CI 1.98, 11.54) for cow/calf pairs. The low figure for 2007 had been included in the trend estimation. As a conservative best estimate, the trend for all animals, 1993-2008, of 6.38% (95% CI 2.88, 10.00), was preferred.

In response to a question, Bannister reported that he was planning for a further survey in 2009, pending a planned modelling exercise to investigate survey design for a long-term monitoring strategy in the context of the population's eventual approach to K and the possible effects of environmental change.

6.3.2 South Africa

Best reported that funding had been received to allow at least another two annual aerial surveys to take place off South Africa. Images from past surveys had been scanned and entered into an electronic data base incorporating the Hiby/Lovell matching system, and quality control checks undertaken. The priority was now to bring the matching of recent surveys up to date. Field counts (uncorrected for duplicates) in the 2008 survey totalled 350 cow-calf pairs, 418 unaccompanied adults and 11 juveniles.

6.3.3 South America

SC/61/BRG15 analysed the distribution patterns of right whales wintering along the Santa Catarina coast, Brazil, to test the hypothesis that these patterns are not random and to map the highest right whale density sites. Geostatistic analyses were performed on right whale aerial sighting data (mostly cow-calf pairs) collected from 1987 to 2003 using the software Spring v. 4.3.3. The detection of sites with higher whale density was performed using Kernel density estimator. A digital bathymetry was constructed and overlaid on the Kernel density analysis results to investigate links between whale concentrations and bathymetric features. Two points of higher right whale concentrations were found, at Ibiraquera and Santa Marta Cape. Lower concentration areas occurred to the north and south of these points, while there was medium right whale density between the two main aggregation points. These higher aggregations were located in an area where the coastline curves and has a higher number of bays, while the shelf declivity in this area is higher than elsewhere. However, there are several bays in which right whale concentrations were low, so other factors (such as sea surface temperature and ocean circulation patterns) may influence distribution in these areas. At Santa Marta Cape there is an extension of the coast towards the sea and associated upwelling, which could play some role in attracting right whales, although this is not a known feeding area: some other intrinsic factor such as temperature must be investigated. Shallow waters and proximity to the coast are the preferred habitat of females with calves, mainly because they enable energy conservation by the calves, but these areas may also be preferred because they are free from underwater obstacles where whales can drift freely with the tide, and may offer some protection against killer whales.

SC/61/BRG18 reported unusual mortality events (UME) of southern right whales off Península Valdés, Argentina. Since 2003, when the Southern Right Whale Health Monitoring Program was established, 291 right whale strandings have been recorded, with peaks in 2005 (47), 2007 (83) and 2008 (100). Most (90%) of these strandings were calves. UMEs occurred over periods ranging from 6 to 12 weeks, mostly in Oct-Nov in 2005 and 2007 but earlier (Aug-Sep) in 2008. Although the number of living calves counted during annual aerial surveys is almost evenly divided between the two gulfs of the peninsula, 68% of the stranded calves died in the southern gulf, Golfo Nuevo, indicating that the cause of the mortalities could be more intense there. Most whales were in advanced states of decomposition and histopathological analyses provided no evidence for cause of death. Of 10 samples (urine, faeces and blood) collected in 2005, two were positive for domoic acid, but levels were low when compared to those reported for marine mammals with domoic acid toxicity symptoms. Three of the five stranding peaks recorded in 2005, 2007 and 2008 occurred within a week of extremely high concentrations of Chl *a*, indicating the deaths could have resulted from harmful algal blooms (HABs). Water samples collected in Golfo Nuevo in September 2007 and 2008 showed high density blooms of *Alexandrium tamarense* before and between the highest peaks in strandings. Toxin concentration in these blooms was above the limit for human consumption but we do not know if it could be harmful to whales. Water samples from October 2007 had high densities of a non-toxic dinoflagellate tentatively identified as *Lepidodinium chlorophorum* that turned the waters of Golfo Nuevo green. Water samples from November and December 2007 and 2008 showed high densities of *Pseudonitzchia spp.* but these peaks occurred after the peaks in whale mortalities. Although some of the evidence suggests that the UMEs may be related to HABs, key pieces of information are missing (e.g., finding higher toxin levels in necropsies). It is possible that the population will continue to grow even if high-mortality events recur, but such events could be devastating for the remaining northern right whale populations. The results show the value of having a stranding program in place with capacity to respond on time and collect vital information from dead specimens.

