Report of the IWC Workshop on the Assessment of Southern Right Whales

Report of the IWC Workshop on the Assessment of Southern Right Whales*

1. INTRODUCTORY ITEMS

The Workshop was held at the Palacio San Martin in Buenos Aires, Argentina from 13-16 September 2011.

1.1 Arrangements for meeting

Iñíguez welcomed participants to the meeting and introduced Santiago Villalba, the Argentine Deputy IWC Commissioner who, on behalf of Ambassador Susana Ruíz Cerutti, the Argentine IWC Commissioner, also welcomed participants and noted Argentina's recognition of the threats to right whales and the need to address them. The list of participants is given as Annex A.

1.2 Election of Chair

Bannister was elected Chair.

1.3 Appointment of rapporteurs

Reeves and Thomas were appointed as rapporteurs. Informal Working Groups appointed their own rapporteurs and their reports are incorporated into this report under the relevant Agenda Items.

1.4 Adoption of Agenda

The adopted Agenda is given as Annex B.

1.5 Review of documents and available data

A list of documents is given as Annex C. In addition, several participants provided relevant material from their own datasets.

2. POPULATION IDENTITY

The 1998 Workshop on the Comprehensive Assessment of Right Whales: A Worldwide Comparison (IWC, 2001b) agreed to divide the Southern Hemisphere into 11 management units for southern right whales based on the distribution pattern and locations of breeding aggregations. These units were: (1) sub-Antarctic New Zealand, (2) mainland New Zealand/Kermadec, (3) Australia, (4) Central Indian Ocean, (5) Mozambique, (6) South Africa, (7) Namibia, (8) Tristan da Cunha, (9) Brazil, (10) Argentina, and (11) Chile/Peru.

In initial discussion, participants noted that in 1998 there was some confusion whether all of these units were considered 'calving' as opposed to whaling grounds. The current meeting provided an opportunity to further characterise the areas on the basis of more recent information. Questions to be explored included the nature of the Tristan da Cunha management unit, the relationship of the South Africa management unit to the whale concentrations in Namibia and Mozambique, and whether regions with more than one calving ground, such as the southwest Atlantic, should be considered units as a whole with sub-structure or as more than one unit. Baker emphasised the need to delineate the spatial/geographical identity of such units while partitioning out their biological structure. In several geographical areas there is uncertainty whether the southern right whale individuals or concentrations observed are part of remnant or relic populations, are recovering local populations, or constitute evidence of distant populations that are expanding and colonising new areas. It was agreed that the meeting should consider these units from the biological standpoint of populations and that new information should be considered in the context of the previous two IWC right whale reports (IWC, 1986; 2001b).

2.1 Distribution

2.1.1 Southwest Atlantic

In the southwest Atlantic, major concentrations of southern right whales are found from May through December on nursery grounds off the coast of Península Valdés (42-43°S) (Rowntree *et al.*, 2001) and southern Brazil (27-29°S) (Espírito Santo *et al.*, 2009; Groch *et al.*, 2003). Since 2000, increasing numbers of cow/calf pairs, single whales and small groups have been seen to the south and north of Península Valdés, from Cabo Vírgenes (52°19´S) in Santa Cruz Province north to 40º45'S in Rio Negro Province (Failla *et al.*, 2008). Studies in Santa Cruz province to the south (Belgrano *et al.*, 2008; SC/S11/RW2) indicate that whales observed there are largely migrating between breeding and feeding grounds. In Brazil, sightings of solitary animals as well as cow/calf pairs have also been recorded north and south (from 33.8 to 8°S) of the major nursery ground concentration (Baracho *et al.*, 2010; Lodi and Tardelli Rodrigues, 2007; Santos *et al.*, 2010; Groch, unpublished observations). Along the coast of Uruguay (33-35°S), solitary individuals and socially active groups of whales (SAGs) are seen regularly during the nursery season with few sightings of cow/calf pairs (Costa *et al.*, 2007; 2005).

FEEDING GROUNDS

The Cape Town Workshop report (IWC, 2001b) identified the known feeding grounds for the Southwest Atlantic population. The only direct link between a nursery and feeding ground comes from five whales identified at Península Valdés that were resighted on feeding grounds off South Georgia and Shag Rocks (*ca* 53°S) (Best *et al.*, 1993; Rowntree *et al.*, 2001). Whaling records, both from the early 19th century and modern legal and illegal whaling indicate two feeding areas: (1) the Patagonian Shelf/Brazil/False Banks (offshore of southern Brazil, Uruguay and Argentina, between 30° and 55°S, and west of 40°W) from October through January; and (2) waters surrounding the Falkland Islands/Islas Malvinas and waters to the north of South Georgia/Shag Rocks (*ca* 53°S). More recently Moore *et al.* (1999) reported sightings of whales in the vicinity of South Georgia from February-May.

DISTRIBUTION IN THE ARGENTINE CALVING GROUND

When research on right whales began at Península Valdés in the 1970s, the animals were distributed in three main aggregations around the Península, one in each gulf and one along the Outer Coast (containing the largest proportion of cow/calf pairs). Changes in the whales' geographic distribution at Península Valdés for the period 1971-2010 include:

(1) abandonment of a major region of concentration along the Outer Coast mostly during the 1980's with whales moving into Golfo Nuevo and Golfo San José;

*A previous version of this report was presented to the meeting as SC/64/Rep5.

(2) establishment of a nursery area adjacent to the centre of growing whale-watching activity in Golfo Nuevo during the 1990's; and
(3) small-scale shifts in distribution within major concentration areas, possibly in response to natural processes and human disturbances (Rowntree *et al.*, 2001).

According to Rowntree and collaborators, the vast majority of whales around Península Valdés have concentrated in the eastern part of Golfo San José and the northern part of Golfo Nuevo from the 1990's to recent years, with few individuals using the Outer Coast. However, Crespo and collaborators reported observations of a high number of right whales along the Outer Coast during an August 2011 aerial survey. According to SC/S11/RW4, during the period 1999-2011 whales were seen farther north and south throughout the season and in deeper waters inside Golfo Nuevo and Golfo San José. The proportion of whales observed in aerial surveys between 2004-2010 on the offshore side of the survey strip increased, and this applied to all types of groups, i.e. cows and calves, breeding groups and solitary individuals (see figs. 9 to 12 in SC/S11/RW4). Crespo suggested that these shifts into deeper waters in the coastal zone and offshore were related to population growth.

DISTRIBUTION IN OTHER ARGENTINE WATERS

SC/S11/RW1 reported 94 right whale sightings (217 animals) in the waters of Santa Cruz province between February 1986 and February 2003. The highest number of sightings was recorded for Golfo San Jorge (28) and Cabo Vírgenes (36). Almost 55% of sightings occurred in February, April, May and June, outside the nursery season. Cow/calf pairs represented 6.38% of all sightings. Foraging for krill and isopods (*Edotia magallanica*) was observed at Cabo Vírgenes, with some migratory whales stopping for a time in this area. The authors concluded that the waters of Santa Cruz may be of great importance for right whale migration and also may be used for breeding. Sightings in the north of the province suggest a possible recolonisation of old breeding or nursery areas, but further studies are needed to confirm this hypothesis. Systematic studies with consistent effort along the Santa Cruz coast will permit a better understanding of the importance of this area for the species.

Aerial surveys of the southwestern coast of Golfo San Matías immediately to the north of Península Valdés (SC/S11/RW4, fig. 16) during the peak of the nursery season found cow/calf pairs, breeding groups and solitary individuals with the highest whale concentrations around Bahía de San Antonio and Puerto Lobos (SC/S11/RW4, table 5). Sightings further north in Golfo San Matías, along the northern Patagonia coast, primarily include solitary animals and mating groups (Cammareri and Vermeulen, In press) and only a few cow/calf pairs appear to be present (Cammareri and Vermeulen, In press; Failla *et al.*, 2008).

DISTRIBUTION IN THE BRAZILIAN CALVING GROUND

Espírito Santo *et al.* (2009) analysed the distribution of right whales along the Santa Catarina coast to explore the hypothesis that the whales are not randomly distributed and to map sites of highest right whale density. Sightings data were used from aerial surveys conducted between 1987 and 2003 to search for whale aggregations and to photo-identify individuals. Using kernel density estimators, two high-density right whale aggregations were identified, one around Ibiraquera beach (28.36°S) and the other around Santa Marta Cape (28.10°S), with an intermediate-density area between them. On the coast of Santa Catarina right whales are concentrated in shallow depths. The region is characterised by a large number of bays and a steeper shelf rise than in the southern portion. An updated kernel density estimator analysis incorporating data from 2004 to 2007 (Santo, ongoing PhD study) reconfirmed this distribution pattern.

DISTRIBUTION IN URUGUAY

SC/S11/RW9 considered the distribution of unaccompanied (non-cow/calf) whales off the coast of Uruguay by month, by whale category (solitary and whale group) and in relation to depth, sea floor slope and distance from shore for the period 2001-09. The core areas for solitary whales and groups were along open, exposed beaches and in protected bays, respectively. The size of area used increased with month, probably as an effect of the increase in the number of whales in the area as the season progressed.

SC/S11/RW7 discussed how environmental factors influence the behaviour and distribution of right whales in Uruguay. The Uruguayan Atlantic coast is used in the winter for socialisation by non-cow/calf whales, although their numbers in nearshore waters are highly variable at short (i.e. within-season) time-scales. The occurrence of right whales in an exposed coastal environment was assessed for the period 2001-04 by using atmospheric pressure as a proxy for sea state. The proportion of individuals forming groups and the numbers and mean group sizes of unaccompanied animals were associated with sea state, highlighting the importance of calm coastal weather conditions for right whales in such an environment.

2.1.2 South central Atlantic

According to Best (1988), the catch history suggests that right whales at Tristan da Cunha were separate from those along the Southwest African coast (and probably Argentina). Sightings were regular, seasonal and 'numerous' (in the sense that islanders considered them a hazard to fishermen) at a time (1940s and 1950s) when sightings elsewhere in the South Atlantic were rare (and before depletion by Soviet whaling in the 1960s). There were (and still are) some females that use the sheltered side of the island as a nursery area (Best *et al.*, 2009), and no matches have been made as yet with South African animals (although the number photographed is very low). Although the population is now depleted, Best still considers that Tristan da Cunha is a separate (but probably small) nursery ground. Its proximity to the Southern Tropical Convergence, however, means that animals from other continental nursery grounds may congregate in its vicinity for feeding (Mate *et al.*, 2011).

2.1.3 Southeast Atlantic

The main right whale nursery ground in the southeast Atlantic is on the southern coast of South Africa. SC/S11/RW15 described the distribution of right whales in this area from 1979-2008 and noted that the majority of whales are found between 18°30' and 21°30' E. The gradual westwards shift in the population described previously continues, at least for whales other than cow/calf pairs, with the relative proportion of animals without calves declining over time. An actual decline in abundance of these unaccompanied whales has been observed post-2009 (P. Best, pers. comm.). A relatively small number of right whales can be found off the Namibian coast in the latter half of the year (SC/S11/RW16).

SC/S11/RW16 compared 80 right whales photographed in Namibia between 2003-10 with the South African aerial catalogue, producing 16 matches, seven in 2010 alone. When interpreting this result it should be borne in mind that the South African catalogue consists primarily of adult females and identifiable calves (effectively non-black calves) while the Namibian catalogue is non-specific so that a very high overall matching rate between the two areas is not to be expected. However of the 13 individuals in Namibia that were albinistic, partially albinistic or that carried a white blaze dorsally (a subset targeted by both catalogues), 12 had been first seen as calves in the nursery areas on the southern coast of South Africa. This provides strong evidence of South African population expansion into Namibia, and no support for a separate Namibian population.

2.1.4 Southwest/central Indian Ocean

In 1997 the first right whale was sighted off Mozambique since the close of commercial whaling in 1923. SC/S11/RW17 described 10 (5 definite; 5 probable) sightings of right whales off Mozambique between 1997 and 2009 during August and September. The number of sightings increased over this period but this may be due to increased search effort over time. It is not clear whether these sightings indicate a range expansion of the South African population or provide evidence of a separate, remnant population in Mozambique. Photographs of the animals off the coast of Mozambique are needed to compare with the South African catalogue. Rosenbaum *et al.* (2001) reported right whale sightings (including a cow/calf pair) in 1997 and 1999 along the east coast of Madagascar and suggested they might be long-distance migrants from the well-documented South African population. They did not exclude the possibility that the whales were part of a remnant population from the historical whaling grounds in Delagoa Bay, Sofala Bay or the Crozet Island feeding grounds. There have been additional, more recent sightings in this area (Rosenbaum, pers. comm.).

2.1.5 Australia

Bannister reported that from opportunistic sightings and aerial surveys since 1976, right whales could be found around the Australia coast in the west as far north as Exmouth (21°57'S, 114°08'E) and in the east as far north as Hervey Bay (25°17'S, 152°50'E) but that currently the majority of the Australian population was distributed in winter between Cape Leeuwin (Western Australia, 34°22'S, 115°08'E) and Ceduna (South Australia, 32°08'S, 133°41'E). Much smaller numbers can be found around the remainder of the coast in south eastern Australia and along the coasts of eastern South Australia, Victoria, Tasmania and New South Wales.

Childerhouse presented data on over 750 sightings of right whales in Tasmania since records started in 1989. The Department of Primary Industries, Parks, Water and Environment (DPIPWE) has a sighting programme that receives reports of 40-60 right whales seen around Tasmania each year. DPIPWE has a catalogue of 70 identified individuals and although there have been no between-year re-identifications around Tasmania, matches recently have been found between Tasmania and South Australia and Western Australia.

2.1.6 Southwest Pacific/New Zealand

Information on the distribution of right whales around the New Zealand mainland is based on opportunistic sighting records kept by the Department of Conservation (DOC). Since 2003, DOC has also collected individual identification photographs and biopsy samples for DNA profiling, including genetically identified sex, mitochondrial control region haplotype and multilocus genotype. The majority of sightings around mainland New Zealand are in winter, but distributed widely around the coastline (Childerhouse, 2009; Patenaude, 2003). The distribution of the locations of opportunistic biopsy sampling around mainland New Zealand is representative of this (fig.1 of Carroll *et al.*, 2011), although sightings may be biased towards human population centres.

Information on the distribution of right whales around the sub-Antarctic Auckland and Campbell Islands comes from vessel-based expeditions initiated during the 1990s (Patenaude and Baker, 2001). Annual expeditions to the Auckland Islands to collect individual identification photographs and genetic samples were conducted during the winters of 1995-98 and 2006-09. The initial set of 4-year expeditions showed that Port Ross and the northern end of the Auckland Islands comprise the major right whale calving area in New Zealand. The expedition results and analysis of genetic samples showed that the area is used by all age/sex classes (Patenaude *et al.*, 1998; Patenaude and Baker, 2001). Right whales have also been reported in Northwest Bay, Campbell Island, between February and September. Direct counts and photo-identification studies show peak use of the area is between July and September (Stewart and Todd, 2001).

The 2006-09 surveys confirmed that right whales continue to use Port Ross and the northern end of the Auckland Islands as a nursery and socialising area (Childerhouse *et al.*, 2009). There have been no winter expeditions to the Campbell Islands since the 1998 assessment when the former meteorological station, which had been manned year-round, was closed.

2.1.7 Southeast Pacific

CHILE/PERU

Little is known about right whale habitat in the eastern South Pacific, other than in coastal areas, primarily owing to the small population size and limited number of sightings. SC/S11/RW22 summarised sightings, primarily from voluntary sighting networks, in Chile and Peru from 1975-2010. Given that the reports often come from non-specialists, there is concern about the accuracy of species identifications, so only sightings confirmed by photographs were included in the dataset. Most right whale sightings off Chile and Peru occurred between July and November. Kernel density analyses of the selected sightings data from the last 36 years (n=79 sightings) revealed two main aggregation areas, one in northern Chile (22°S to 26°S) and the other in central and southern Chile (30°S to 37°S). However, these results may be biased by the close proximity to cities and the associated greater observation effort and higher likelihood of reporting. No concentration of cow-calf pair sightings was found in any area, so neither of the two main areas of concentration can yet be considered a calving or nursery ground.

Sightings from the Magellan Straits and Beagle Channel were considered to involve individuals from the western South Atlantic and therefore excluded from the analyses (see below). Sightings from the Antarctic Peninsula were also excluded since it is unknown to which population they correspond. Also two published sightings from the 1980s were excluded because they were judged by the authors to be inconsistent with right whale behaviour/ecology. Sightings that were close in space and time were grouped for the analyses.

2.2 Movements (telemetry, photo-id and genetics)

2.2.1 Southwest Atlantic

Individual whales photo-identified off Península Valdés have been resighted further to the south in Golfo San Jorge and Cabo Vírgenes (SC/S11/RW1; Belgrano, pers. comm.)

and off Uruguay and Brazil (see table below). Resightings include females that were observed with newborn calves in alternate calving cycles in Argentina and Brazil.

