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## Editorial

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Welcome to this volume, the third Special Issue of the *Journal of Cetacean Research and Management*. Special Issues are published from time to time and focus on specific topics. The first and second issues in this series were dedicated to, respectively, Chemical Pollution and Cetaceans (Reijnders *et al.*, 1999) and the Worldwide Status of Right Whales (Best *et al.*, 2001). This issue reports on the status of Southern Hemisphere humpback whales.

The humpback whale (*Megaptera novaeangliae*) is perhaps the most easily recognised cetacean due to its extremely long wing-like pectoral fins, the characteristic shape of the dorsal fin and the presence of many tubercles on the head and flippers. The species is widely distributed in all major oceans including polar, temperate and tropical areas. Most populations migrate between high latitude summer feeding grounds and tropical winter breeding and nursery grounds. Although trans-equatorial movement has been observed for Southern Hemisphere populations (e.g. Pacific coast of Central America), such exchange between populations of the hemispheres is thought to be generally restricted by the 6-month difference in their breeding seasons. As much of the global habitat of humpback whales includes populated coastlines, they have become the modern icon of the whalewatching industry. Their inquisitive nature, large size and spectacular behaviour, which often includes breaching, have helped this expanding industry develop into a multi-billion dollar business.

Historically, humpback whales were commercially important for other reasons. They were a target of open-boat, coastal whalers in the nineteenth century, but it was only after the development of more mechanised forms of whaling (also known as 'modern whaling') that the species became the main target of the industry (Tønnessen and Johnsen, 1982). In the Southern Hemisphere, exploitation initially occurred in the early 1900s in coastal areas both in high (e.g. the Antarctic Peninsula and South Georgia) and low (e.g. southern Africa and east and west Australia) latitudes but expanded to pelagic areas primarily after the mid 1920s. In October 1963, the International Whaling Commission protected Southern Hemisphere humpback whales from whaling, but illegal whaling continued thereafter until the early 1970s (Yablokov, 1995). At the time of protection many of the Southern Ocean populations were extremely small. Approximately 210,000 Southern Hemisphere humpback whales were killed by commercial whaling in the twentieth century (Findlay, 2001; IWC catch database).

In 1982, the IWC agreed on a cessation of all commercial whaling (commonly known as 'the moratorium'), to take effect from 1986. As part of the decision it also agreed that it would undertake a 'comprehensive assessment' of the moratorium on whale stocks, although it did not define what this meant at the time (Donovan, 1989). The 'comprehensive assessment' was eventually defined by the Scientific Committee as an in-depth evaluation of the status of all whale stocks in the light of management objectives and procedures. It included the examination of: current stock size, recent population trends, carrying capacity and productivity. Of course to do this requires knowledge of population structure and an evaluation of status requires knowledge of the pre-exploitation abundance of the populations. The latter is obtained using population dynamics models in conjunction with the historic catch record (Donovan, 1989). Subsequently, the Committee has been undertaking Comprehensive Assessments (or in-depth assessments) of a variety of species/populations, often, but not always, as a prelude to the *Implementation* process for the Revised Management Procedure.

The Comprehensive Assessment of Southern Hemisphere

humpback whales has been on the agenda of the IWC Scientific Committee for many years. At its 1997 meeting, the Committee recognised seven Breeding Stocks (labelled A to G) in the coastal waters of the east coast of South America (A), the west coast of southern Africa (B), the east coast of Africa (C), the west coast of Australia (D), the east coast of Australia and the western Pacific Islands (E), the central south Pacific Islands (F) and the west coast of South America (G), and feeding destinations associated with these stocks (IWC, 1998). In addition, an eighth population in the northern Indian Ocean, then named Breeding Stock X and now referred to as the 'Arabian Sea Population', was grouped with the Southern Hemisphere for assessment purposes. Progress had been made on various fronts (e.g. new estimates of abundance and rates of increase were made available for many stocks) after the 1997 meeting, but the assessment was hampered primarily because a reconciled catch series was still needed (IWC, 1997; 1998). Preliminary assessments were conducted between 2000 and 2002 and again in 2004 (IWC, 2001, 2002, 2003, 2005) and their results led to the development of improved catch series and the collection of information on abundance, trends and stock structure that could be used in an full assessment. At the 2005 meeting, the Scientific Committee agreed that it was in a position to initiate the full assessment of Southern Hemisphere humpback whales.