In discussion, it was suggested that a correlation of these mortalities with the nutritional conditions available to the population on its feeding grounds might be useful, given the influence that food availability seemed to have had on North Atlantic reproductive performance. In response it was pointed out that the feeding grounds for this population were unknown, although stable isotope analyses were being used to study their trophic relationships.

It was also pointed out that because of the long-term nature of the monitoring of this population, it could prove an excellent candidate for modelling the effects of UMEs on whale populations in general.

Kelp gulls at Península Valdés, Argentina eat the living skin and blubber of southern right whales, so that the whales spend less time resting and more time in higher-energy behaviour fleeing from the attacks (SC/61/BRG19). Between 1999 and 2001, 154 juvenile whales were observed during continuous focal animal samples and 187 gull attacks were recorded. During hourly scans, 652 gull attacks were recorded on whales of all age classes. The majority of attacks (81%) were aimed at mother-calf pairs, 9% at juveniles and 8.4% at adults. The attack rate on mother-calf pairs (2.7 attacks/h) was five times higher than for juveniles; it was highest for juveniles when interacting with mother-calf pairs and lowest when in groups containing adults only. Attack frequency in Golfo San José and Golfo Nuevo increased from 12% in 1995 to an average of 26% in 2007-2008. Gulls aimed 90.4% of the attacks at existing skin lesions and the remainder at apparently smooth skin. The percentage of whales with gull-induced lesions increased from 1% in 1974 to 76.8% in 2008. These increases may be due to the growth of kelp gull colonies stimulated by the availability of fish refuse at landfills. A small proportion of the gulls that were visible at any one time were involved in the attacks, suggesting specialization. Gull attacks interrupt social interactions and possibly affect the normal behavioural development of juvenile whales: intense gull harassment could compromise calf survivorship in this population, although a cause-effect relation is hard to prove. Mitigation measures arising from workshops held in 2003, 2004 and 2008 include optimizing waste management practices to reduce the food available to the gulls, and evaluating the possibility of culling specialist gulls to reduce the attack rate. Some action on the former has already been taken, while a proposal for experimental gull culling with the main objective of reducing the attack frequency will be prepared by a working group this upcoming season.

The databases developed by research projects in Argentina and Brazil are the longest for this southern right whale population, and have been highlighted as very relevant to monitor the population dynamics and health of the species. For this reason, and given the situation described in the previous papers, the sub-committee strongly recommends the uninterrupted continuation of the monitoring surveys of the population off the east coast of South America.

6.3.4 Report of intersessional working group

Brownell reported that the last SC assessment of southern right whales was undertaken in 1998 in Cape Town, South Africa. The results of this meeting were published as an IWC special issue in 2001. In 2007, as part of the IUCN review of the status of the world's cetaceans, southern right whales were classified as 'Least Concern' (Reilly *et al*. 2008), but the Peru, Chile subpopulation was classified as 'Critically Endangered'. At the SORP meeting in Sydney in March 2009, several steering group members met and suggested that each regional research group should work on an assessment in their region and then, depending on progress in the next one or two years, a formal meeting might be held in 2012 or 2013 which may or may not be associated with an annual SC meeting [pre-meeting].

7. WORK PLAN

The following work plan was proposed for the coming year.

(1) Assess the stock structure and abundance of the Eastern Canada and West Greenland bowhead whales in order to advise the Commission as requested in Schedule 13(b)(3)(iv)

(2) Provide information to the SWG of the AWMP for the Implementation Review of Eastern North Pacific gray whales.