SC/S11/RW27 described inter-annual and seasonal patterns of distribution of right whales along the southern Brazilian coast during photo-identification surveys flown at the time of peak seasonal whale abundance in 1987-2003. The majority of sightings were groups of two whales (67.3%, *n*=150) although groups of up to four were also common. Most groups (58.3%, *n*=130) were single females with calves while 35.9% (*n*=80) of sightings were of one to eight non-calves. The geographic distribution of sightings was not uniform, indicating specific areas are important wintering habitat for this recovering population. Survey effort varied, but patterns of distribution could be identified. The distribution of cow/calf pairs and unaccompanied whales overlapped somewhat, but a major concentration area, especially for cow/calf pairs, was identified within the standard survey area which coincides with the previously recognised aggregation area off Brazil. Whales arrived in July and August, reached a peak in September, and declined in October and November. More recent data from 2004-10 indicate similar seasonal patterns of distribution.

Aerial surveys were conducted from late July to early August between 2007 and 2010 to photo-identify right whales in Golfo San Jorge, Santa Cruz Province, Argentina (SC/S11/RW23). Thirty one whales were counted, of which ten (32%) were photo-identified. Cow/calf pairs were seen on only two occasions, namely in 2007 and 2009. Photo-identification was possible only for the pair seen in 2009. A partial albino individual photo-identified in 2008 was compared with the Península Valdés catalogue and provided the first match between the two areas. The study indicates that animals could be using Santa Cruz waters for migration between feeding and calving/nursery grounds. Moreover, the north of the province could be used for socialising. However, more research is needed to confirm that hypothesis.

Analysis of photo-identification photographs from Uruguay (SC/S11/RW8) resulted in 256 catalogued whales in the period 2001-09, of which nine individuals unaccompanied by a calf were re-identified within the same season, with residency times ranging from 20 to 41 days. Furthermore, six whales were re-identified between seasons, possibly indicating some degree of fidelity to the Uruguay coast. Lesions caused by gull attack have been observed on 11 photo-identified animals (2001-06 data) in Uruguay, suggesting that they have come from Península Valdés. The high percentage of whales observed in SAGs, involving mating and courtship behaviour, and the low number of cow/calf pairs, suggest that the Uruguay coast is a socialising area and possibly a breeding ground.

2.2.2 Southeast Atlantic

Mate *et al.* (2011) obtained data from 21 satellite-monitored radio tags deployed on right whales in South African waters (16 in St Sebastian Bay on the south coast; five in Saldanha Bay on the west coast) in September 2001, 15 of which transmitted for 25-161 days. Most coastwise movement on the south coast was westerly with cow/calf pairs moving slowest. Three animals tagged on the west coast and one on the south coast moved north into St Helena Bay, a probable feeding ground, where residence times were 36-100 days. Five animals tracked after leaving the coast maintained a bearing of 201°-220° before branching out over the southeastern Atlantic from 37° to 60°S and between 13°W and 16°E, travelling 3,800-8,200 km over the ensuing 53-110 days before transmissions ceased. Two areas were identified as possible feeding areas based on the 'non-migrating' nature of sections of the track: these were between 37°S and 45°S (42% of non-migrating locations) and south of 52°S (53% of non-migrating locations), possibly associated with the Subtropical Convergence and Antarctic Polar Front, respectively. Of the five individuals, two moved directly to the higher latitude area (including an animal that had stayed in St Helena Bay for 100 days before leaving the South Africa coast); one did not venture south of 45°S and two individuals moved between the two presumed feeding areas.

SC/S11/RW13 reported on linkages between animals that frequent the South Africa coast and the Southern Ocean derived from satellite telemetry and photo-identification data. Five whales satellite-tagged off South Africa in September 2001 subsequently ranged over the southeast Atlantic as described above. Four matches were also made between whales photographed on the South Africa coast and in the Southern Ocean: three were encountered in the same general area as that visited by the satellite-tagged animals in the southeastern Atlantic, but the fourth (a second-year male) was photographed at Marion Island (46°54'S, 37°45'E) in the southwestern Indian Ocean or Area IIIE (Postma *et al.*, 2011). No matches were found between animals off South Africa and 37 individuals photographed in Area IV of the Antarctic.

SC/S11/RW16 described matches found between the nursery ground off South Africa and Namibia/Northern Cape Province from 2003-10. Details are given in Item 2.1.3. It was agreed that the results provide strong evidence of connectivity between the nursery ground on the south coast of South Africa and the coast of Namibia/Northern Cape Province.

2.2.3 Australia

At the Cape Town Workshop in 1998 attention was drawn to photo-identification records indicating a link between probable feeding grounds at 42°S and 64°S and calving grounds on the southern Australian coast, between Head of Bight, South Australia and further west (IWC, 2001b, p.10) as well as evidence suggesting a generalised westerly movement of whales along the southern Australian coast in winter and an easterly trend on the feeding grounds in summer.

Movement between the Antarctic and the southern Australian coast (between Head of Bight, South Australia and further west), also reported at the Cape Town Workshop (see Bannister, 2001) was further confirmed more recently by matches of photographs from the 2007/08 SOWER cruise in the area 64-65°S, 105-111°E, with those of five animals previously recorded on the southern Australian coast. An additional animal was photographed at 40°29'S (IWC, 2009 p.181). Further evidence along those lines was provided by photographic matches with animals previously identified on the southern Australian coast with six animals encountered in 63-64°S, 100-113°E on the 2009/10 SOWER cruise. These Antarctic locations are supported by sightings information from JARPA cruises.

A single tag was deployed on a southern right whale off Tasmania in September 2010 which transmitted for 115 days and covered 9,800km. The whale headed south from Tasmania towards the ice as far south as 64°S, then returned north to 55°S before again moving south to 65°S, presumably in search of feeding locations.

Childerhouse reported that the Australian Government was planning to hold a workshop (late 2011 or early 2012) to discuss the development of an Australian right whale satellite tagging program. The aim was to discuss priority research questions and potential research sites. The program would allow for biopsy sampling at the same time.

2.2.4 Southwest Pacific and New Zealand

Gales *et al.* (2010) described satellite tracking of right whales at the Auckland Islands. Six satellite tags were attached during July and August 2009. Transmission lasted for an average of 75 days (range: 1-167 days) and provided data on migratory movements of three whales whose tags continued to transmit once they left the Auckland Islands. All travelled to the south of South Australia between 38° and 48°S, although one visited the mainland New Zealand coast before heading west.

2.2.5 Chile/Peru

Most sightings (see SC/S11/RW22) involved reports on one or two days. Only six records indicated a longer residency time in the same or nearby locations. A cow/calf pair was tracked through the sighting network and by photo-identification for over a month as the animals moved south from 31°55'S to 33°19'S, covering more than 94 n.miles.

SC/S11/RW21 reported on a broad-scale UNEP/Spain marine mammal spatial planning exercise initiated in early 2011 in the eastern Pacific coordinated by the Permanent Commission for the South Pacific (CPPS). The project aims to provide an overview of essential habitats and regional migration routes for marine mammals in need of protection. The Chile/Peru (Southeast Pacific) right whale population is among the five cetacean species included in the analysis. Modelling work will be carried out on right whale habitat to identify critical areas and propose management measures to allow population recovery. Activities at this stage include data collation, GIS analysis and mapping of existing ecological and socio-economic data and anthropogenic threats.

The right whale dataset includes 172 opportunistic sightings from Peru, Chile and Antarctic waters from the period 1964-2011; the data analysed in SC/S11/RW22 are a subset of that dataset. Distribution maps have been generated for environmental parameters such as temperature and depth. Right whale sightings are concentrated during the winter and autumn off Peru and north and central Chile. Records during the winter and spring are concentrated in southern Chile and the western Antarctic Peninsula. Records of cow/calf pairs are concentrated between 15°S and 40°S and peak between September and October. The area has the highest primary productivity on the western coast of South America, indicating that conflict with fisheries could be a problem. Some overlap with the western Atlantic population seems possible on feeding grounds in the Magellan Straits and maybe further south.

The Workshop **recommends** that **s**urveys, photo-identification and genetic studies should be conducted as a priority to better understand the distribution and size of the South East Pacific population. In addition, it makes the following specific **recommendation**:

Objective: to obtain information on distribution and abundance, to clarify status and threats, and to identify focussed mitigation actions as appropriate.

Methods: The sparse available data come from limited opportunistic sightings that inevitably are unable to provide a basis for conservation and management.

(a) Determine geographical/temporal areas where quantitative studies can best be conducted:
  - examine existing data (including historical whaling records) for evidence of concentrations of other, better-known populations, e.g. via temporal/geographical spatial modelling, and use the results in a predictive way for Chile-Peru;
  - encourage collaboration amongst scientific groups and marine users to improve the reporting of sightings and to increase the effort to obtain photographs (including increased public awareness);

(b) design a systematic (aerial) survey programme to cover potential calving or nursery areas, bearing in mind logistical and practical limitations; and

(c) further consider stock structure issues by examining existing genetic samples (incl. museum specimens where possible) and collect new samples in southern Chile/Argentina.

2.3 Genetic differentiation

2.3.1 Southwest Atlantic

SC/S11/RW3 assessed genetic differentiation on right whale calving and feeding grounds using a large DNA dataset (*n*=374 samples) obtained from whales off Península Valdés. The authors confirmed the genetic differentiation previously known between Península Valdés and calving areas off South Africa, Australia and New Zealand at both the haplotype and nucleotide levels. They also confirmed the lack of differentiation between Península Valdés and the feeding ground off South Georgia. Península Valdés whales were genetically different from whales sampled on the southwestern Australia breeding ground at the haplotype but not the nucleotide level; however, this statistical comparison lacks power due to the small sample size from the Australian calving ground.

Comparison of southern Brazil and Argentina samples based on mtDNA control region sequences suggests some differentiation ($\Phi st=0.037$, $p<0.05$) (SC/S11/RW25). However, mtDNA is a maternally inherited marker and the result could be a reflection of the historical philopatry of some females to specific calving grounds along the Atlantic coast of South America, as previously indicated by photo-identification studies (Cooke *et al.*, 2001; Groch *et al.*, 2003; Payne *et al.*, 1990); the mtDNA results could be biased by a maternal lineage marker. The microsatellite results, that take into account recent gene flow because microsatellites are a biparentally inherited marker, are more relevant for addressing population structure. Contrary to the mtDNA results, microsatellites do not support differentiation between southern Brazil and Argentina samples (Rst =0.007). The results presented in SC/S11/RW25 support the hypothesis that whales from Brazil and Argentina belong to the same population, although these individuals could mix on the feeding grounds with whales from other genetically distinct calving grounds (e.g. South Africa, see Patenaude *et al.*, 2007). The authors stated that recognition of a single stock of right whales along the Atlantic coast of South America reinforces the importance of integrated conservation actions and management plans, especially among Brazil, Uruguay and Argentina, for the full recovery of the species in this area.

Demographic analyses concerning the effective population size of the southwest Atlantic population (SC/S11/RW26) were presented using genetic data (69 sequences of mtDNA control region) as an alternative and independent estimation to demographic estimation by counting. The authors used data from Argentinean and Brazilian samples. These were assumed to be a single population according to data presented in SC/S11/RW25. The female effective population size (N_{ef}) for this whole population was estimated using the formula: $N_{ef}=\theta/2\mu g$ (μ=1.75E-8 mutations per site per year, g=18.1 years as generation time and θ= genetic diversity. The overall effective population sizes ($2N_{ef}$) estimated by the coalescent model and Waterson's method were 142,066 (CI: 101,026-211,522) (θ_{Lamarc}=0.045) and 56,194 individuals ($\theta_{Waterson}$=0.0178), respectively. The authors also calculated the population size fluctuation over time using mtDNA data using the Bayesian Skyline Plot method and they found a significant population decline during the end of the Pleistocene and the beginning of the Holocene around 22 and six thousand years ago, with the start of the inflection of the median curve at 17,000 years ago. In this sense, this data suggest that the southwest Atlantic population had already experienced a loss of genetic diversity before commercial hunting began in the 17th century.

2.3.2 Chile/Peru
No genetic information was available for this area and population.

2.3.3 Southeast Atlantic
No new genetic information was presented for the southeast Atlantic.

2.3.4 Australia
See Item 2.3.6.

2.3.5 Southwest Pacific and New Zealand
DNA profiles were used to identify individuals and track within- and between-year movements of right whales around mainland New Zealand (Carroll, unpublished data; Alexander *et al.*, 2008). Based on samples collected between 2003 and 2007, mainland New Zealand is used by cow/calf pairs for as long as a month during the winter (Alexander *et al.*, 2008). Additionally, there have been two between-year recaptures in the mainland dataset: 1 cow was seen with a calf in 2005 and 2009, and another with a calf in 2006 and 2010 (Carroll *et al.*, 2011). Within-year resightings of photo-identified whales also suggest right whales are resident around mainland New Zealand for at least several days (Childerhouse, 2009).

Carroll *et al.* (2011) described the first documented movement of individual right whales between mainland New Zealand and the New Zealand sub-Antarctic. Whales were identified using DNA profiles, and of the 43 whales sampled off mainland New Zealand (2003-09), seven were also sampled in the New Zealand sub-Antarctic between 2006 and 2008. Of these seven, five were females and two were males; one male was sampled as a calf off mainland New Zealand in 2003 and subsequently recaptured as a presumed juvenile in the New Zealand sub-Antarctic in 2006. In contrast to the genetic information, there were no matches between whales photo-identified off mainland New Zealand and the New Zealand sub-Antarctic (Childerhouse, 2009; Patenaude, 2003).

The first evidence of long-term fidelity to the New Zealand sub-Antarctic ground was based on recapture of whales identified by DNA profiles from the 1995-98 and 2006-09 field expeditions (SC/S11/RW20). Comparison of the 223 non-calf whales (106 females, 113 males and 4 of unknown sex) sampled during the 1995-98 expeditions and 520 non-calf whales sampled during the 2006-2009 expeditions revealed 33 matches: seven males and 26 females. The recapture of 26 females represents around 25% of the females from the 1995-98 expeditions, and of these, 20 were identified in the field as cows (by close association with a calf) when captured in one or both sets of expeditions. In addition, four of the 12 calves sampled during the 1995-98 field surveys were recaptured during the 2006-09 field expeditions.

2.3.6 New Zealand and Australia
Previous work suggested that at least two genetically distinct stocks are recovering on the coastal calving grounds of Australia and New Zealand (Baker *et al.*, 1999; Patenaude *et al.*, 2007). Historical migration patterns and spatially variable patterns of recovery suggest each of these stocks is further subdivided into at least two stocks: New Zealand, comprising the New Zealand sub-Antarctic and mainland New Zealand; and Australia, comprising southwest and southeast stocks. Carroll *et al.* (2011) expanded upon previous work to investigate population subdivision by analysing over 1,000 samples collected at six locations across New Zealand and Australia, although sample sizes were small from some locations. Mitochondrial (mtDNA) control region haplotypes (500 bp) and microsatellite genotypes (13 loci) were used to identify 707 individuals and to test for genetic differentiation.

There was no significant differentiation in mtDNA haplotype or microsatellite allele frequencies between mainland New Zealand and the New Zealand sub-Antarctic. Moreover, there were seven direct matches of DNA profiles between those two regions (see Item 2.3.5). Given the current and historical evidence, the authors hypothesised that individuals from the New Zealand sub-Antarctic are slowly re-colonising mainland New Zealand, as the whales that formerly inhabited the mainland New Zealand calving ground appear to have been extirpated.

There is also preliminary genetic evidence that southeast Australia (SEA) right whales represent a remnant stock, distinct from southwest Australia (SWA) whales. This is based on significant differentiation in mtDNA haplotype frequencies (F_{ST}=0.15, p<0.01, Φ_{ST}=0.12, p=0.02) and contrasting patterns of recovery. More complex population structure across the southern coast of Australia is also possible. For example, work by Patenaude and Harcourt (2006) showed significant differentiation in mtDNA haplotype frequencies between calving areas in the Great Australian Bight and Western Australia, so there may be sub-structure within the southwest Australian stock. In addition, there was a small but significant difference in microsatellite allele frequencies between animals from Western Australia and Victoria (F_{ST}=0.02, G'_{ST}=0.08, p<0.05). The Workshop **recommended** that this should be investigated in future with more samples obtained from across a wide geographic range.

After pooling some sampling locations, significant differences in mtDNA haplotype frequencies were found between the three proposed stocks of New Zealand, SEA and SWA (overall F_{ST}=0.07, Φ_{ST}=0.12, p<0.001). In contrast, the differentiation in microsatellite loci was not significant (overall F_{ST}=0.004, G'_{ST}=0.019, p=0.07), suggesting ongoing or recent historical reproductive interchange. There was a small but significant difference in microsatellite allele frequencies between New Zealand and SWA (G'_{ST}=0.02, p<0.05); however, this is a preliminary finding and should be confirmed with larger samples.