(3) Perform the annual review of catch information and new scientific information for the B-C-B Seas stock of bowhead and Eastern North Pacific gray whales in order to advise the Commission as requested in Schedule 13(b)(1)and (2).

(4) Review new information on all stocks of right whales, Western North Pacific gray whales, and the small stocks of bowhead whales.

(5) Review the report of the intersessional Steering Group on the assessment of southern right whales.

8. ADOPTION OF REPORT

The report was adopted on 8 June 2009 at 18:20.

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Appendix 1

AGENDA

1. Opening remarks
1.1 Election of Chair
1.2 Appointment of rapporteurs

2. Adoption of agenda

3. Review of available documents (BRG 1–27, FI 12, 21, 22, 40, O8, AWMP1, 2, ProgRep Denmark)

4. Gray whales
4.1 Western North Pacific gray whales
4.1.1 New scientific information (BRG 8, 9, 10, 22, 24, 25, 26)
4.1.2 Conservation advice (BRG 14)
4.2 Eastern North Pacific gray whales
4.2.1 New scientific information (BRG 5, 12, 13, 27)
4.2.2 Catch and stranding information
4.2.3 Preparation for *Implementation Review*
4.2.4 Management advice

5. Bowhead whales
5.1 Bering-Chukchi-Beaufort (B-C-B) Seas stock of bowhead whales
5.1.2 New scientific information (BRG 1, 3, 4, 7, 17, 20, 21, 23, FI 12, FI 22)
5.1.3 Catch information (BRG 6)
5.1.4 Management advice
5.2 Eastern Arctic bowhead whales
5.2.1 Stock structure
5.2.2 Other new scientific information
5.2.3 Catch information
5.2.4 Management advice
5.3 Other stocks of bowhead whales (BRG 2, FI 21)

6. Right whales
6.1 North Atlantic right whales (BRG 11, FI 15)
6.2 North Pacific right whales (BRG 16)
6.3 Southern right whales
6.3.1 Australian and New Zealand area
6.3.2 South African area
6.3.3 South American area (BRG 15, 18, 19, 31)
6.3.4 Plans to review Southern right whales (BRG 30)

7. Work plan

8. Adoption of report

Appendix 2

SUMMARY REPORT OF THE CO-ORDINATION GROUP ON A WESTERN GRAY WHALE TELEMETRY PROGRAMME

The western population of North Pacific gray whales is critically endangered. The population is estimated to contain about 130 individuals age one or older, of which only about 25 are reproductive females. This population faces a number of anthropogenic threats throughout its range including interactions (some fatal) with coastal net fisheries along its migration route(s) and oil and gas development in and near its principal summer feeding area (see document SC/61/ForInfo40 for a detailed review of threats to the population). The wintering area of the population is presently unknown and information on the migration routes is fragmented. The absence of this knowledge represents a significant hindrance to the implementation of range-wide conservation efforts. Satellite telemetry has been proposed repeatedly as an efficient way to investigate the migratory routes and wintering grounds of western gray whales. Scientists have been cautious about tagging these whales, however, because of the population's very low numbers. The use of telemetry to obtain migration and wintering area information has been discussed by the IWC Scientific Committee and various panels convened under the auspices of IUCN for a number of years. Summaries of these discussions, including an addendum on western gray whales as a case study, are included in a recent report prepared for the US Marine Mammal Commission and IUCN (SC/61/ForInfo1).

To ensure that a telemetry programme is carried out in the safest possible manner, taking into account advice from both the IWC Scientific Committee and the IUCN Western Gray Whale Advisory Panel (WGWAP), a co-ordination group (i.e. authors of this document) was established at the 2007 Annual Meeting and recently modified to include Burdin, Larsen and Tsidulko. This group was tasked with providing scientific guidance in regard to development of a telemetry programme, including advice on experimental protocols, study design and measures to be taken to minimise the risk of negative impacts on individuals or the population as a whole. In addition, the group was to ensure consistency between any advice given by the Scientific Committee with any given by the WGWAP. Also in 2007, the Scientific Committee recommended that the IWC act as co-ordinator for the tagging/telemetry project to ensure that it is carried out in a risk-averse manner and to enable sponsors to contribute financially without necessarily assuming responsibility for the programme's design, conduct or results.

Considerable time has been devoted to discussion of tagging western gray whales and the potential for injury or compromised health of individuals due to tagging, particularly with respect to the 25 or so reproductive females in the population. Keeping this concern in mind, the IWC Scientific Committee, IUCN and the Western Gray Whale Advisory Panel (WGWAP) have recognised the value of telemetry studies provided that suitable safeguards are in place to minimise risks to whales. These safeguards include the following: (1) the work should be carried out by experienced investigators using tested techniques; (2) tag design and deployment methodology should be of best-practice standard, including (a) tag length being the minimum possible to achieve a pre-determined attachment duration and (b) use of sterile techniques to minimise infection; (3) the work should be restricted to known males in good body condition and identified in 'real time' (i.e. in the field while tagging is being attempted) from previous photo-id and genetic studies; (4) field protocols to minimise risks and limit the time spent with individuals should be developed and presented for review by the co-ordination group in advance of fieldwork; (5) follow-up work on the potential effects of tagging should be a key part of any programme, and in particular every effort should be made to resight tagged whales during the period of the study; and (6) tracking data should be available to the IWC in as near 'real time' as possible.

Researchers undertaking the tagging of these whales will follow the guidelines used by the Society for Marine Mammalogy with regard to the treatment of marine mammals in field research. These guidelines are intended to reflect internationally accepted and scientifically valid approaches to field research on marine mammals and represent the requisite ethical standards of the international marine mammal scientific community. Recognising that this programme of research will occur in Russian waters, it is understood that all national permits, permissions and research standards must be followed. Additionally, Russian participation in the research programme is highly encouraged.

In consideration of the aforementioned safeguards, the co-ordination group recommends that: (1) no more than 12 tags be deployed on 12 male western gray whales in good body condition off Sakhalin Island in 2010; (2) real-time identification and selection of candidate whales will draw upon the genetic (sex determination) and photo-identification data sets collected by the Russia-US research team between 1994 and 2008 and rely on the unique ability of one team member (Amanda Bradford) to recognise individual whales by sight; (3) the co-ordination group encourages Bradford to spend approximately one month in the field working as part of the Russia-US photo-identification team in advance of the tagging operations in order to re-familiarise herself with the identification characteristics of each whale, (4) to maximise the duration of data transmission, in hope of identifying not only the migration route(s) but also the wintering destination(s) of the animals, the tags should provide positional information once daily and be able to transmit such information for a minimum of 120 days; (5) tags used on western gray whales are tested first on eastern gray whales to ensure that attachment techniques and tag performance are such that they will maximise the likelihood that they will meet or exceed the objective of 120+ days of data return; and (6) taking weather, migratory timing and the ability to conduct follow up studies into account, it is suggested that tags be deployed during the mid-August to mid-September period.

Further, it is hoped that collaborators in all the range states will be involved in the programme in some way, whether by contributing information on the specific locations of tagged whales and how to obtain additional information on these animals or making visual observations of the animals. This will require that the range state collaborators have real time access to the location of tagged whales in their waters.

Given that the IWC will serve as the co-ordinator of this tagging programme, researchers identified to conduct the study will provide the IWC via its co-ordination group with a detailed scope of work that contains information and technical details of their methods, field protocols, analysis plans and reporting deliverables. This scope of work would undergo proper evaluation and consideration by the co-ordination group well in advance of any fieldwork to ensure that it is satisfactory with respect to safeguards and chances of success.

The programme outlined in SC/61/BRG31 adheres to the previous recommendations by the IWC Scientific Committee, various IUCN panels and a recent IUCN range-wide workshop (SC/61/ForInfo40) that a satellite-tagging programme be designed and undertaken, with due consideration of the need to minimise risks to the health of individual animals and to the population's recovery. Much of the information expected from the programme is urgently needed to aid ongoing conservation efforts. Thus, the co-ordination group will continue to oversee development of the programme and ensure that every effort is made to attempt tagging during mid-August to mid-September 2010 (while recognising the potential logistical problems including finance, available personnel and permit requirements).