The Workshop noted the large number of biopsies from New Zealand relative to those from Australia. Carroll explained that the New Zealand data were the result of an intensive dedicated biopsy effort; no such effort has yet been undertaken on a similar scale in Australia.

2.4 Other (geochemical markers)

2.4.1 Southwest Atlantic

SC/S11/RW3 reported the analysis of stable carbon and nitrogen isotope ratios from skin samples obtained from live whales (*n*=196) at Península Valdés from 2003 to 2006, as well as from baleen plates from stranded whales. The authors discovered a non-normal, multimodal isotope distribution using the skin samples and presented this as evidence of a non-homogeneous food source, indicating at least three different feeding areas. A comparison with published and unpublished stable carbon and nitrogen isotope data from krill and copepods from the western South Atlantic and the Atlantic sector of the Antarctic indicates that areas with isotope values similar to the Polar Front/South Georgia, the Patagonian Shelf and Uruguay represent probable feeding areas for this population. The migratory patterns indicated by the stable isotope ratios from baleen plates were interpreted by the authors as follows:

(1) some whales restrict their movements to a specific feeding area (potentially the same areas detected using skin samples); and
(2) other whales may migrate through and use several different feeding grounds.

2.4.2 Relationship between Chile/Peru and southwest Atlantic right whale populations

Belgrano *et al.* (2008) concluded that two distinct management units should be considered when evaluating southern right whales in Chile: a Chile-Perú stock off the Pacific coast and a southwest Atlantic stock in the Straits of Magellan and the Beagle Channel. This distinction has not been clear in the past. Some whales reported in whaling records for Chile were actually caught in the southwest Atlantic south of Tierra del Fuego or near the eastern entrance of the Straits of Magellan, and therefore probably included southwest Atlantic whales, rather than whales from a southeast Pacific Chile/Perú stock. Despite extensive search effort in the western areas of the Straits of Magellan and the Patagonian and Fuegian channels, no right whales have been observed there, supporting the hypothesis that animals observed in the eastern part of the Straits of Magellan belong to the southwest Atlantic population (Gibbons *et al.*, 2006).

2.4.3 Southeast Atlantic and western Indian Ocean

The Workshop concluded that Namibia and South Africa should be considered as one management unit. However, available information is inadequate to draw conclusions about the connectivity of Mozambique (and Madagascar) whales to other populations. It was agreed that they should be considered a separate population until evidence shows otherwise.

Two alternative hypotheses were proposed regarding the history of right whales off Namibia and South Africa: (1) there were originally two separate calving grounds, with that off Namibia being effectively extirpated; or (2) there was originally a single calving assemblage that contracted (or shifted) its latitudinal range when depleted.

On the question of how to characterise Mozambique, it was recognised that a single cow-calf pair does not constitute a viable population. Concerning the source of animals seen in Mozambique, one possible scenario is that they are emigrants from the population in South Africa. Continued immigration and breeding could result in a separate aggregation and, eventually, a separate population. Alternatively, these animals, and the few right whales reported in Madagascar, may be a small remnant previously undetected because of low numbers and low sighting effort (it was noted that Delagoa Bay (now Maputo Bay) was a recognised 19th century whaling ground where cow-calf pairs formed part of the catch).

The Workshop discussed the larger overall issue of whether, when a few whales are seen in a 'new' area, they represent small remnants, or instead re-colonisation by animals from a currently more robust population. Genetic information and patterns of return and fidelity of identified individuals can help resolve this issue. For example, in both the southeast and southwest Atlantic known whales move back and forth between the highest-density nursery areas and the smaller or 'newer' areas with low densities. In contrast, one might expect whales of a remnant population to be observed in only one area.

2.4.4 Australia and New Zealand

Childerhouse reported that work had commenced on a project to analyse stable isotopes from over 600 right whale samples from Australia and New Zealand. Results were not yet available but would be presented to the IWC Scientific Committee next year. Biopsy sampling will be conducted in parallel with the proposed Australian satellite tagging programme (see Item 2.2.4).

The Workshop **recommended**:

(1) Increased geographic coverage of biopsy sampling and genetic information from Australian areas of high density together with more sampling in south-eastern Australia**.** While in practice that may not be easy given the remoteness and generally poor weather conditions, there is an urgent need for more samples, further analysis of existing samples and a satellite tagging programme, as well as further analysis of existing samples. The Australian authorities are **encouraged** to proceed with their workshop proposal.
(2) Analysis, and publication of the results of the existing nine years of sightings data from 2003 around mainland New Zealand, held by the New Zealand Department of Conservation, together with further exploration of the apparent connection between the Auckland Islands and mainland New Zealand. Some records of right whales were included in past New Zealand progress reports – the Workshop **agrees** that these should be re-examined and their reliability be established.
(3) Further analysis of existing genetic samples from South Africa (*n* =~600), to investigate relationships with other southern populations.

2.5 Conclusions on population structure and information needs

In regard to the question of whether remnant populations, or instead the geographical expansion of larger populations, are being observed in Australia and the Southwest Pacific/New Zealand, Butterworth questioned how large a relic or remnant population would have to be for it to persist over a long period. Referring specifically to Mozambique where it is uncertain whether the one cow/calf pair seen in recent years is part of a remnant population or of an expanding population from South Africa, he asked how a population consisting of just a few individuals could survive for decades. Is this consistent with the concept of 'minimum viable population'? Cooke responded that there is no knowledge of a minimum number below which a relic or remnant population of baleen whales might cease to be viable. In fact, a very small population of baleen whales might persist, depending in part on demographic aspects. Brownell noted that individual right whales might survive for six or seven decades and thus a 'remnant' population could persist at low numbers for many decades.

The Workshop discussed the challenge of distinguishing between a situation where a relic population exists and one where extirpation has occurred and new colonisers have arrived. In a remnant population there may be only one or two haplotypes as compared to many more in larger populations. Burnell suggested that it might not be possible to tease out the genetics in a case where the 'remnant' area has been 'swamped' by animals from somewhere else and the colonists are genetically similar to the source population. Cooke noted that in the case of re-colonisation, there might be only a single founder, so again only a few haplotypes would be represented. It was noted that although historical samples would be helpful, these have been sought in the past and few seem to exist.

Mozambique, Tristan da Cunha, and Southeast Australia are areas where genetic and photo-identification work is needed to determine if the animals there represent remnant stocks or are parts of larger nearby populations. While genetic and photo-identification data are lacking, right whales in the Chile/Peru population are assumed to be a separate remnant stock, primarily because of their current and historic geographic isolation from other populations.

The Workshop **agreed** to the hierarchy of stocks/habitats summarised in Table 1.

3. REMOVALS

3.1 Direct catches (inclusion struck-and-lost)

The previous right whale Workshops thoroughly reviewed known historical catches (IWC, 1986; 2001b). Here only new information is reported.

3.1.1 Southwest Atlantic

From November 1961 through February 1962 a Soviet whaling ship took 1,312 right whales to the east of Argentina (Tormosov *et al.*, 1998) (Fig. 1). Most of the whales were killed in November and December on the Patagonian Shelf, to the east and northeast of Península Valdés. Since the number of right whales at Península Valdés begins to decline in late October and most have left the area by December, this suggests that the region where the whales were killed was the first feeding ground they visited after leaving the nursery ground at Península Valdés. The convergence of the Malvinas/Falklands and Brazil currents in this region creates a temperature stratification that makes it an extremely productive fishing ground (Rowntree *et al.*, 2008).

3.1.2 Southeast Atlantic

In addition to the information provided to the Cape Town Workshop (IWC, 2001b), Best (2006) reported that an episode of whaling in the St Helena Bay/Saldanha Bay area of South Africa between 1787/88 and 1791/92 may have accounted for as many as 1,780 right whales, followed by a shift in interest to the Walvis Bay area. Logbook data indicate that of 58 whales struck, 41 were processed, giving a whales struck to whales processed ratio of 1.41:1; 8 of the lost whales are known to have died, giving a whales killed to whales processed ratio of 1.20:1. These figures refer to near-shore whaling in relatively shallow water, and will not necessarily be applicable to offshore ('pelagic') whaling.

3.1.3 Southwest Indian Ocean

In the southwest Indian Ocean during the 1960s, Soviet whalers killed about 200 right whales west of the Crozet Islands mainly in December and very small numbers around the Kerguelen Islands (Tormosov *et al.*, 1998).

3.1.4 Australia and New Zealand

As part of the New Zealand National Institute of Weather and Atmospheric Research project 'Taking Stock', the New Zealand and east Australia catch series published by Dawbin (1986) has been reconstructed, reviewed and revised (Carroll *et al.*, 2011).

For coastal catches in New Zealand the original sources for each year were identified and minor errors corrected in the Dawbin (1986) catch series. For the years 1829-40, high and low scenarios were considered. The low scenario followed Dawbin's (1986) original sources, but only provided information on whaling operations in part of the region. The high scenario was based on McNab (1913) for 1829-40, which includes details on landings throughout New Zealand. The catch series for the time period 1853-1930 was based on New Zealand export records. This is not ideal as the export records were incomplete and do not account for local consumption. Export data were converted to the number of whales caught per year using the Dawbin (1986) estimate of volume of oil or baleen per whale. Missing years in the export records were interpolated using a 5-year moving average. The revised coastal catch series for New Zealand was estimated to be between 500 (low scenario) and 800 whales (high scenario), i.e. higher than that reported by Dawbin (1986). Because of the lack of access to original sources, the coastal catch series for southeast Australia was not revised.

For pelagic catches off New Zealand and southeast Australia the Dawbin (1986) catch series was reconstructed using the summary of voyages from American whalers in Starbuck (1878) and the summary of voyages for French whalers in Du Pasquier (1986). Data on daily vessel positions and activity were extracted by the authors from several sources (Du Pasquier, 1986; Maury, 1852; Starbuck, 1878; Townsend, 1935) and were used to identify a set of voyage logbooks for inspection. Voyage logbooks were considered 'complete' if they identified to species ≥ 75% the whales recorded and they had entries for at least 70% of the days at sea during the voyage. The dataset came from over 160 logbooks, with 8 to 17 per year for 1837 to the late 1850s. Removals were calculated by estimating the total number of voyages departing the home port, the proportion that went to New Zealand or east Australia, and the mean catch of right whales per voyage. Variance was calculated based on the number of right whales caught per voyage.

The resulting dataset gave an estimate of approximately 13,800 whales taken off New Zealand and 1,600 off southeast Australia. A struck but lost rate of 0.31 was estimated from the logbook data, giving an upper bound of about 20,000 right whales killed off New Zealand and about 2,300 off southeast Australia.

Combining pelagic and coastal catches, the revised total catch for New Zealand and southeast Australia was estimated to be 39,080-40,400, i.e. substantially higher than Dawbin (1986) estimate of 26,000. The higher catch levels were due to higher estimates of catches by the American fleet, the correction for struck but lost whales, and the improved accounting for shore-based whaling. Uncertainties, such as the extent of bay whaling by American offshore whalers during the austral winter, remain to be investigated further.

3.1.5 Southeast Pacific

One calf was harpooned by fishermen in the 1980s and this was reported previously (SC/S11/RW22).

Table 1

Structure for a hierarchy of SRW stocks/habitats (note that historically, all calving grounds were also whaling grounds).

Region	Calving ground	Known* or inferred feeding ground(s)	Other associated* or inferred whaling grounds	Associated habitat (i.e. documented movements)
Southwest Atlantic	Península Valdés	Patagonian shelf, South Georgia*		Uruguay; coastal Argentina, Tristan da Cunha, Brazil
	Southern Brazil (27°-29°S) but calves seen to north and south of this	Brazil Banks, Patagonian shelf		Península Valdés
South central Atlantic	Tristan da Cunha/Gough Is?	South Tropical Convergence (STC) SE of Tristan da Cunha	SE of Tristan da Cunha	Península Valdés
Southern Africa	South Africa	West South African coast (St Helena Bay)*, southern Benguela, Antarctic (south of 52°S, 13°W-16°E*) and sub-tropical (e.g. STC SE Tristan da Cunha*)	SE of Tristan da Cunha*	West South Africa, Namibia, Marion Island
	Namibia *(possibly now extirpated but recolonising from South Africa)*	See above		South Africa
(SW/central Indian Ocean?)	Mozambique/Madagascar? *(possible link with/recolonising from South Africa)*	Crozet Is, Kerguelen	Crozet Is, Kerguelen	
Southwest Pacific	Mainland New Zealand *(possibly now extirpated but recolonizing from* Sub-Antarctic NZ*)*	Kermadecs/Louisville Ridge	Kermadecs/Louisville Ridge	Sub-Antarctic NZ
	Sub-Antarctic NZ	STC south of Australia*, sub-Antarctic		Mainland New Zealand
Australia	SE Australia *(very depleted if separate unit)*	Unknown		South central Australia, SW Australia
	South central Australia	Antarctic and sub-tropical convergence*		SE Australia, SW Australia, sub-Antarctic NZ
	SW Australia	Antarctic and sub-tropical convergence*	Coast of New Holland Ground	South central Australia, SE Australia
Southeast Pacific	15°-41°S (Chile/Peru)? No specific concentration identified *(very depleted if separate unit)*; lack of information	West Antarctic peninsula	Unknown	Coastal Chile/Peru

3.2 Incidental catches

3.2.1 Southwest Atlantic

During 2002-10, data were collected on right whales stranded on the coast of Santa Catarina State, southern Brazil, especially the central-southern coast (SC/S11/RW28). This is a wintering ground for a right whale population recovering from intensive commercial whaling. A total of 16 strandings was registered, including all age and size classes of adults, subadults and calves, the latter constituting 62.5% of the stranded whales. Both females and males stranded, but with a sex ratio of 2:1. All strandings were of lone, dead individuals except for three live strandings. One of these animals died shortly after it stranded, one was successfully rescued and the other had to be euthanased. Strandings occurred from July to September with a peak of 75% in September which coincides with the peak of occurrence and abundance of the species in the region. Clear evidence of an anthropogenic cause of death was observed in only one stranded whale. Although no systematic beach, boat or aerial survey had been conducted to evaluate stranding mortality, a stranding network protocol was established in 2007, in the context of the Right Whale Environmental Protection Area created in the region and the National Action Plan for the Conservation of Great Whales. This continued effort should enhance scientific knowledge and management procedures for right whale conservation in Brazil. Groch also reported that there are 3 or 4 non-fatal entanglements of right whales in fishing gear per year. Of course, not all strandings are of anthropogenic origin.

3.2.2 Southeast Atlantic

Meyer *et al.* (2011) reported on right whale entanglements off South Africa. The major causes are static fishing gear, especially that associated with rock lobster fishing on the west coast and the large-mesh nets set off KwaZulu-Natal to reduce shark attack. Over the period 1999-2009 one right whale is known to have died from entanglement in a shark net. Peters noted that the number of shark nets has been reduced in very recent years in favour of baited drumlines to minimise accidental entanglement of non-targeted species. No known deaths from entanglement in fishing gear (shark nets excluded) were recorded for the period 1999-2009. Peters noted that right whales released alive from either shark nets or fishing gear are not followed so it is not known if there are deaths subsequent to release. One right whale washed ashore with yellow propylene line tightly wrapped around its right flipper, indicating previous entanglement, but it was not possible to determine whether or how this had contributed to the whale's death (SC/S11/RW14).

3.2.3 Australia and New Zealand

Kemper *et al.* (2008) described 1 fatal entanglement and 12 non-fatal entanglements of right whales in Australian waters between 1950 and 2006. In addition, 25 carcasses, with cause of death undetermined, were reported from Australian waters during that time period.

3.2.4 Southeast Pacific

Galleti reported that a calf stranded and died on a Chilean beach in the 1980s, bearing both net marks (apparently from entanglement) and small-boat propeller cuts (see SC/S11/RW22). Felix noted that a review of strandings from 2007 concluded that this calf died after being wounded by whale-watching boat propellers.

3.3 Ship strikes

3.3.1 Southwest Atlantic

ARGENTINA

Rowntree *et al.* (2001) reported 19 confirmed and 3 probable ship strikes on right whales between 1970 and 2000; in most cases, the evidence was wounds or scars inflicted by small boat propellers. More recently, two juveniles were sighted alive off Península Valdés (18 October 2000 and 7 October 2001) with confirmed dorsal propeller scars (Sironi, pers. obs., Whale Conservation Institute/Instituto de Conservación de Ballenas); an adult was found dead with a deep cut along its blowholes on the beach at Puerto Madryn in 2002 (Carribero, pers. obs.), and a 14.9m female was found dead with a 6m dorso-lateral cut in Punta Cormoranes, Golfo Nuevo (Valenzuela *et al.*, 2010). Another individual reported off Caleta Olivia, Santa Cruz, on 24 August 2003 had extensive dorsal bruising (Van Waerebeek *et al.*, 2007). Argentina's Progress Reports to the IWC Scientific Committee report that on 12 July 2008, a right whale was killed instantly in a collision with an Argentine Navy ship manoeuvring at the pier in Puerto Madryn, and in another event in 2008 a 13m male stranded dead on the coast of Monte Hermoso, Buenos Aires province, with evidence of a probable ship strike; and on 3 August 2010 the container ship *Langeness* (161m in length under the flag of Antigua and Barbuda) collided with a right whale near Almirante Storni pier, Puerto Madryn. This whale apparently survived the strike. A number of right whales with wounds inflicted by ships and boats have been photographed off Puerto Pirámides in Península Valdés. Further information on strandings at Península Valdés is presented in Item 4.2.