The co-ordination group is aware of and interested in a variety of emerging, potentially less invasive tag designs. However, these emerging technologies have yet to be sufficiently tested on eastern gray whales. The co-ordination group encourages that studies be undertaken as soon as possible to evaluate the performance of new tag technologies and their effects on eastern gray whales but that doing such should not further delay efforts to tag western gray whales with existing (proven) tags. A candidate population would be the well-studied Pacific coast feeding aggregation off Washington and Oregon, USA and British Columbia, Canada in which inter- and intra-annual resightings of the same individuals are frequent, making follow up studies possible. Such techniques, once tested and proven, may then be candidates for use in future tagging studies on western gray whales.

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Appendix 3

PROGRESS REPORT ON IUCN WESTERN GRAY WHALE ADVISORY PANEL WORK FROM JUNE 2008 TO JUNE 2009

R. Reeves, D. Weller, F. Larsen, G. Donovan, J. Cooke and R. Brownell

As mentioned in last year's report of the sub-committee (JCRM 11, Suppl., p. 187), an update on the activities of the Western Gray Whale Advisory Panel (WGWAP), which is convened by the International Union for Conservation of Nature (IUCN), is to be provided annually. This document provides such an update for WGWAP work carried out from June 2008 to June 2009.

The WGWAP has held two formal meetings since IWC/SC 60. These were WGWAP-5 in Lausanne, 3-6 December 2008, and WGWAP-6 in Geneva, 21-24 April 2009. As previously, the work of the panel has consisted primarily of (a) reviewing and commenting on western gray whale field research and monitoring work sponsored by Sakhalin Energy (also known as SEIC, Sakhalin Energy Investment Company) and (b) carrying out a variety of collaborative tasks with company-sponsored scientists and other outside experts within the context of Task Forces. Two Task Force meetings took place over the last year, one by the Seismic Survey Task Force (Vancouver, 31 January-2 February 2009) and the other by the Photo-identification Task Force (Geneva, 19-20 April 2009). The reports of all WGWAP and Task Force meetings, as well as the cumulative list of formal recommendations made by the WGWAP and its predecessors since 2004 are (or soon will be) available on the IUCN Western Gray Whale website (http://www.iucn.org/wgwap/). The list of recommendations includes an indication of their implementation status. According to the WGWAP terms of reference, Sakhalin Energy is obliged to respond to panel recommendations by either implementing them or explaining its reasons for not implementing them, and the company responses become part of the public record.

In keeping with this policy of transparency, which is a key aspect of the WGWAP process, most of the documents considered at panel meetings, including the annual reports by contractors carrying out field research and monitoring work with western gray whales on behalf of Sakhalin Energy, are made public on the IUCN website. In last year's report, 'the sub-committee commended the participation of the oil company Sakhalin Energy Investment Company in the WGWAP process, and recommended that other oil and gas development companies working on the Sakhalin Island shelf co-operate fully with the WGWAP process' (JCRM 11, Suppl., p.173).

At its fifth meeting in December 2008, the WGWAP was given preliminary information on the results of the 2008 field season. On the basis of that information, it concluded that the number of whales using the near-shore (Piltun) feeding area appeared to have been 'exceptionally low' during the July to late September feeding period (as compared to previous years) and that this scarcity may have been related to underwater noise from operations by oil and gas companies other than Sakhalin Energy, including that from (a) onshore pile-driving activities at a construction site on the northern Piltun barrier spit in close proximity to the feeding area and (b) a seismic survey near the northern edge of the feeding area. Pending the availability of information to allay its concerns about the dramatically reduced use of the Sakhalin near-shore feeding area by gray whales in 2008, the panel recommended a 'moratorium …on industrial activities, carried out by Sakhalin Energy and all other Sakhalin-based oil and gas companies, that might be expected, in the absence of independently verified mitigation measures (such as those developed by the Seismic Survey Task Force for seismic surveys), to disturb gray whales in and near their main feeding areas during the primary summer/autumn feeding season (July through October)'.

At its sixth meeting in April 2009, the WGWAP received the final results of industry-sponsored western gray whale monitoring work during the 2008 season. These results generally corroborated and reinforced the concerns that had arisen during the December 2008 meeting, and this led the panel to recommend that Sakhalin Energy not proceed with its planned 4D seismic survey in 2009, pending the results of a full programme to monitor the distribution and abundance of whales in 2009. The company accepted the recommendation and agreed to postpone its seismic survey until 2010. In the interim, the Seismic Survey Task Force was to be reconstituted to continue its development of a robust mitigation and monitoring programme in the event that Sakhalin Energy decides to proceed with the survey in 2010.

Among other items of potential interest to this sub-committee, the Photo-ID Task Force completed a series of exercises to compare catalogues and other aspects of the work of the two photo-ID teams active in Sakhalin waters (the Institute of Marine Biology team sponsored jointly by Sakhalin Energy and Exxon Neftegas Limited, and the Russia-US team sponsored in recent years primarily by International Fund for Animal Welfare). Significant progress was made at the Task Force meeting in Geneva on plans for a population analysis based on the combined photo-ID data sets, something that has long been encouraged by the Scientific Committee. Also, it was confirmed at WGWAP-6 that an Environmental Monitoring Task Force led by a benthic ecologist from the WGWAP (G. VanBlaricom) would make a site visit to Sakhalin Island in the summer of 2009 to evaluate and report on Sakhalin Energy's long-term benthic sampling programme.

Appendix 4

RECOMMENDATIONS AND CONCLUSIONS FROM THE IUCN RANGE WIDE WORKSHOP ON WESTERN GRAY WHALES

The sub-committee endorsed the following recommendations and conclusions of the IUCN Rangewide Workshop with some clarifications made during sub-committee discussions. The recommendations cover three broad areas: status and monitoring, threats and improved mitigation, and improved information outside the feeding grounds.

Status and monitoring

The sub-committee emphasises the importance of reducing human-caused mortality to zero and recommends that such reduction be a core goal of the conservation plan being developed for western gray whales.

The importance of continued population monitoring to determine if mitigation measures are working cannot be over-emphasised. A fundamental requirement is that annual monitoring effort in the field, using both photo-identification and the collection of biopsies from new animals, be maintained at a level adequate to support analyses using an appropriate population assessment model (e.g. that of Cooke (2008)). Any adverse demographic changes must be detected as early as possible, and preferably while there is still time for remedial action. The sub-committee therefore strongly recommends that research effort off Sakhalin Island, in support of annual population assessment through modelling, be continued as the highest priority monitoring tool for this population.

The recent observations of gray whales along the southeastern and southwestern coasts of Kamchatka and in the northern Sea of Okhotsk demonstrate the importance of obtaining photo-identification data from other areas in addition to the northeastern Sakhalin Shelf. Therefore, the sub-committee recommends that photo-identification effort be continued or expanded in other areas where western gray whales are known to occur, such as off Kamchatka and Magadan. It also encourages that a biopsy component be added to the photo-identification work in these areas. The sub-committee further recommends that all photographs from Kamchatka be compared to the Sakhalin catalogues maintained by the Institute of Marine Biology (IBM) and the Russia-US programme.

Photo-identification studies form an essential component of a number of elements of the conservation effort for western gray whales. The sub-committee strongly endorses the recommendations made previously by the WGWAP and the IWC Scientific Committee concerning joint analyses of the Russia-US and IBM catalogues. It further recommends that the photographs from Kamchatka and other parts of the population's range be included in any such joint analyses and notes the importance of continuing efforts to identify additional feeding areas of western gray whales.