In 2009, a dead right whale, probably from the southwest Atlantic population, was photographed floating at sea at Punta Delgada, within the Straits of Magellan, showing evenly spaced abrasions/gouges in the blubber (i.e. possibly the result of a ship strike).

URUGUAY

Between 2003 and 2007, seven right whales were recorded in Uruguayan waters with large wounds due to ship strikes (Píngaro *et al.*, 2010). Five of the seven records were post-mortem and two were of whales seen alive with large propeller scars. One of the live whales was an adult female accompanied by a calf. The dimensions, locations and other characteristics of the wounds on the seven animals indicated propeller cuts from large vessels. The moderate decomposition of the five carcasses suggested they had died recently and indicated a high probability the ship strikes had occurred in Uruguayan waters. The dates of the records are consistent with the seasonal presence of right whales in shallow Uruguayan waters (June-November) during the calving season. The authors of Píngaro *et al.* (2010) provided preventative recommendations and proposed the period August-October as a 'High Risk Time for Collision' in Uruguayan waters.

BRAZIL

At the Cape Town Workshop (IWC, 2001b), Greig *et al.* (2001) reported on ship strikes along the coast of Brazil. Groch reported additional sightings of two whales with propeller scars, one an adult, the other a calf. In addition SC/S11/RW28 described a dead calf with propeller scars or wounds.

3.3.2 Southeast Atlantic

SC/S11/RW14 reported 29 non-calf deaths between 1999 and 2010. Five of the animals bore injuries consistent with ship strikes. In two other instances the deaths were reported as the result of ship strikes or associated in time with reported ship strikes, but no external signs were apparent. There were seven other reported instances of non-fatal ship strikes on southern right whales between 1999 and 2010. Four (or < 0.5%) of the adult females in the photo-id catalogue bore obvious ship-strike scars dorsally, dating from 1993, 1995, 1998 and 2002, respectively. All four have been seen subsequently accompanied by calves.

3.3.3 Australia and New Zealand

Updated data on removals of right whales in Australia were summarised by Kemper *et al.* (2008) for 1950-2006. They described two fatal and three non-fatal ship strikes. As a proportion of the total records for each region, there were fewer ship strikes of right whales in Australia (11%) than in South Africa (16%). Australia National Progress Reports and annual ship strike reports to the IWC up to 2010 provide additional information on two calves killed by ship strike (2008 and 2009) and three reports of entanglement in pot ropes (2007, 2008, and 2009). Two of the latter whales were released alive and the other swam away without having been disentangled. Also reported was a single adult female showing a healed ship strike wound with no obvious residual effects.

3.3.4 Southeast Pacific

There were no reports from this region.

3.3.5 Information needs

The Workshop **recommended** submission of ship strike reports and entanglement information from all countries and encouraged nations to report ship strikes in particular to ensure that National Progress Reports to the IWC are comprehensive. Such information should also be provided to the ship strike database. There is a need to implement reliable, coordinated reporting systems at appropriate local and national levels.

4. BIOLOGICAL PARAMETERS

4.1 Reproduction

Some new information on southern right whale reproduction was presented, specifically concerning female age at first parturition and calving interval based on analyses of photo-identification data.

SC/S11/RW18 applied the methodology of Payne *et al.* (1990) to data from South Africa, indicating a mean calving interval of 3.16 years (95% CI 3.14, 3.19; *n*=2,270). Adding information on known-aged animals (gray-blazed calves identified subsequently as themselves producing calves) provided a median estimate of the age at first parturition of 7.67 years (95% CI 7.19, 8.16; *n*=79).

Carroll noted that two whales photo-identified at the Auckland Islands, New Zealand, were first observed with calves at the age of nine years.

4.2 Survivorship (including die-offs)

Using the methodology of Payne *et al.* (1990), the estimated annual survival rate of adult female right whales in South Africa was 0.990 (95% CI 0.985, 0.994) (SC/S11/RW18). Adding information on known-age and known-sex animals (gray-blazed calves) provided an estimate of the first-year female survival rate of 0.737 (95% CI 0.568, 0.906). Brandão *et al.* (2012) applied the methodology of Cooke

(2003), which takes explicit account of individual resighting histories for the period 1979 to 2010. This led to an estimate of the post first-year female survival rate of 0.987 (95% CI 0.984, 0.989) and an estimate of the first-year female survival rate of 0.914 (95% CI 0.816, 1.000)[1].

SC/S11/RW24 reviewed the unusually high mortality of right whales at Península Valdés from 2007 through 2010. Deaths of 314 whales were documented over this 4-year period, 89% of them calves less than 4 months old. From 1971 through 2002 the number of dead calves recorded each year increased at 6.8% per year, the same as the population's estimated growth rate over that period (Cooke, 2003). Effort to find dead whales increased over the 40 years of study but was constant from 2003 through 2010. Since 2003, the mean number of dead whales counted per three-year period increased by 376%; it is unlikely that the high levels of mortality observed in recent years can be explained by increased effort at detecting and reporting carcasses only.

The March 2010 IWC Workshop (IWC, 2011) reviewed the available data on die-off events and concluded that the three most likely causes were as follows: a decrease in food availability, biotoxins from harmful algal blooms, and disease. Subsequent to that Workshop, histological examination of tissue samples from 108 dead whales found no common or significant lesions to explain the high mortality. Significantly more dead whales were documented in Golfo Nuevo, the southern gulf of the peninsula, than in Golfo San José, the northern gulf, even though approximately equal numbers of whales are normally present in each of the two gulfs.

Factors that could prove relevant to determination of causation include differences in the timing of peaks in mortality across years and in the lengths of dead calves as well correlations between peaks in strandings and chlorophyll *a* blooms (determined from satellite data). Peaks in mortality occurred early in the nursery season (before 30 September) in 2005 and 2007 and late in the season (after 1 October) in 2008 and 2009. Whales around Península Valdés begin to feed sporadically when spring plankton blooms appear at the end of September, creating the possibility that the late-season peaks in calf mortality were related to biotoxin exposure via milk. Satellite data for Península Valdés in 2005 and 2007 indicate high densities of chlorophyll *a* in the weeks immediately preceding the peaks in mortality in those years.

The calves that died during the late-season peaks in 2008 and 2009 had increased their body length by 1-2 m, i.e. at a rate similar to that of living calves of the same age off South Africa (Best and Rüther, 1992). This militates against the possibility that they were suffering from a lingering illness or were malnourished; instead they appear to have died from some acute catastrophic cause. Although most of the dead calves examined in 2008 and 2009 appear to have died shortly after birth, the mean lengths of dead calves from mid-August to the end of September were significantly longer in 2008 and 2009 than in 2005 and 2007. Best and Rüther found that multiparous females give birth to larger calves than primiparous females. The unusually broad range in the lengths of dead calves in this time period may indicate that a population-wide phenomenon, such as a decrease in food availability, was responsible for the high mortality. Peaks in deaths in 2008 and 2009 occurred before there was any evidence of plankton blooms locally. There is always a possibility, however, that the whales would have consumed biotoxins on their feeding grounds, and biotoxins can cross the placental barrier and cause brain damage and death shortly after birth.

There is little evidence of toxic algal blooms around Península Valdés, and there are no reports of large-scale mortality of pinnipeds, dolphins or seabirds there, whereas if such blooms were to occur, die-offs of marine species besides right whales would be expected.

4.3 Other

On the question of sex ratio at birth, Carroll reported that biopsies from 50 calves in New Zealand indicated parity. Of six stranded calves in Brazil for which sex was determined, three were female and three male (SC/S11/RW28). Rowntree provided a summary of the data on sex of stranded right whales at Península Valdés from 2003 through 2010 (see Table 2). The sex ratio of the calf component of those strandings was close to parity (47% male). Although Oliveira *et al.* (2009) based on the biopsies of 21 calves from southern Brazilian population reported the sex ratio of two females for one male, this was not statistically different (χ^2 test, a=0.05; df=1) from the expected ratio of 1:1.

Table 2

Sex ratio of right whales stranded at Península Valdés, 2003-10 (data provided by V. Rowntree).

Sex	Calves	Juveniles	Adults
M	137	2	2
F	155	13	30
Total	292	15	32
M/Total	0.47	0.13	0.06

5. STATUS

The importance of long-term monitoring programmes to determine and monitor the status of southern right whale populations and the efficacy of conservation measures cannot be over-emphasised. A recommendation to this effect is given under Item 7.3.

5.1 Population modelling approaches

Population modelling had been used previously to estimate demographic parameters for southern right whales in two regions: Argentina (Cooke, 2003; Cooke *et al.*, 2001; Payne *et al.*, 1990) and South Africa (Best and Underhill, 1998; Best *et al.*, 2001). At this meeting, analyses using extensions or adaptations of the maximum likelihood approach of Cooke *et al.* (2001) were used to update estimates for the same two populations. In addition, SC/S11/RW20 used the super-population POPAN model (Árnason and Schwarz, 1996; Árnason and Schwarz, 1999), implemented in program MARK (White and Burnham, 1999), to estimate super-population size and yearly abundance of right whales in New Zealand over two survey periods, 1995-98 and 2006-09, and the Pradel model (Pradel, 1996), also implemented in MARK and over the same time periods, to estimate rate of increase separately for males, females and the two sexes combined.

Cooke reported that photo-id data have been collected each winter in the southern right whale (*Eubalaena australis*) calving ground at Península Valdéz, Argentina from 1971 to the present. The nature of the data and collection method are described by Payne *et al.* (1990). Annex D developed after the Workshop for the 2012 Scientific Committee meeting, provides an update of the analysis by Cooke *et al.* (2001; 2003) using data collected from 1971-2010.

[1]CI's based on Hessian estimates of standard error, truncated above at 1 for survival rates.

In order to be able to fit the increase in frequency of 2-year calving intervals observed in recent years, the population model was modified to allow for inter-annual variation in all transition probabilities between reproductive classes. Annex D provides an interim update for the purpose of updating the entries in the hemisphere-wide summary (see Table 3). A more in-depth analysis of these data is in progress by Cooke that will integrate the information from Argentina and Brazil. The Workshop **recommends** that this work be completed as soon as possible.

5.2 Genetic diversity and N_{min}

SC/S11/RW26 provided a preliminary analysis of the effective population size of the south-western Atlantic population of southern right whales using genetic data (69 mtDNA control region sequences). Data from Argentinian and Brazilian samples were combined and they were assumed to be from a single population (SC/S11/RW25). The female effective population size (N_{ef}) for the whole population was estimated using the formula: $N_{ef} = \theta/2\mu g$ (μ = 1.75E-8 mutations per site per year, g = 18.1 years as generation time and θ = genetic diversity). The overall effective population sizes ($2N_{ef}$) estimated by the coalescent model and Waterson's method were 142,066 (CI: 101,026-211,522) (θ_{Lamarc}=0.045) and 56,194 individuals ($\theta_{Waterson}$=0.0178), respectively. Population fluctuations were estimated over time using mtDNA data and the Bayesian Skyline Plot method. This indicated an appreciable population decline between the end of the Pleistocene and beginning of the Holocene around 22 and 6 thousand years ago, with the start of the inflection of the median curve at 17,000 years ago. These data suggest that the south-western Atlantic population had already experienced a loss of genetic diversity before commercial hunting began in the 17th century.

5.3 Historic population size

Here historic population size means at the beginning of commercial whaling in about 1780. The following section describes the final modelling exercise undertaken by Butterworth and Brandão after the 2012 Scientific Committee meeting incorporating the results of the analysis by Cooke for Argentina (see Item 5.1). While incorporated in this section under historic population size it provides a hemisphere wide assessment of historic abundance relative to present abundance.

The model

To obtain an estimate of the initial pre-exploitation size K of a population, the following difference equation was used to describe the dynamics of a whale stock:

$$P_{t+1} = P_t + rP_t\left(1 - \left(\frac{P_t}{K}\right)^{\mu}\right) - C_t \qquad (1)$$

where:

- P_t is the total population size in year t;
- r is the intrinsic growth rate (the maximum the population can achieve, when its size is very low);
- μ is 2.39 (this sets the *MSY* level, *MSYL*=0.6*K* as conventionally assumed for such analyses by the IWC Scientific Committee); and
- C_t the total catch (in terms of number of animals) in year t.

Assuming P_0=K, and given values for the parameter r as well as a catch history series, equation (1) can be used to generate population size estimates P_t corresponding to a particular value of K for each of years $t = 0,\ldots t_{current}$ where year 0 corresponds to the start of exploitation and $t_{current}$ = 2009. Given a population size estimate P_{t*}^{obs} for a recent year t^*, where $t^* \le t_{current}$, a 'best' estimate for K can be found by successively substituting different values for K until the difference between the model estimate $\hat{P}_{t*}^{obs}$ and observed population size estimate P_{t*}^{obs} is sufficiently small.

Equation (1) is the population model used in the *Catch Limit Algorithm* of the Revised Management Procedure (IWC, 1993). This provides a good approximation to the sex-and-age structured model 'BALEEN II' (De la Mare, 1989) conventionally used by the Scientific Committee for stock assessment computations. The approach described above is an example of what is described as 'Hitting with fixed MSYR' in such exercises.

Current population size

$t^*_{current}$ was set at 2009 and the estimates of total population size obtained for each of the breeding stock areas included in the analysis are presented in Table 3 (and see discussion under Item 5.4). Together they provide an estimate for P_{2009}^{obs} of 13,611 right whales in the Southern Hemisphere for use in the population model.

A key parameter for this computation (the 'conversion factor') was used to convert estimates of mature females to the total number of individuals in a population. There had been considerable discussion of this parameter at the Workshop with different values being considered for different areas. However, calculations undertaken after the 2012 Scientific Committee meeting revealed that it was appropriate to use single conversion factor (see Table 3) of 3.94, the average of the values for South Africa (3.92) and the Southwest Atlantic (3.95).

The Workshop **recommended** further investigation of the sensitivity of the conversion factor used to estimate total population size from the estimated parous female component. Such investigation needs to consider that there has been only a relatively short period of recovery and therefore the age distribution is unlikely to be steady and the estimated survival rate is likely to be biased upwards from the average that would apply in a steady situation.

Historical catches

Catch data for the Southern Hemisphere were considered in IWC (2001b). The base-case catch history series reported in table 7 of IWC (2001b), with the attached caveats, has been used in fitting the population model. As was done before, in all instances the catch data per decade were converted to annual estimates by assuming an even distribution of catches over each ten-year period.

Results

Fig. 1 shows the results of this population modelling exercise for the base-case catch series and for two values of r (0.06 and 0.07). The assumption of r = 0.07 suggests an initial total population size of about 70,000. Fig. 2 shows the r = 0.07 trajectory for the base-case catch series on an expanded

Table 3

Summary of estimates of certain demographic parameters and present (2009) abundance levels for different calving ground 'units' used for the modelling exercise described under Item 5. For comparative purposes the information used in 1997 is given in square brackets. Note that a dash indicates no information. 'Mature' or 'adult' females here and elsewhere in the report refers to parous females.