Threats and improved mitigation

A good spatial and temporal understanding of the migratory routes, breeding areas and movements of western gray whales is essential if effective conservation measures are to be developed and implemented to protect them from anthropogenic threats throughout their range, particularly entanglement and entrapment in fishing gear, vessel traffic and industrial activities. At present, there is a severe shortage of such information. The most efficient (and probably only) way to achieve the necessary knowledge is to undertake a carefully planned satellite tagging programme. A successful programme will provide essential insights on threats (e.g. what they are, their spatio-temporal character and severity), reveal new information about the biology and behaviour of the animals to allow the development of effective mitigation measures, and better inform research and conservation planning.

In short, satellite tagging of western gray whales will address the following critical objectives:

(1) *Further identification of feeding habitats of western gray whales*. This would (a) lead to photographic identifications of whales in feeding areas other than Sakhalin and Kamchatka, allowing improved population assessment, and (b) point to additional areas in need of protection from harmful human activities.
(2) *Identification of migratory timing and routes between summer feeding and winter breeding areas* to improve assessment of threats along the migration routes and identify where mitigation is most critically needed.
(3) *Identification of the winter breeding area(s)* so that threats there can be identified and mitigated.

As noted by other groups that have considered the need for such information, the sub-committee stresses the importance of an extensive cost-benefit review of telemetry studies in terms of how they would be expected to contribute to conservation versus how they might pose risks to individual western gray whales. After a full discussion of the work of other international groups, and especially a careful consideration of the review of telemetry studies and potential health effects commissioned by the US Marine Mammal Commission (the 'Weller report'), the sub-committee strongly endorses the previous recommendations by the IWC Scientific Committee and various IUCN panels that a satellite tagging programme be designed and undertaken as soon as possible. It stresses that initiation of the satellite-tagging programme should not be further delayed, and the sub-committee recommends that every effort be made to attempt tagging at the end of the 2010 field season. That being said, it is essential that every safeguard be undertaken to minimise risks to the health of individual animals and to the population's recovery (see Item 2.11.1) and it endorses the approach and recommendations of the IWC Scientific Committee and the WGWAP in this regard. It emphasises that the potential for achieving a key precautionary element within the tagging effort, *i.e.* selecting candidate whales for tagging based on their sex, relative age, health status and other factors, is diminishing with time as it depends on the Russia-US team's availability and that team's ability to keep current with the individual whales.

In parallel with the telemetry programme on western gray whales, and in view of the general need to obtain further data on any potential effects of satellite tagging on the health of individual whales (see Item 2.11), the sub-committee also recommends that an evaluation study be undertaken as soon as possible using the well-studied Pacific Coast feeding aggregation of eastern gray whales regularly seen off Washington and British Columbia in which resightings of the same individuals are frequent (Weller, 2008).

Entrapment and mortality

Entrapment in set nets in Japan has caused several deaths of western gray whales in recent years. Given the critically endangered status of the population, the sub-committee strongly recommends that every effort be made to release entrapped animals as expeditiously as possible. In order to encourage this, the sub-committee encourages the appropriate Japanese authorities to develop carefully considered incentive schemes for all gray whales that are released alive and free of fishing gear. This scheme would be expected to involve a requirement for appropriate documentation to confirm species identification and that the release was successful. It would also ensure the collection of basic information, such as approximate length of the animal, date, location, photographs, skin samples *etc*. Such information is important in helping to fill gaps in information on migration timing and routes. Information on such releases should be reported to the IWC Scientific Committee annually.

In this regard, the sub-committee, welcoming the measures that have already been implemented by Japan, also encourages the appropriate Japanese authorities to continue the campaign to educate all set-net fishing cooperatives concerning (a) the critically endangered status of western gray whales, (b) the historical role of set nets in bycatches of gray whales and (c) the need to make every effort to release any entrapped or entangled western gray whale alive.

In addition, the sub-committee encourages authorising agencies to identify appropriate individuals who can make up a rapid-response team to assist fishermen in the event that a badly entangled gray whale is found and specialised assistance is needed to release it. The team should consist of individuals with experience in whale biology and behaviour, handling ropes under stress, and small vessel safety, and be trained and equipped with custom-designed tools. The team should receive training and equipment from appropriate, established disentanglement experts (e.g. from either North America or Australia) who have extensive experience dealing with free-swimming, entangled whales or with otherwise complicated entanglements of large whales. Such a team could be used to release entangled, but free-swimming, gray whales if any are reported.