Region	Calving ground (see Table 1 for details) [breeding unit]	Growth rate r^1 [1997]	Annual ♀ survival S [1997]	Age at first parturition tm [1997][#]	Latest estimate mature females [used in 1998]	2009 estimate of mature females used in model [1997]	2009 total population estimate used in model [1997]	No. of haplotypes
SW Atlantic	Península Valdés	0.062 (2000-10)	0.976	8.4	1,074 in 2010	1,011	4,029	25 (275bp)
	[Argentina]	[0.071 pre-1997]	[0.98]	[9.0]	[330 in 1990]	[547]	[2,577]	37 (630bp)
	Southern Brazil				Incl. in		0	24 (275bp)
	[Brazil]	[-]	[-]	[-]	Península Valdés	[29]	[137]	
					[25 in 1995]			
South central	Tristan Da Cunha/				20		79[2]	-
Atlantic	Gough Is?				[20 in 1985][3]	[48]	[226]	
	[Tristan Da Cunha]	[-]	[-]	[-]				
Southern	South Africa	0.068	0.987	7.4	1,205 in 2010	1,125	4,411	21 (275bp)
Africa		[0.072]	[0.98-0.99]	[9.1]	[613 in 1996]	[659]	[3,104]	
	Namibia				Included in SA		0	-
		[-]	[-]	[-]	[<10]	[0]	[0]	
(SW/central	Mozambique/						0	-
Indian?)	Madagascar?				<10			
	[Mozambique][4]	[-]	[-]	[-]	[<10]	[0]	[0]	
SW Pacific	Mainland NZ							6 (275bp)
	[NZ/Kermadec]	[-]	[-]	[-]	[-]	[0]	[0]	7 (500bp)
	Sub-Antarctic NZ				678 in 2009[5]		2,672[2]	9 (275bp)
	[New Zealand]	[-]	[-]	[-]	[69 in 1997]	[70]	[330]	11 (500bp)
Australia	SE Australia	-	-	-	-	-	-	6 (275bp)
								6 (275bp)
	S central Australia							8 (275bp)
	and SW Australia	0.068		9.1	614 in 2009		2,420[2]	8 (500bp)
	[Australia]	[0.0825]	[-]	[-]	[220 in 1995]	[254]	[1,197]	
SE Pacific	15°-41°S?							-
	[Chile/Peru]	[-]	[-]	[-]	[<10]	[0]	[0]	
Total						[1,607]	13,611	51[6]
							[7,571]	

[1]This is the annual proportional increase, which is related to the instantaneous rate of increase (r^*) given by (e.g.) a log-linear regression by the equation $r = \exp(r^*) - 1$. [2]Estimated mature females in 2010 x 3.94 - this is the average of the values for South Africa (3.92) and the southwest Atlantic (3.95). [3]Report said probably too low. [4]In 1998 there was also a separate central Indian Ocean 'breeding unit' for which there were no data and zero was used for 1997 abundance. [5]Inferred from estimate of 1,221 females (excluding calves); if n is number of mature females, then $3.94n = 2*1{,}221 + n/3$ assuming a 3 year calving interval. [6]Underestimate particularly because of limited sample size for South Africa and Australia. [#]Unless otherwise stated in this report attainment of female maturity is assumed equivalent of age at first parturition to be consistent with the structure of the BALEEN II model.

scale over the period from 1880. Overall this trajectory illustrates:

(i) the rapid depletion of the stock following the substantial catches of the early-mid 1800's;
(ii) the almost complete lack of any sign of a recovery after 1850, for almost 100 years, followed by a gradual recovery after protection in 1935; and
(iii) the effects of the illegal Soviet catches of the 1960's in delaying further recovery by about 20 years. The trajectory also indicates that the entire Southern Hemisphere population reached a low point of about 400 animals in 1920, and is now approaching about 20% of its pre-exploitation abundance.

The above analysis provided a reasonable, although rough, guide to how close the overall right whale population in the Southern Hemisphere is to recovery. It was agreed that there would be little value in trying to refine the accuracy or resolution of this assessment, given the many assumptions and substantial uncertainty surrounding much of the input. Further refinement of modelling efforts should focus on stock-level rather than global analyses.

5.4 Present abundance

5.4.1 South Africa

Brandão *et al.* (2012) provided 2010 population estimates of 1,205 (95% CI 1,121, 1,289) adult females and a total of 4,725 (95% CI 4,306, 5,144) whales of both sexes (including calves) for South Africa.

SC/S11/RW11 used photo-ID mark-recapture methods to estimate the abundance of right whales on a feeding ground off the west coast of South Africa (St Helena Bay area). The whales were designated as either distinctive or highly distinctive (HD) on the basis of permanent markings other than callosities as well as the number of callosities. The POPAN Jolly-Seber model implemented in the software program MARK provided abundance estimates of 1,305 (95% CI 1,033, 1,577) and 80 (95% CI 55, 104) for the distinctive and HD groups respectively. This indicates that approximately a third of the population that visits the South African coast frequents the St Helena Bay area in spring/summer.

5.4.2 Brazil

Aerial surveys of right whales have been conducted in the south of Brazil since 1987 for census, individual identification through photographs, behaviour studies, and an evaluation of anthropogenic threats (SC/S11/RW27). Direct counts of whales sighted from the aerial platform (airplane 1987-1998 and helicopters from then onwards) were used to obtain a total of individuals present in any given year, month and the whole study period. Totals of 1,266 whales (adults and calves), 817 adults and 499 calves were counted for the whole study period in the peak of the season (September). The total number of all whales counted ranged from 16 individuals in 1988 to 194 in 2006 (mean=66.63 whales/year). The number of adults varied from 10 in 1988 to 145 in 2006 (mean=43 adults/year) while the number of calves ranged from six in 1987, 1988 and 1993 to 54 in 2007 (mean=23.63 calves/year). Sightings from monthly surveys conducted between July and November from 2002 to 2010 indicated that whales

Fig. 1 Total population size (all Southern Hemisphere combined).

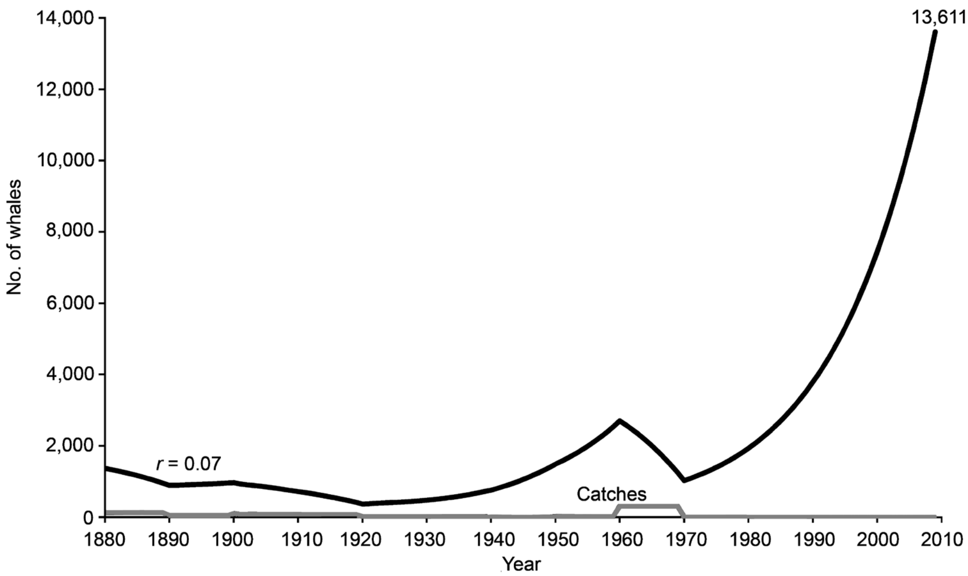

Fig. 2 Total population size and catches for 1880-2009 (all Southern Hemisphere combined).

began arriving in the study area in July, reached a peak of occurrence in September and declined in November. The total numbers of all whales, females and calves increased over the years, continuing the population trend observed in the years prior to regular systematic survey.

5.4.3 Argentina
See Item 5.5.2 for discussion of abundance and trends in right whale abundance at Península Valdés.

5.4.4 New Zealand
Vessel-based photo-identification and genetics data from the subantarctic Auckland Islands, New Zealand, were investigated using a mark-recapture framework and DNA profiles from more than 750 individuals, sampled during two sets of winter field surveys (1995-98 and 2006-09) (SC/S11/RW20). Results suggested a population of 1,085 (95% CL 845, 1,399) males and either 1,434 (95% CL 1,145, 1,835) or 1,221 (95% CL 848, 1,757) females depending on the model used. The authors of SC/S11/RW20 preferred the latter estimate for the female component because it incorporates heterogeneity in capture probability linked to the reproductive cycle.

5.4.5 Australia
Bannister indicated that the best estimate for the present population of right whales visiting the west coast of Australia between Cape Leeuwin and Ceduna is 2,900 and thus the total 'Australian' population is likely to be about about 3,500 animals (SC/S11/RW10).

5.5 Trends in abundance

5.5.1 South Africa
Aerial counts of cow-calf pairs on the South African coast, adjusted for duplicates, increased exponentially at a rate of 6.8% p.a. (95% CI 6.3, 7.4%) from 1979 to 2008 (SC/S11/RW15).

SC/S11/RW18 presented results of the methodology of Payne *et al.* (1990) applied to aerial survey data for right whales off South Africa to estimate calving intervals, with information on known-aged animals (gray-blazed calves) added. This gave an instantaneous growth rate of 0.068 per annum with 95% CI of [0.064; 0.072]. The model in Brandão *et al.* (2012) estimated a 73% probability that gray-blazed calves can be identified individually on reaching maturity.

Brandão *et al.* (2012) applied the methodology of Cooke (2003), which takes explicit account of individual resighting histories for the period 1979 to 2010. The results indicate an instantaneous population growth rate of 0.068 (approx. 95% CI 0.064, 0.072) per annum. The rate is slightly less over the first few years of the 1979-2008 period analysed, and further there are indications that it was much less shortly before that, probably a reflection of illegal Soviet whaling in the 1960s.

The methodology in Brandão *et al.* (2012) allows for a three-year reproductive cycle: receptive to calving to resting. In simple terms, the α parameter allows for the possibility of a two-year cycle, the β parameter a four-year cycle, and the γ parameter a five-year-cycle. The estimates obtained for these parameters were:

α (probability that a mature whale that calves becomes receptive the next year) = 0.02

β (probability that a resting mature whale rests for a further year) = 0.12

γ (probability that a receptive mature whale rests rather than calves the next year) = 0.07

Extensions of the model were also run in which variability was admitted with time, separately in the β and then in the γ parameter. The former revealed no obvious pattern but the latter suggested that the 1980s were a good period for reproduction and the early 1990s the reverse.

5.5.2 Argentina

After the Workshop, Cooke provided an update (see Annex D) of the capture-recapture analysis of the Península Valdés photo-id series (1971-2010). The method was similar to that used in Cooke *et al.* (2003) (which analysed data though 2000), but modified to allow variation in survival rates. The new estimate of the annual rate of increase over the entire period was 6.2% (95% CI 5.6%, 6.8%). The number of 'reproductive' females (defined as females that had had at least one calf in their lives to date) was estimated to have been 1,074 (95% CI 988, 1,160) in 2010. Assuming a 50:50 sex ratio, this corresponds to a total population size of 4,245 (95% CI 3,765, 4,725) whales including calves in 2010.

Both calf and non-calf survival were estimated to have declined over the period, such that the rate of increase was estimated to have declined to 5.0% over the last 10 years.

The results showed increases in the estimated proportions of 2, 4 and 5-year calving intervals relative to 3-year intervals which had previously been the norm. The 2-year intervals were thought by Cooke to have been associated with calf deaths, while the 5-year intervals were thought to have been associated with cryptic calf or foetus loss prior to arrival at Península Valdès. The increased proportion of 2-year intervals is a new phenomenon, but an increase of 5-year intervals had previously occurred during the severe El Niño event in the early 1980s (Leaper, 2005).

Cooke also analysed data from southern Brazil separately from the Argentina data, because the results of cross-matching were not yet available. The Brazil data showed a low, stable abundance from 1987 through 1997 followed by an extremely rapid expansion over the following decade, which was too fast to be an endogenous increase. The estimated average annual rate of increase over the period 1987-2010 was 12.0% (CI 8.5%-14.2%). The results indicated a pulse of immigration, which peaked in the early 2000s. Population size in 2010 was estimated at 197 mature females (CI 146-234). Cooke reported that it was not a simple matter to raise this to a total population estimate because the age distribution and sex ratio of immigrants is unknown.

In discussion of whether there might have been a relict or remnant population off Brazil that was extirpated, Brownell pointed out that right whales were still being taken by whalers off Brazil through 1973. Rowntree informed the meeting that the single baleen plate from Brazil analysed thus far had a completely different isotopic signature to those from Argentina. She and her co-workers inferred that that animal had fed only or primarily on the Patagonian Shelf rather than using foraging areas in the Antarctic and sub-Antarctic.

Crespo and colleagues (SC/S11/RW4) estimated the population rate of increase off Península Valdés for the period 1999-2011 based on the slope of the linear regression of the log-number of the total number of whales (r= 7.0%, 95% CI 4.6-9.3%; R^2= 0.93, *n*=6) and the total of newborn calves (r=6.5%, 95% CI 2.8-10.1%; R^2= 0.82, *n*=6) during the peak of the season (excluding the years of 2008-10). These values are in the same range as those obtained from photo-identification mark-recapture methods applied to adult females.

The Workshop emphasised that the estimated numbers for Brazil and Argentina should not be summed, because of the known substantial overlap in individuals. The Workshop believed that interpretation of the trends in both areas could be substantially facilitated by a joint analysis using the results of the cross-matching update that is currently in progress. Data from Uruguay should also be included in the updated cross-matching if time permits. Rowntree pointed out that some whales seen in Brazil with a calf were not seen in Argentina in the same year.

With regard to the annual CENPAT programme of aerial surveys around Península Valdés, which is independent of the long-term aerial photo-identification programme, led in recent years by Sironi and Rowntree, that provided the basis for population assessment work led by Cooke, the Workshop concluded that its greatest value was in providing a broader-scale ('big picture') perspective. In other words, the CENPAT programme substantially increases the areal and temporal survey coverage beyond that of the more localised photo-identification programme and makes it possible to track large-scale changes in the timing and geographic extent of right whale distribution throughout the season. For this reason, it was **recommended** that the CENPAT programme be continued on an annual basis.

5.5.3 New Zealand

Pradel models incorporating recaptures across the two survey periods over the period 1995-2009 at the Auckland Islands, New Zealand, produced similar rates of annual population increase of 0.07 (95% CL 0.05, 0.10) for males and 0.06 (95% CL 0.1, 0.14) for females (SC/S11/RW20).

5.5.4 Australia

Annual photo-identification surveys in Australia from 1993-2010 indicate an exponential rate of increase for 'all animals' of 0.0657 (95% CI 0.0381-0.0933), corresponding to a percent annual increase rate of 6.79 (95% CI 3.88-9.78); for cow/calf pairs the figures are 0.0660 (95% CI 0.0288-0.1031) and 6.82 (95% CI 2.92-10.86) respectively (SC/S11/RW10). Those are the 'best estimates' of current annual increase rate for the part of the Australian population that visits the southern Australian coast between Cape Leeuwin, Western Australia and Ceduna, South Australia.

6. FACTORS THAT MAY AFFECT RECOVERY

6.1 Direct removals
There is no evidence of directed killing (whaling) of southern right whales since the 1980s.

There is limited evidence of non-deliberate direct removals by entanglements in fishing gear and ship strikes (see Items 3.2 and 3.3; Table 4). In areas with good documentation of abundance and trends, notably eastern South America, South Africa, New Zealand, South Australia and Western Australia, known levels of such removals do not appear to be having appreciable effects on population recovery. However, it was noted that even occasional removals, especially of adult females, from the very small (and possibly non-recovering) populations in areas such as southeastern Australia and southwestern South America could affect those populations' recovery. Galletti pointed out that historic concentration areas of right whales along the Chilean coast closely match coastal human population centres today, and this may enhance the chances of ship strikes and entanglements.

In all parts of the range, it is important to monitor mortality and develop a better basis for determining the 'sustainability' of ongoing removals. Such monitoring should always include obtaining data on sex and at least relative age of the dead whales, given, for example, the disproportionate importance of parous females to population recovery.

6.2 Other factors that may affect population trends
Other than direct removals, a variety of human activities are known or likely to affect right whales 'indirectly' (Table 4).

At the Workshop in Puerto Madryn in March 2010 (IWC, 2011), three leading hypotheses were identified to explain the spikes in mortality of whales (especially calves) at Península Valdés in 2005 and 2007-09: reduced food availability for adult females, biotoxins and infectious disease. The Workshop was not able to determine which of these hypotheses was the most likely, and it was acknowledged that some combination of factors may have been involved in different years. A fourth possible contributing factor, chemical contaminants, was considered less likely, and demographic factors, such as killer whale attacks, disturbance from whale-watching activities, vessel strikes and fishing gear entanglements, were ruled out as significant factors contributing to the high mortality levels. The parasitic behaviour of kelp gulls, which eat the skin and blubber of live whales at Península Valdés, opening large wounds and affecting whale behaviour, particularly that of young calves, was given considerable attention at the Puerto Madryn Workshop. The frequency of gull attacks and the proportion of whales with gull-peck lesions (1% in 1974, 77% in 2008) have increased since first being observed in this population in the 1970s.

Infectious disease deserves ongoing consideration, with special attention to the potential of gulls as vectors, see IWC (2011). Groch reported that although not common, gull attacks similar to those previously observed only at Península Valdés have been seen in southern Brazil in recent years. In view of the risk that this learned behaviour on the part of gulls could proliferate, and given the severe impacts of gull attacks documented at Península Valdés, the Workshop recommended that Brazilian authorities consider taking immediate action (e.g the removal of attacking gulls) if and when similar gull behaviour is observed.

Climate change affects ocean conditions, with serious implications for biological organisms and processes (IPCC, 2007). This may have serious negative effects on krill (*Euphausia superba*) abundance which in turn may affect the recovery of southern right whales (IWC, 2011). Krill larvae feed on ice-algae that grow on the under-surface of sea ice. Ecosystem models indicate that a regional warming of 1°C in the Scotia Sea could reduce krill abundance in the region by 95% in the next 100 years (Murphy *et al.*, 2007). Krill abundance has been shown to decline in El Niño years when sea surface temperatures are higher than normal (Trathan *et al.*, 2007). The right whale population that calves off Península Valdés has fewer calves than expected following years of low krill abundance around South Georgia (Leaper *et al.*, 2006). Gentoo penguins and fur seals experienced similar reproductive failures in those years.

Krill abundance could be further reduced as a result of expansion of the aquaculture industry, which is increasing the demand for krill, and as a result of new Norwegian technology for harvesting and processing krill, which may greatly increase the annual take (Nicol and Foster, 2012). Although CCAMLR has responsibility for managing the exploitation of living resources in the Antarctic (such as krill and Patagonian toothfish), its modelling and management efforts to date have focused primarily on land-based predators (e.g. penguins, seabirds, pinnipeds) on the assumption that they are more strongly tied to specific sites than are krill-eating cetaceans including southern right whales. Valenzuela indicated that stable isotope analyses suggest fidelity to feeding grounds on the part of southern right whales, and in his view, this calls into question the underlying assumption of the CCAMLR models that these highly mobile animals would respond to local krill depletion simply by changing their foraging pattern. It is recommended that CCAMLR be encouraged to consider more explicitly the potential trophic effects of krill harvesting on baleen whale populations.

Peters noted that there was no indication of any die-off of right whales in South Africa, although there is an urgent need for a more coordinated mortality reporting system there.

A number of participants expressed concern about the potential acoustic impacts on right whales of seismic surveys associated with the offshore oil and gas industry. Oil and gas development is underway or planned in at least Australia, Argentina, Uruguay, Brazil and South Africa. Hinten noted that Australia has a well-developed system of environmental impact assessment in place and an ongoing programme to study the effects of seismic airguns and other acoustic energy sources on baleen whales. The Workshop stressed the importance of subjecting large development projects, including oil and gas development, wind turbines, port expansion and mariculture, to rigorous impact assessment that explicitly considers the potential effects on southern right whales. Mitigation measures should be implemented to limit identified risks. The Workshop also encouraged the continuation and expansion of research to improve understanding of the effects of noise on whales.

Galletti pointed to harassment by whalewatching vessels as a potential problem for right whales in some areas and it was noted that the IWC's Scientific and Conservation Committees are working jointly to improve understanding of this potential threat and to develop protocols for minimising the risks to cetacean populations.

Modification of the coastal zone is another concern in some areas. For example, in Chile a scallop aquaculture development has made at least one area inhospitable to whales (Galletti, pers. comm.) and in Uruguay there are plans for port expansion and breakwater construction in a near-shore area important to right whales (Riet, pers.

Table 4

Actual and potential threats, priorities for action and potential approaches to mitigation.

Actual/potential threat	Human activity/ies	Prioritisation for action	Actual/potential mitigation measures
Bycatch leading to serious injury/death/ impairment of ability to feed efficiently or to undertake other vital processes	Gillnet, longline and trap/pot fishing (both industrial and artisanal); debris; aquaculture barrier nets	Low (but important to monitor, particularly in areas such as SE Australia, mainland NZ and SE Pacific where the population is very low and impact could be serious)	Disentanglement teams (e.g. South Africa, Australia); educate and motivate fishermen to minimize floating and vertical lines associated with gear; time/area closures may be effective if need is established and good information is available on spatial and temporal distribution; gear modifications; changes in fishing practices
Serious injury/death from ship strikes	Commercial, military, recreational, tourism and other vessel traffic (recognising that strikes by small recreational vessels may less often lead to death or serious injury than strikes by large ships)	Low to medium (effort should be directed at research to determine threat levels and assess 'sustainability')	Shipping lanes (traffic separation), speed restrictions, exclusion zones and/or protected areas may be effective if need is established and good information is available on spatial and temporal distribution; coordination with International Maritime Organisation (and other intergovernmental organisations)
Acute toxicity (leading to death) or chronic toxicity (leading to impaired health)	Habitat degradation (e.g. runoff, aquaculture waste) leading to increased frequency/toxicity/scale of harmful algal blooms	Medium (effort should be directed at monitoring and research, including stranding response + epidemiological investigations), but High in areas such as Península Valdés	Dependent on results of monitoring and research but precautionary efforts should be made to reduce coastal pollution
Disturbance and possible displacement from important areas by noise	Ship traffic, construction, seismic surveys, whale watching, aircraft, wind turbines	Medium (better documentation of effects including dose-response analyses, controlled exposure experiments)	Restrict and manage activities (e.g. establish closed areas) and/or change methods based on rigorous environmental impact assessment
Disturbance and possible displacement from important areas by harassment	Whale watching and swim-with programs; kelp gulls	High in some areas	Management by relevant authorities based on science-based guidelines
Prey depletion	Overfishing of krill, habitat degradation due to pollution, climate change	Medium (effort directed at research on trophic ecology, whale movements, krill population dynamics, biomass, distribution) but High in some areas (e.g. South Georgia)	Effective fishery regulations based on good science, encouragement of CCAMLR to include consideration of potential effects of krill fishing on baleen whale populations
Death or debilitation by infectious disease	Poor waste disposal practices	Medium (effort should be directed at research including stranding response and epidemiological investigations) but High in Península Valdés because of kelp gull issues	Improved management of urban, industrial and agricultural waste (e.g. landfills, sewage, refuse from fish processing plants)
Acute and chronic toxicity to whales and their prey; fouling of baleen	Oil and other industrial (e.g. nuclear) development	High where such activities occur or are proposed	Contingency plans in areas where risk is high
Displacement and loss of habitat	Urban and other coastal development	Medium generally but High in areas such as Chile where aquaculture is being developed rapidly	Restrict and manage activities based on rigorous environmental impact assessment; identification of critical habitat
Cumulative impacts	Any or all of above	Medium (greatest need is to develop means of assessing)	Dependent on results of assessment

comm.). In some instances, such as that of a planned annual port dredging project in northern Patagonia (Province of Rio Negro) with a high seasonal concentration of right whales, it should be possible to schedule activities in a way that avoids overlap with the period of peak whale residency. In Brazil, expansion of the port of Imbituba located in the middle of the main concentration area for right whales (possibly a calving ground) will result in increased ship traffic and thus an increased risk of ship strikes.

Additional concerns raised related specifically to very small and/or geographically restricted populations of right whales. For such populations, epizootics and oil spills, for example, could be catastrophic. The effects of small population size, including demographic stochasticity and inbreeding depression, deserve consideration, as does the possibility that such populations are in a 'predator pit' where even small increases in the risk of predation (by killer whales) could jeopardise persistence. These small-population concerns strengthen the argument for a precautionary approach to management.

7. RECOMMENDATIONS

7.1 Population structure and stock identity

7.1.1 General recommendations

Population structure and stock identity of southern right whales remain incompletely described. A particular challenge is to distinguish adjacent stocks with different demographic histories and apparent rates of recovery. To address this, it is recommended that a circumpolar collaboration proceed to assemble standard genetic information from all available samples (see Table 5). Recognising the difficulties of obtaining permits and carrying out collaborative exchanges of samples, efforts should be made to standardise markers and establish quality control guidelines for the exchange of data (Morin *et al.*, 2010). Long-term photo-identification studies have shown that female southern right whales exhibit fidelity to nursery grounds, returning repeatedly to particular coastal sites for calving and calf rearing (Bannister, 1990; Best, 1990; Burnell, 2001; Payne, 1986). This fidelity acts as an isolating mechanism that creates 'matrilineal subpopulations' (Burnell, 2001), therefore maternally inherited mtDNA provides a powerful tool to examine population structure (e.g Baker *et al.*, 1999; Carroll *et al.*, 2011; Patenaude *et al.*, 2007). The ease of laboratory analysis facilitates between-laboratory comparisons.

For the purpose of assessing male-mediated gene flow, identifying individuals, inferring paternities and assessing 'bottleneck' effects, microsatellites remain the markers of choice, although they are difficult to standardise between laboratories. This means that samples must be exchanged to standardise sizing and to bin alleles (allelic standards). Use of Whole Genome Amplification might help overcome problems of sample size and resolve permit issues. Future developments, including genome and next-generation sequencing and the development of SNPs, will also aid future comparisons and make it possible to address other research questions.

It is **recommended** that mtDNA haplotypes be standardised according to the following procedures. Use a minimum of 500 bp of the mitochondrial control region (5' end) to identify haplotypes that overlap with those used previously (Carroll *et al.*, 2011). Where possible, extend the consensus region into the tpro (tRNA) to a length of 630 bp fragment used in SC/S11/RW3. Establish quality control using Phred scores or similar ABI for quality control.

It is **recommended** that the nomenclature for mtDNA haplotypes be standardised (following Carroll *et al.*, 2011, supplementary material).

It is **recommended** that microsatellite loci be standardised by using a standard suite of loci previously employed to investigate population structure and to identify individual southern right whales.

It is **recommended** that samples be exchanged to establish allelic standards, provide quality control and ensure that comparisons between laboratories are possible.

It is **recommended** that biopsy samples, satellite tagging data and photo-identification data be linked, where possible.

7.1.2 Specific recommendations

It is **recommended** that the available mtDNA sequences (2,456 samples) be assembled to update the previous analysis by Patenaude *et al.* (2007) (see Table 5) of the genetic structure of southern right whales on their calving/nursery grounds.

Collection of tissue samples from the following regions is strongly recommended.

(1) Southeast Australia: Preliminary genetic evidence suggests that right whales in southeast Australia represent a remnant stock, distinct from those in southwest Australia. The numbers of whales in southeast Australia are not increasing at the same rate as those in the southwest. Increased geographic coverage and a greater number of samples from high-density areas across south-central and southwest Australia, in addition to southeast Australia, are needed to address the questions of population structure and stock identity. There is the potential for complex population structure and more than two stocks in southern Australia. Satellite tagging should be undertaken in conjunction with biopsy sampling.
(2) Chile/Peru: Biopsies should be collected opportunistically in Chile and Peru to enable comparisons with the southwest Atlantic stock.
(3) Southern coast of Africa: Biopsies are needed from areas such as Mozambique and Namibia, where remnant stocks of right whales may still calve and nurse their young. Samples should be compared with those obtained from the South African calving grounds. Attempts should be made to distinguish substructure (i.e. distinct calving areas) from range expansion (i.e. from South Africa).
(4) Southern Brazil: The genetic distinctiveness of animals using the calving ground in southern Brazil should be further investigated through comparisons with animals sampled in the Península Valdés calving ground.

Table 5

Number of tissue samples collected from southern right whales in the regions and calving grounds given in Table 1, time periods of collection, tissue repository and who curates the samples, and associated publications.

Region	Calving ground	No. of samples	Time period collected	Tissue held by	Associated publication
SW Atlantic	Península Valdés	374	2003-06 (biopsy); 2003-09 (stranding)	University of Utah; curated by Luciano Valenzuela	SC/S11/RW3; Valenzuela *et al.* (2009)
		26	1998-2001	NRDP, Canada; curated by White Lab	Brown *et al.* (1991); Malik *et al.* (2000)
		>40	2010-11 (stranding)	University of Utah; curated by Vicky Rowntree and Luciano Valenzuela	-
	Southern Brazil	48	1998-2001	GEMARS/VERGS; curator: Paulo Henrique	SC/S11/RW25; SC/S11/RW26
Southern Africa	South Africa	600-650	1995-97	Palsbøll Lab	Schaeff *et al.* (1999); Rosenbaum *et al.* (2000); Best *et al.* (2003); Patenaude *et al.* (2007)
SW Pacific	Mainland New Zealand	62	2003-10	University of Auckland; curated by Baker	Carroll *et al.* (2011); Alexander *et al.* (2008)
	Sub-Antarctic New Zealand	354 834	1995-98; 2006-09	University of Auckland; curated by Baker	Carroll *et al.* (2011)
Australia	Southeast Australia	24	1995-2010	University of Auckland	Carroll *et al.* (2011)
	South central Australia	24	2001-04	University of Auckland	Patenaude and Harcourt (2006)
	Southwest Australia	20	1995	University of Auckland; curated by Baker and Bannister	Carroll *et al.* (2011); Patenaude *et al.* (2007)
Total		**2,456**			

Recognising the importance of being able to allocate offshore ('pelagic') catches in the Southern Ocean and in low-latitude areas to the appropriate calving grounds, as well as to evaluate the impacts of krill removals in the Antarctic in relation to specific calving grounds, it is **recommended** that genetic (biopsy), photo-identification and satellite tagging data are applied to identify linkages.

Further investigation is also **recommended** of: (a) apparent connections between whales in the New Zealand sub-Antarctic and those in mainland New Zealand; and (b) philopatry to mainland New Zealand. This should be pursued in at least two ways: (a) by analysing the existing sighting records held by the New Zealand Department of Conservation; and (b) by continuing to collect sightings and photo-identification data and biopsy samples opportunistically.

7.2 Removals

The Workshop noted that there was evidence of continuing removals via entanglements in fishing gear and ship strikes. In order to determine the severity of these threats at the population level it is essential to obtain good estimates of their extent, particularly given the high likelihood that reports underestimate the true extent, possibly severely. The Workshop therefore **recommended** improved collection and submission of ship strike reports and entanglement information from all countries; there is a need to implement reliable, coordinated reporting systems at appropriate local and national levels. Effective stranding networks and appropriate post mortem examinations can be a valuable tool in this regard (IWC, 2011). It **strongly encouraged** nations to report ship strikes and provide this information to the IWC ship strikes database and to ensure that progress reports to the IWC are comprehensive.

7.3 Status

7.3.1 Population modelling

GENERAL

The Workshop **recommended** further investigation of the sensitivity of the conversion factor used to estimate total population size from the estimated adult female component. Such investigation needs to consider that there has been only a relatively short period of recovery and therefore the age distribution is unlikely to be steady and the estimated survival rate is likely to be biased upwards from the average that would apply in a steady situation.

SPECIFIC

The Workshop **strongly recommends** that a final and complete version of at least the population assessment of the Argentinian data be presented at the 2012 Scientific Committee meeting. It also **recommends** that progress towards the 'joint assessment', using data from both Argentina and Brazil, be made as quickly as possible and that an update also be presented on this work at the 2012 Scientific Committee meeting.

7.3.2 Long-term monitoring

The Workshop **strongly reiterates** the importance of long time-series to inform, prioritise and evaluate conservation and management actions. In particular (e.g. see the analyses in Bannister *et al.*, 2011), it stresses the value of obtaining annual data sets, particularly those that include information on the calving intervals of individual females, for their great importance for analyses of the influences of climate and environmental variables on southern right whale reproduction (Leaper *et al.*, 2006). Survey designs incorporating gaps, which may be suitable for monitoring a long-term trend in recovery of a well-established population (albeit with wider confidence intervals), do not provide the resolution necessary to interpret inter-annual variability in calf production, cohort shifts and other changes that have been shown to be related to such variables. The Workshop therefore **strongly recommends** that, wherever possible, all existing such southern right whale datasets (e.g. Argentina, Australia and South Africa) be continued on an annual cycle; it also strongly recommends that similar programmes be established wherever possible for other areas. Such information is also essential for monitoring the effectiveness of mitigation measures and Conservation Management Plans.

7.4 Factors affecting population trends

The Workshop **strongly reiterated** the research and management recommendations made at the Workshop on the Southern Right Whale Die-off (IWC, 2011).

In addition, in view of the given the severe impacts of gull attacks documented at Península Valdés and the risk that this learned behaviour on the part of gulls could proliferate, the Workshop **recommended** that Brazilian authorities consider taking immediate action if and when similar gull behaviour is observed.

Given the potential threats to krill in the Antarctic, the Workshop **recommended** that CCAMLR be encouraged to consider more explicitly the potential trophic effects of krill harvesting on baleen whale populations.

The Workshop **stressed** the importance of subjecting large development projects, including oil and gas development, wind turbines, port expansion and mariculture, to rigorous impact assessment that explicitly considers the potential effects on southern right whales. Mitigation measures **should be implemented** to limit identified risks. The Workshop also **encouraged** the continuation and expansion of research to improve understanding of the effects of noise on whales in general and right whales in particular.

7.5 Outlines for CMPs where appropriate

The IWC has worked since 2008 to develop an agreed outline and process for Conservation Management Plans in the context of the IWC, a valuable conservation tool. The Workshop believed that at this time knowledge is insufficient for developing a *fully formed* Conservation Management Plan for all southern right whale populations i.e. with identified and evaluated threats and proposed mitigation and management actions. It **agreed** that at this stage, much of the focus (and hence time and resources) within draft CMPs might be best spent on developing specific targeted scientific actions to gather needed baseline information and to improve understanding of these populations and the threats facing them in order to move towards the development of more complete CMPs in the future (for example, see the recommendation for Chile-Peru under Item 2.2.2). As part of this process, the Workshop **recommended** that any draft plans take into account the recommendations made at the present Workshop and the Workshop on the die-off of southern right whales (IWC, 2011) and use these as the basis of action development.