When safe and appropriate, the scientific members of the team could help to collect specific information from such events (e.g. photographs for use in photo-identification, tissue samples, estimates or measurements of animal size, health assessment etc.). They could also be involved in specialised necropsy work (see below).

Although the recent entanglements have occurred in Japanese waters, the sub-committee recognised that the potential for such entanglement exists in all range states. It was pleased to learn that three rescue (response) teams had been established in the Republic of Korea and that these teams are designated to release any marine animals, including gray whales, either live-stranded or accidentally caught in fishing gear. The sub-committee encourages the further development of these teams through communication with experienced response teams elsewhere in the world.

The sub-committee recommends that the appropriate authorities in the other range states (Russia, Democratic People's Republic of Korea and China) initiate educational campaigns specifically targeted at fishermen who use the types of fishing gear that could entrap or entangle western gray whales. These campaigns should explain the critically endangered status of the population, the risks of entrapment or entanglement, and the necessity to report any gray whale found in gear (alive or dead) and to release any live gray whales found.

The sub-committee noted that the results of the recommended telemetry programme will greatly assist in focussing the above efforts on areas where gray whales are most likely to occur.

The sub-committee noted that necropsies conducted in an expeditious manner by experts have great value in determining cause of death, assessing pre-mortem animal health, and improving mitigation measures. The sub-committee recommends that facilitation of such necropsies be made a priority in all range states, involving all relevant qualified individuals and organizations. It also recommends that a detailed protocol be developed by IUCN, taking due account of experience elsewhere in the world (e.g. with North Atlantic right whales), and distributed widely to maximise the amount of data and information obtained from dead western gray whales. The sub-committee endorses previous recommendations by the IWC Scientific Committee that range states should submit necropsy reports on western gray whales to the IWC Scientific Committee for review.

Improved information from outside the known feeding grounds

Although a great deal of new information on western gray whales has become available since the previous workshop in 2002 (IWC, 2004), almost all of it has come from the feeding grounds near Sakhalin Island. In addition to the work carried out there, some recent photo-identification data has been collected from the southern Kamchatka region in Russia and there is recent information on sightings, bycatches and strandings in Japan. Despite dedicated research effort to find gray whales in waters of the Republic of Korea since 2003, no sightings have been made and no new bycatches or strandings have been reported. There is very little new information of any kind on gray whales in China, where research and monitoring remains a major challenge. No information of any kind is available from the Democratic People's Republic of Korea.

The sub-committee therefore recommends that arrangements for detecting, reporting and investigating occurrences of gray whales, for example through stranding and sighting networks, be enhanced in all range states and particularly in China. It emphasises that this should be accompanied by efforts to improve the capacity and ability of researchers in the range states to investigate and validate reports of gray whales, *e.g.* through photography or tissue sampling. Importantly, as recommended previously by the IWC Scientific Committee, any tissue samples should be made available for genotype matching with the biopsy archive of the Russia-US programme.

Recognising the difficulty of detecting individuals away from the known concentrations on the feeding grounds, and given that the total number of animals is so small and information on breeding grounds and migration is so poor, the sub-committee recommends that high priority be given to developing accurate and effective public awareness campaigns in the range states, involving use of *inter alia* the internet, newspapers, radio and, if possible, television. The sub-committee encourages IUCN and IWC to assist relevant authorities in each of the range states in this regard.

Reference

Cooke, J.G., Weller, D.W., Bradford, A.L., Burdin, A.M. and Brownell, R.L. 2008. Population assessment of western gray whales in 2008. 10pp. Paper SC/60/BRG11 presented to the IWC Scientific Committee, June 2008, Santiago, Chile (unpublished). 10pp. [Paper available from the Office of this Journal].