Conservation action plans (in a broader sense) have been developed or are under development in various parts of the range of southern right whales. Galetti emphasised the importance of developing conservation plans which include scientific research, the maximum protection practical, measures such as avoidance of negative human-whale interactions, and stakeholder involvement. Groch described the Conservation Management Plan recently completed for the great whales in Brazil. Hinton noted the importance of putting in place management or recovery plans and noted the requirement to do so under Australian domestic law. He noted that such plans cannot wait for complete knowledge of species of concern, but that a precautionary approach requires that they be put in place before full understanding is available.

The Workshop **recognised** the importance of national conservation measures and plans and their relevance and importance to the development of IWC CMPs that encompass waters of more than one nation as well as the high seas.

8. PUBLICATION

Participants agreed that the material presented at the current Workshop should be published as soon as possible and should not wait for publication of a Workshop volume. The report of the Workshop will be prepared for SC/64 and presented by the Chair, Bannister, to that meeting.

9. ANY OTHER BUSINESS

Ambassador Susana Ruiz Cerutti addressed the final session of the Workshop. She thanked participants for their dedication to the task at hand and said that Argentina was honoured to host the third workshop on southern right whales since 1988. She noted that Argentina assigns great importance to any assessment of right whales, especially since this charismatic species is crucial to coastal development in Argentina and responsible for extensive whale-watching opportunities. In the past these whales were hunted almost to extinction and Ambassador Cerutti noted that the species now faces other threats, from climate change, entanglement, ship strikes, chemical pollution and gull harassment. She stated that more has to be done to tackle these problems and the current workshop represents an excellent opportunity to assess the actual and potential threats and to establish priorities and potential actions for protection of the species. In closing she expressed her confidence that it would be possible to move forward with proper measures to address the conservation of southern right whales.

10. ADOPTION OF REPORT

The report was adopted by email correspondence after the meeting. The Chair thanked the hosts for excellent facilities provided, Brownell as Convenor, Reeves and Thomas as rapporteurs and the participants for their hard work. The Workshop thanked the Chair for his efficient handling of the long agenda.

REFERENCES

Alexander, A., Carroll, E., Steel, D., Constantine, R., Patenaude, N., Harcourt, R. and Baker, C. 2008. Individual identification, regional movements and genetic differentiation of the mainland New Zealand southern right whale population 2003-2007. New Zealand Department of Conservation, (PO box 10420, Wellington). 23pp.

Árnason, A. and Schwarz, C. 1996. A general methodology for the analysis of open-model capture-recapture experiments in open populations. *Biometrics* 52: 860-73.

Árnason, A.N. and Schwarz, M.K. 1999. Using POPAN-5 to analyse banding data. *Bird Study* 46(Suppl.): S157-68.

Baker, C.S., Patenaude, N.J., Bannister, J.L., Robins, J. and Kato, H. 1999. Distribution and diversity of mtDNA lineages among southern right whales (*Eubalaena australis*) from Australia and New Zealand. *Mar. Biol.* 134(1): 1-8.

Bannister, J. 2001. Status of southern right whales (*Eubalaena australis*) off Australia. *J. Cetacean Res. Manage.* (special issue) 2: 103-10.

Bannister, J.L. 1990. Southern right whales off western Australia. *Rep. int. Whal. Commn* (special issue) 12: 279-88.

Bannister, J.L., Hedley, S.L., Bravington, M.V. and Burnell, S.R. 2011. Monitoring population dynamics of right whales off southern Australia. Project 2009/41: Final Report to the Australian Marine Mammal Centre, 13th April 2011. 23pp.

Baracho, C., Mas-Rosa, S. and Marcovaldi, E. 2010. Primeiro registro da baleia-franca-do-sul (*Eubalaena australis*) no litoral norte da Bahia - Brasil. Reunion de Trabajo de Especialistas en Mamíferos Acuáticos de America del Sur, 10; Congresso de la Sociedad Latinoamericana de Especialistas en Mamíferos Acuáticos - SOLAMAC, 4. Valdívia, Chile. Libro de Resúmenes. 14-19 de octubre. [Available from the author].

Belgrano, J., Gribaudo, C., Arcucci, D., Kröhling, F. and Iñiguez, M. 2008. Recent increase in the number of southern right whales (*Eubalaena australis*) in Golfo San Jorge, Santa Cruz, Patagonia Argentina. Paper SC/60/BRG4 presented to the IWC Scientific Committee, June 2008, Santiago, Chile (unpublished). 4pp. [Paper available from the Office of this Journal].

Best, P. 2006. The presence of right whales in summer on the west coast of South Africa: the evidence from historical records. *Afr. J. Mar. Sc.* 28(1): pp.159-66.

Best, P. and Underhill, L. 1998. Population size, growth rate and survival of southern right whales *Eubalaena australis* off South Africa, 1979-1996. Paper SC/M98/RW15 presented to the IWC Special Meeting of the Scientific Committee towards a Comprehensive Assessment of Right Whales Worldwide, 16-25 March, Cape Town, South Africa (unpublished). 15pp. [Paper available from the Office of this Journal].

Best, P.B. 1988. Right whales, *Eubalaena australis*, at Tristan da Cunha. A clue to the 'non-recovery' of depleted stocks? *Biol. Conserv.* 46: 23-51.

Best, P.B. 1990. Trends in the inshore right whale population off South Africa, 1969-1987. *Mar. Mammal Sci.* 6(2): 93-108.

Best, P.B., Brandão, A. and Butterworth, D.S. 2001. Demographic parameters of southern right whales off South Africa. *J. Cetacean Res. Manage.* (special issue) 2: 161-69.

Best, P.B., Glass, J.P., Ryan, P.G. and Dalebout, M. 2009. Cetacean records from Tristan da Cunha, South Atlantic. *J. Mar. Biol. Ass. UK*. 89(5): 1023-32.

Best, P.B., Payne, R., Rowntree, V., Palazzo, J.T. and Both, M.D. 1993. Long-range movements of South Atlantic right whales, *Eubalaena australis*. *Mar. Mammal Sci.* 9(3): 227-34.

Best, P.B. and Rüther, H. 1992. Aerial photogrammetry of southern right whales, *Eubalaena australis*. *Journal of Zoology (Lond.)* 228: 595-614.

Best, P.B., Schaeff, C.M., Reeb, D. and Palsbøll, P. 2003. Composition and possible functions of social groupings of southern right whales in South African waters. *Behaviour* 140: 1469-94.

Brandão, A., Butterworth, D.S., Müller, A. and Best, P.B. 2012. Application of a photo-identification based assessment model to southern right whales in South African waters. Paper SC/64/BRG24 presented to the IWC Scientific Committee, June 2012, Panama City (unpublished). 15pp. [Paper available from the Office of this Journal].

Brown, M.W., Kraus, S.D. and Gaskin, D.E. 1991. Reaction of North Atlantic right whales (*Eubalaena glacialis*) to skin biopsy sampling for genetic and pollutant analysis. *Rep. int. Whal. Commn* (special issue) 13: 81-89.

Burnell, S.R. 2001. Aspects of the reproductive biology, movements and site fidelity of right whales off Australia. *J. Cetacean Res. Manage.* (special issue) 2: 89-102.

Cammareri, A. and Vermeulen, E. In press. Alteration of southern right whale (*Eubalaena australis*) behaviour by human induced disturbance in Bahía San Antonio, Patagonia, Argentina. *Aquat. Mamm.*: 16pp.

Carroll, E., Patenaude, N., Alexander, A., Steel, D., Harcourt, R., Childerhouse, S., Smith, S., Bannister, J., Constantine, R. and Baker, C.S. 2011. Population structure and individual movement of southern right whales around New Zealand and Australia. *Mar. Ecol. Prog. Ser* 432: 257-68.

Childerhouse, S. 2009. Photo-identification of southern right whales around mainland New Zealand in 2007 and 2008. Report to the New Zealand Department of Conservation, PO Box 10420, Wellington, New Zealand.

Childerhouse, S., Carroll, E.L. and Rayment, W. 2009. Preliminary trip report for southern right whale research trip to the Auckland Islands July/August 2009. 4pp. Report to the New Zealand Department of Conservation, PO Box 10420, Wellington, New Zealand.

Cooke, J., Rowntree, V. and Payne, R. 2003. Analysis of inter-annual variation in reproductive success of South Atlantic right whales (*Eubalaena australis*) from photo-identification of calving females observed off Península Valdés, Argentina, during 1971-2000. Paper SC/55/O23 presented to the IWC Scientific Committee, May 2003, Berlin (unpublished). 16pp. [Paper available from the Office of this Journal].

Cooke, J.G. 2003. Report of the Scientific Committee. Annex D. Report of the Sub-Committee on the Revised Management Procedure. Appendix 12. Stock structure hypotheses for the North Atlantic minke whale *Implementation Review. J. Cetacean Res. Manage. (Suppl.)* 5: 149-50.

Cooke, J.G., Rowntree, V.J. and Payne, R.S. 2001. Estimates of demographic parameters for southern right whales (*Eubalaena australis*) observed off Península Valdés, Argentina. *J. Cetacean Res. Manage*. (special issue) 2: 125-32.

Costa, P., Piedra, M., Franco, P. and Paez, E. 2007. Distribution and habitat use patterns of southern right whales, *Eubalaena australis*, off Uruguay. *J. Cetacean Res. Manage*. 9(1): 45-51.

Costa, P., Praderi, R., Piedra, M. and Franco-Fraguas, P. 2005. Sightings of southern right whales, *Eubalaena australis*, off Uruguay. *Latin American Journal of Aquatic Mammals* 4(2): 157-61.

Dawbin, W.H. 1986. Right whales caught in waters around south eastern Australia and New Zealand during the nineteenth and early twentieth centuries. *Rep. int. Whal. Commn* (special issue) 10: 261-67.

De la Mare, W.K. 1989. Simulation studies on elements of a revised whale management procedure. Paper SC/F89/M5 presented to the IWC Scientific Committee Comprehensive Assessment Workshop on Management Procedures, February 1989 (unpublished). 35pp. [Paper available from the Office of this Journal].

Du Pasquier, T. 1986. Catch history of French right whaling mainly in the South Atlantic. *Rep. int. Whal. Commn* (special issue) 10: 269-74.

Espírito Santo, S.M., Franco, D. and Groch, K.R. 2009. Geostatistical density analysis of southern right whale (*Eubalaena australis*) occurrences along the coast of Santa Catarina, Southern Brazil - preliminary information. Paper SC/61/BRG15 presented to the IWC Scientific Committee, June 2009, Madeira, Portugal (unpublished). 5pp. [Paper available from the Office of this Journal].

Failla, M., Vermeulen, E., Carabajal, M., Arruda, J., Godoy, H., Lapa, A., Mora, G., Urrutia, C., Balbiano, A. and Cammareri, A. 2008. Historical records of southern right whales (*Eubalaena australis*) of the province Rio Negro, North Patagonia, Argentina (1991-2008). Paper SC/60/BRG1 presented to the IWC Scientific Committee, June 2008, Santiago, Chile (unpublished). 10pp. [Paper available from the Office of this Journal].

Gales, N., Double, M.C., Robinson, S., Jenner, C., Jenner, M., King, E., Gedamke, J., Childerhouse, S. and Paton, D. 2010. Satellite tracking of Australian humpback (*Megaptera novaeangliae*) and pygmy blue whales (*Balaenoptera musculus brevicauda*). Paper SC/62/SH21 presented to the IWC Scientific Committee, June 2010, Agadir, Morocco (unpublished). 9pp. [Paper available from the Office of this Journal].

Gibbons, J., Capella, J., Kusch, A. and Carcamo, J. 2006. The southern right whale *Eubalaena australis* (Desmoulins, 1822) in the Strait of Magellan, Chile. Anales Instituto Patagonia 34: 75-80.

Greig, A.B., Secchi, E.R., Zerbini, A.N. and Dalla Rosa, L. 2001. Stranding events of southern right whales, *Eubalaena australis*, in southern Brazil. *J. Cetacean Res. Manage*. (special issue) 2: 157-60.

Groch, K.R., Fabián, M.E. and Palazzo, J.T. 2003. Monitoring behavioral responses of southern right whales to whale watching activities in the southern Brazilian coast and an evaluation of its conservation implications. Paper SC/55/WW5 presented to the IWC Scientific Committee, May 2003, Berlin (unpublished). 23pp. [Paper available from the Office of this Journal].

Intergovernmental Panel on Climate Change. 2007. Climate change 2007: the physical basis, summary for policy makers. Contribution of Working Group I to the fourth assessment report of the Intergovernmental Panel on Climate Change. World Meteorological Organization and United Nations Environment Program. [Paper available from *http://ipcc.ch/SPM2feb07.pdf*].

International Whaling Commission. 1986. Report of the Workshop on the Status of Right Whales. *Rep. int. Whal. Commn* (special issue) 10:1-33.

International Whaling Commission. 1993. Special Meeting of the Scientific Committee on the Revised Management Procedure. *Rep. int. Whal. Commn* 43:221-28.

International Whaling Commission. 2001a. Report of the Workshop on Status and Trends of Western North Atlantic Right Whales. *J. Cetacean Res. Manage*. (special issue) 2:61-87.

International Whaling Commission. 2001b. Report of the Workshop on the Comprehensive Assessment of Right Whales: A worldwide comparison. *J. Cetacean Res. Manage.* (special issue) 2:1-60.

International Whaling Commission. 2009. Report of the Scientific Committee. Annex F. Report of the sub-committee on bowhead, right and gray whales. *J. Cetacean Res. Manage.* (Suppl.) 11:169-92.

International Whaling Commission. 2011. Report of the Southern Right Whale Die-Off Workshop, 15-18 March 2010, Puerto Madryn, Argentina. *J. Cetacean Res. Manage.* (Suppl.) 12:365-98.

Kemper, C., Coughran, D., Warenke, R., Pirzl, R., Watson, M., Gales, R. and Gibbs, S. 2008. Southern right whale (*Eubalaena australis*) mortalities and human interactions in Australia, 1950-2006. *J. Cetacean Res. Manage*. 10(1): 1-8.

Leaper, R. 2005. Some thoughts on relating environmental variables to whale population dynamics in the Southern Ocean and possible time series. Paper SC/57/IA20 presented to the IWC Scientific Committee, June 2005, Ulsan, Korea (unpublished). 6pp. [Paper available from the Office of this Journal].

Leaper, R., Cooke, J., Trathan, P., Reid, K. and Rowntree, V. 2006. Global climate change drives southern right whales (*Eubalaena australis*) population dynamics. *Biology Letters* 2: 289-92.

Lodi, L. and Tardelli Rodrigues, T. 2007. Southern right whale on the coast of Rio de Janeiro State, Brazil: conflict between conservation and human activity. *J. Mar. Biol. Assoc. U.K.* 87: 105-07.

Malik, S., Brown, M.W., Kraus, S.D. and White, B.N. 2000. Analysis of mitochondrial DNA diversity within and between North and South Atlantic right whales. *Mar. Mammal Sci.* 16(3): 545-58.

Mate, B.R., Best, P.B., Lagerquist, B.A. and Winsor, M.H. 2011. Coastal, offshore and migratory movements of South African right whales revealed by satellite telemetry. *Mar. Mammal Sci.* 27(3): 455-76.

Maury, M.F. 1852. Whales chart of the world. Map. Sheet 1 (Washington, 1852), sheets 2-4 (no date).

McNab, R. 1913. The Old Whaling Days: A History of Southern New Zealand from 1830-1840. Whitcombe and Tombs, Christchurch. 508pp.

Meyer, M.A., Best, P., Anderson-Reade, M. and Kirkman, S. 2011. Trends and interventions in large whale entanglement along the South African coast. *Afr. J. Mar. Sci.* 33(3): 429-39.

Moore, M.J., Berrow, S.D., Jensen, B.A., Carr, P., Sears, R., Rowntree, V.J., Payne, R. and Hamilton, P.K. 1999. Relative abundance of large whales around South Georgia (1979-1998). *Mar. Mammal Sci.* 15(4): 1,287-302.

Morin, P.A., Martien, K.K., Archer, F.I., Cipriano, F., Steel, D., Jackson, J. and Taylor, B.L. 2010. Applied conservation genetics and the need for quality control and reporting of genetic data used in fisheries and wildlife management. *J. Heredity* 101(1): 1-10.

Murphy, E.J., Trathan, P.N., Watkins, J.L., Reid, K., Meredith, M.P., Forcada, J., Thorpe, S.E., Johnston, N.M. and Rothery, P. 2007. Climatically driven fluctuations in Southern Ocean ecosystems. *Proceedings of the Royal Society B* 274: 3057-67.

Nicol, S. and Foster, J. 2012. The fishery for Antarctic krill – recent developments. *Fish Fish*. 13: 30-40.

Oliveira, L.R., Ott, P.H., Flores, P.A.C., Siciliano, S., Santos de Almeida, R. and Bonatto, S.L. 2009. First molecular estimate of sex ratio of southern right whale calves, *Eubalaena australis*, for Brazilian waters. *J. Mar. Biol. Ass. UK*. 89(5): 1,003-07.

Patenaude, N.J. 2003. Sightings of southern right whales around 'mainland' New Zealand. Science for Conservation Series 225: 1-37. [Available from: New Zealand Department of Conservation, PO Box 10-420].

Patenaude, N., Baker, C.S. and Gales, N.J. 1998. Observations of southern right whales on New Zealand's sub-Antarctic wintering grounds. *Mar. Mammal Sci.* 14(2): 350-55.

Patenaude, N., Portway, V., Schaeff, C., Bannister, J.L., Best, P.B., Payne, R.S., Rowntree, V., Rivarola, M. and Baker, C.S. 2007. Mitochondrial DNA diversity and population structure among southern right whales (*Eubalaena australis*). *J. Hered*. 98(2): 147-57.

Patenaude, N.J. and Baker, C.S. 2001. Population status and habitat use of southern right whales in the sub-Antarctic Auckland Islands of New Zealand. *J. Cetacean Res. Manage.* (special issue) 2: 111-16.

Patenaude, N.J. and Harcourt, R. 2006. Australia's southern right whales show stock differentiation. Final report to the Deaprtment of Environment and Heritage, Macquarie University, Sydney.

Payne, R. 1986. Long term behavioral studies of the southern right whale (*Eubalaena australis*). *Rep. int. Whal. Commn* (special issue) 10: 161-67.

Payne, R., Rowntree, V., Perkins, J.S., Cooke, J.G. and Lankester, K. 1990. Population size, trends and reproductive parameters of right whales (*Eubalaena australis*) off Peninsula Valdes, Argentina. *Rep. int. Whal. Commn* (special issue) 12: 271-78.

Píngaro, R.G., Juri, E., Le Bas, A., Bianco, J., Ortiz, J. and Palazzo, J.T., Jr. 2010. Records of collisions between large vessels and southern right whales (*Eubalaena australis*) in Uruguayan waters, 2003-2007. Paper SC/62/BC2 presented to the IWC Scientific Committee, June 2010, Agadir, Morocco (unpublished). 7pp. [Paper available from the Office of this Journal].

Postma, M., Wege, M., Bester, M.N., van der Merwe, D.S. and de Bruyn, P.J.N. 2011. Inshore occurrence of southern right whales (*Eubalaena australis*) at Subantarctic Marion Island. *African Zoology* 46(1): 188-93.

Pradel, R. 1996. Utilization of capture-mark-recapture for the study of recruitment and population growth rate. *Biometrics* 52: 703-09.

Rosenbaum, H.C., Brownell Jr, R.L., Brown, M.W., Schaeff, C., Portway, V., White, B.N., Malik, S., Pastene, L.A., Patenaude, N.J., Baker, C.S., Goto, M., Best, P.B., Clapham, P.J., Hamilton, P., Moore, M., Payne, R., Rowntree, V., Tynan, C.T. and DeSalle, R. 2000. Worldwide genetic differentiation of *Eubalaena*: questioning the number of right whale species. *Mol. Ecol.* 9(11): 1793-802.

Rosenbaum, H.C., Razafindrakoto, Y., Vahoavy, J. and Pomilla, C. 2001. A note on recent sightings of southern right whales (*Eubalaena australis*) along the east coast of Madagascar. *J. Cetacean Res. Manage.* (special issue) 2: 177-80.

Rowntree, V.J., Payne, R. and Schell, D.M. 2001. Changing patterns of habitat use by southern right whales (*Eubalaena australis*) on their nursery ground at Península Valdés, Argentina, and in their long-range movements. *J. Cetacean Res. Manage.* (special issue) 2: 133-43.

Rowntree, V.J., Valenzuela, L.O., Franco Fraguas, P. and Seger, J. 2008. Foraging behaviour of southern right whales (*Eubalaena australis*) inferred from variation of carbon stable isotope ratios in their baleen. Paper SC/60/BRG23 presented to the IWC Scientific Committee, June 2008, Santiago, Chile (unpublished). 10pp. [Paper available from the Office of the IWC].

Santos, M., Siciliano, S., Castro Vincente, A.F., Alvarenga, F., Zampirolli, E., Pacheco de Souza, S. and Maranho, A. 2010. Cetacean records along Sao Paulo state coast, southeastern Brazil. *Brazilian Journal of Oceanography* 58(2): 123-42.

Schaeff, C.M., Best, P.B., Rowntree, V.J., Payne, R., Jarvis, C. and Portway, V.A. 1999. Dorsal skin color patterns among southern right whales (*Eubalaena australis*): Genetic basis and evolutionary significance. *J. Hered.* 90(4): 464-71.

Starbuck, A. 1878. History of the American whale fishery from its earliest inception to the year 1876. Appendix A. pp.1-768+6pls. Report of the US Commissioner of Fish and Fisheries, Part 4, 1875-76. Government Printing Office, Washington, D.C. [Reprinted in 1964 in two volumes by Argosy Antiquarian Ltd, New York].

Stewart, R. and Todd, B. 2001. A note on observations of southern right whales at Campbell Island, New Zealand. *J. Cetacean Res. Manage.* (special issue) 2: 117-20.

Tormosov, D.D., Mikhalev, Y.A., Best, P.B., Zemsky, V.A., Sekiguchi, K. and Brownell Jr, R.L. 1998. Soviet catches of southern right whales, *Eubalaena australis*, 1951-1971; biological data and conservation implications. *Biol. Conserv*. 86(2): 185-97.

Townsend, C.H. 1935. The distribution of certain whales as shown by logbook records of American whaleships. *Zoologica* (NY) 19(1-2): 1-50+6 maps.

Trathan, P.N., Forcada, J. and Murphy, E.J. 2007. Environmental forcing and Southern Ocean marine predator populations: effects of climate change and variability. *Phil. Trans. R. Soc. B*. 362: 2351-65.

Valenzuela, L.O., Sironi, M., Rowntree, V.J., La Sala, L., Pozzi, L., Mohamed, N., Musmeci, L., Andrejuk, J., Uhart, M., Chirife, A., Maron, C. and Seger, J. 2010. Population genetic structure of live and dead southern right whales (*Eubalaena australis*) off Península Valdés, Argentina. Paper SC/62/BRG15 presented to the IWC Scientific Committee, June 2010, Agadir, Morocco (unpublished). 12pp. [Paper available from the Office of this Journal].

Valenzuela, L.O., Sironi, M., Rowntree, V.J. and Seger, J. 2009. Isotopic and genetic evidence for culturally inherited site fidelity to feeding grounds in southern right whales (*Eubalaena australis*). *Mol. Ecol.* 18(5): 782-79.

Van Waerebeek, K., Baker, A.N., Félix, F., Gedamke, J., Iñiguez, M., Sanino, P.G., Secchi, E., Sutaria, D., van Helden, A. and Wang, Y. 2007. Vessel collisions with small cetaceans worldwide and with large whales in the Southern Hemisphere; an initial assessment. *LAJAM* 6(1): 43-69.

White, G.C. and Burnham, K.P. 1999. Program MARK: Survival estimation from populations of marked animals. *Bird Study* 46(Supplement): 120-38.

Annex A

List of Participants

C. Scott Baker
John Bannister
Somena Belgrano
Nadia Boscarol
Bob Brownell
Steve Burnell
Doug Butterworth
Emma Carroll
Simon Childerhouse
Justin Cooke
Enrique A Crespo
Greg Donovan
Fernando Félix
Barbara Galletti
Karina Groch
Guillermo Harris
Gavin Hinten
Miguel Iñíguez
Ana Matanollo
Ingrid Peters
Randy Reeves
Frederico Reit
Vicky Rowntree
Mariano Sironi
Peter Thomas
Luciano Valenzuela
Els Vermeulen
Santiago Villalba

Annex B

Agenda

1. Introductory items
2. Population identity
    - 2.1 Distribution
    - 2.2 Movements (telemetry, photo-identification and genetics)
    - 2.3 Genetic differentiation
    - 2.4 Other (geochemical markers)
    - 2.5 Conclusions on population structure and information needs
3. Removals
    - 3.1 Direct catches (incl. struck-and-lost)
    - 3.2 Incidental catches
    - 3.3 Ship strikes
4. Biological parameters
    - 4.1 Reproduction
    - 4.2 Survivorship (including die-offs)
    - 4.3 Other
5. Status
    - 5.1 Population modelling approaches
    - 5.2 Genetic diversity and N_{min}
    - 5.3 Historic population size
    - 5.4 Present abundance
    - 5.5 Trends in abundance
6. Factors that may affect recovery
    - 6.1 Direct removals
    - 6.2 Factors affecting population trends
7. Recommendations
    - 7.1 Research related
        - 7.1.1 Population structure and stock identity
    - 7.2 Outlines for CMPs where appropriate
8. Publication
9. Any other business
10. Adoption of Report

Annex C

List of Documents

SC/S11/RW

1. Belgrano, J., De Haro, C., Gribaudo, C., Tossenberger, V. and Iñíguez, M. The occurrence of southern right whales (*Eubalaena australis*) in Santa Cruz, Patagonia, Argentina (1986-2003). 9pp.
2. Rowntree, V., Uhart, M., Sironi, M., Chirife, A., La Sala, L., Pozzi, L., Musmeci, L., Mohamed, N., Andrejuk, J., Sala, J.E., Carribero, A., Franco, M., Seger, J., Brownell Jr, R.L. and Rowles, T. Mortalities of right whales (*Eubalaena australis*) at Península Valdés between 1971 and 2010: recent increases and their possible causes. 22pp.
3. Valenzuela, L.O., Sironi, M., Seger, J. and Rowntree, V. Genetic population structure of Patagonian right whales and assessment of foraging strategies by stable isotope analysis. 21pp.
4. Crespo, E.A., Pedraza, S.N., Dans, S.L., Coscarella, M., Svendsen, G. and Degrati, M. Number of southern right whales *Eubalaena australis* and population trend in the neighbourhood of Península Valdés during the period 1999-2011 by means of aerial and boat surveys. 15pp.
5. No paper.
6. No paper.
7. Fraguas, P.F., Costa, P., Severova, V. and Calliari, D. Occurrence of southern right whale (*Eubalaena australis*) in Uruguayan Atlantic coast related to environmental conditions. 15pp.
8. Jorge, G., Riet-Sapriza, F. and Costa, P. Status and behaviour of southern right whales (*Eubalaena australis*) in the Uruguayan Atlantic coast. 16pp.
9. Riet-Sapriza, F., Jimenez, E., Jorge, G. and Costa, P. Utilization distribution of southern right whales *Eubalaena australis* off the coast of Uruguay. 10pp.
10. Bannister, J. Population trend in right whales off southern Australia 1993-2010. 8pp.
11. Peters, I.T., Best, P.B. and Thornton, M. Abundance estimates of right whales on a feeding ground off the west coast of South Africa. 7pp.
12. Peters, I.T., Best, P.B., Pastene, L.A. and Matsuoka, K. Development of a Southern Ocean right whale photo-identification catalogue. 3pp.
13. Best, P.B. and Peters, I.T. Linkages between right whales in South African waters and the Southern Ocean. 7pp.
14. Best, P.B., Meyer, M.A., Kotze, D., Hofmeyer, G.J.G. and Thornton, M. Mortalities of right whales in South African waters and associated factors (excluding entanglement), 1999-2010. 14pp.
15. Best, P.B. Review of aerial photo-identification surveys for right whales off South Africa, 1979-2010. 20pp.
16. Roux, J.P., Braby, R. and Best, P.B. Southern right whales off Namibia and their relationship with those off South Africa. 6pp.
17. Banks, A., Best, P., Gullan, A., Guissamulo, A., Cockcroft, V. and Findlay, K. Recent sightings of southern right whales in Mozambique. 21pp.
18. Brandão, A., Best, P.B. and Butterworth, D.S. Monitoring the recovery of the southern right whale in South African waters. 18pp.
19. No paper.
20. Carroll, E.L., Childerhouse, S., Fewster, R.M., Patenaude, N., Steel, D., Dunshea, G., Boren, L. and Baker, C.S. Updated abundance and estimate of rate of increase for the New Zealand southern right whale. 20pp.
21. Félix, F. and Escobar, G. Efforts in developing spatial planning analysis for the southeast Pacific right whale (*Eubalaena australis*). 7pp.
22. Vernazzani, B.G., Brito, J.L., Cabrera, E., Cardenas, J.C. and Brownell, R.L., Jr. Sightings of southern right whales (*Eubalaena australis*) off Chile and Peru from 1975 to 2010. 12pp.
23. Belgrano, J., Kröhling, F., Arcucci, D. and Iñíguez, M. Southern right whale photo-identification catalogue in Golfo San Jorge, Santa Cruz, Argentina (2007-2010). 6pp.
24. Rowntree, V., Uhart, M., Sironi, M., Chirife, A., La Sala, L., Pozzi, L., Musmeci, L., Mohamed, N., Andrejuk, J., Sala, J.E., Carribero, A., Franco, M., Seger, J., Brownell Jr, R.L. and Rowles, T. High mortalities of southern right whales (*Eubalaena australis*) on their nursery ground at Península Valdés, Argentina. 22pp.
25. Ott, P.H., Flores, P.A.C., Freitas, T.R.O. and White, B.N. Genetic diversity and population structure of southern right whales, *Eubalaena australis*, from the Atlantic coast of South America. 7pp.
26. De Oliveira, L.R., Ott, P.H., Grazziotin, F.G., White, B. and Bonatto, S. Effective population size and bottleneck signals in the Atlantic population of the southern right whale. 7pp.
27. Groch, K.A. and Flores, P.A.C. Census of southern right whales off Brazil. 5pp.
28. Groch, K.R., Correa, A.A., Da Rocha, M.E.C., Serafini, P.P., Moreira, L.M.d.P., Da Silva, R.d.R. and Flores, P.A.C. Right whales strandings off Santa Catarina State, southern Brazil, 2002-2010. 6pp.
29. Butterworth, D.S., Brandão, A., Müller, A. and Best, P.B. Preliminary results for a photo-identification-based assessment of southern right whales in South African waters. 8pp.
30. Goodall, R.N.P., Benegas, L.G., Bellabianca, N., Ricci-aldelli, L. and Pimper, L.E. The presence of southern right whales off eastern Tierra del Fuego, 1987-2011. 7pp.

Annex D

Southwest Atlantic right whales: interim updated population assessment from photo-id collected at Península Valdéz, Argentina

Justin Cooke

Photo-id data have been collected each winter in the southern right whale calving ground at Península Valdéz, Argentina from 1971 to the present. The nature of the data and collection method are described by Payne *et al.* (1990). This appendix provides an update of the analysis by Cooke *et al.* (2001; 2003) using data collected from 1971-2010. In order to be able to fit the increase in frequency of 2-year calving intervals observed in recent years, the population model was modified to allow for inter-annual variation in all transition probabilities between reproductive classes (parameters α, β and γ defined in Cooke *et al.*, 2003: in the 2003 analysis only γ was allowed to vary). This Appendix provides an interim update for the purpose of updating the entries in the hemisphere-wide summary provided in Table 3. A more in-depth analysis of these data is in progress.

Parameter	Estimate	SE
Mean age at first parturition (yr)	8.4	0.4
Calf survival (to 1st parturition)	0.83	0.04
Annual breeding (parous) female survival rate	0.976	0.003
Population numbers in 2010:		
Calves	319	44
Breeding (parous) females	1,074	44
Females 1+	1,963	113
Total population (assuming 50:50 sex ratio)	4,245	245
Average annual rate of increase (%) in 1+ population, 2000-10	6.2	0.3

REFERENCES

Cooke, J.G., Rowntree, V., Payne, R. 2001. Estimates of demographic parameters for southern right whales (*Eubalaena australis*) observed off Península Valdés, Argentina. *J. Cetacean Res. Manage* (special issue) 2:125-132.

Cooke, J.G., Rowntree, V., Payne, R. 2003. Analysis of inter-annual variation in reproductive success of South Atlantic right whales (*Eubalaena australis*) from photo-identifications of calving females observed off Península Valdés, Argentina, during 1971-2000. Paper SC/55/O23 presented to the IWC Scientific Committee, Berlin, May 2003 (unpublished). 16pp. [Paper available from the Office if this Journal].

Payne, R., Rowntree, V., Perkins, J., Cooke, J.G., and Lankester, K. 1990. Population size, trends and reproductive parameters of right whales (*Eubalaena australis*) off Península Valdés, Argentina. *Rep. int. Whal. Commn* (special issue 12):271-78.