An International Symposium and Workshop on Southern Hemisphere humpback whales was held in Hobart, Tasmania, from 4 to 7 April 2006 under the auspices of the IWC (IWC, 2011a). The meeting was organised by Nick Gales and colleagues from the Australian Antarctic Division, with assistance of Alex Zerbin, Ken Findlay and John Bannister, and was chaired by John Bannister. The meeting attracted 36 scientists from Africa, Asia, Europe, North and South America, and Oceania. Scientists with experience in the assessment of North Atlantic humpback whales (IWC, 2002) also participated.

The goals of the Workshop were to: (1) review the abundance, population structure and status of southern humpback whale breeding stocks and their relationship with feeding grounds in the Southern Oceans; and (2) advance the Comprehensive Assessment of these stocks to near completion using the best available data. A total of 69 papers presented results from recent research on distribution, movements, stock structure, abundance, trends in abundance, estimation of life-history parameters and catch data for Southern Hemisphere humpback whales in their breeding and feeding grounds, or in migratory corridors. Early in the meeting, it became clear that due to the complexity of the stock structure of Breeding Stocks B, C, E and F there were insufficient data to perform an assessment of these stocks and of the Arabian Sea population. Therefore discussion was focused on input data and population dynamic model structure for those stocks (A, D and G) for which an assessment could be conducted at the following IWC annual meeting in St. Kitts and Nevis (i.e. in June 2006). The Workshop also made a number of recommendations for additional data collection and analysis, particularly in relation to improving understanding of stock structure and feeding ground distribution so that catches could be allocated to appropriate populations (IWC, 2011a).

The assessment of Breeding Stocks A, D and G was completed at the end of the IWC annual meeting in 2006 (IWC, 2007). The availability of an absolute abundance estimate for Breeding Stock A (eastern South America), along with data on population trend and relatively unambiguous catch allocations, meant that this assessment was judged by the Committee to be the most precise. The Committee concluded that this population was at nearly 30% of its pre-exploitation size. Breeding Stock D (Western Australia) was estimated to be at 70–80% of pre-

exploitation abundance. While estimates of trend and total population size were also available for this stock, inference on current status was possibly influenced by greater uncertainty in catch allocation due to mixing with Breeding Stock E in the Antarctic. Finally, the status of Breeding Stock G (western South America) was much less certain (point estimates varied between 30 and 70% of pre-exploitation size) due in large part to lack of trend information on the breeding grounds and uncertainty in stock structure.

After the completion of the assessment of Breeding Stocks A, D and G, the Committee spent five years (2007–2011) reviewing information and methods required to conduct an assessment of the African humpback whale populations (stocks B and C). The stock structure on these breeding grounds was more complex and allocation of feeding ground catches to the sub-components of the breeding stocks was confounded with very limited movement and mixing data. The Committee concluded that there were at least two genetically distinct populations (referred to as sub-stocks B1 and B2) within the range of Breeding Stock B (western Africa), with partially overlapping distributions in migratory routes and feeding grounds. Because existing data were insufficient to clarify the degree of overlap or mixing of these two sub-stocks, the SC conducted their assessments with both a single and a two-stock model. The former estimated that Breeding Stock B has probably recovered to about half of its pre-exploitation size, but substantial uncertainty was associated with this estimate (IWC, 2011b). The two-stock model suggested that sub-stock B2 was more depleted than sub-stock B1, but it was not possible to assess whether this difference was real or whether this was caused because incomplete sampling coverage precluded an accurate estimation of the population size in sub-stock B2 (IWC, 2011b). The Committee concluded that there could be as many as four sub-stocks within the range of Breeding Stock C (named sub-stocks C1–4; IWC, 2006, 2009) and that data were available to conduct assessments only for sub-stocks C1 (the east African mainland coast) and C3 (Madagascar) (IWC, 2009). Population dynamics modelling suggested that these sub-stocks had recovered to nearly 65–98% (C1) and 76–83% (C3) of their pre-exploitation abundances (IWC, 2010).

With the completion of the assessment of the African stocks, the Committee has turned its attention to Oceania, (Breeding Stocks E [Eastern Australia] and F [South Pacific Islands]). Assessments for these populations will be completed over the next few years.

All of the assessments, at the level of the individual breeding stocks, are compromised to some degree by the paucity of empirical data on which to model mixing patterns. In all likelihood, the nature and extent of mixing will be highly influenced by factors including population density (stage of recovery), environmental variability, and relative density and recovery of other krill predators. Thus historic data derived from Discovery marks and contemporary data acquired from satellite tracking, photo-identification, or genetics may signal very different and potentially highly variable mixing patterns. A circumpolar model, considering all stocks in combination may provide a more precise estimate of the overall status of Southern Hemisphere humpback whales. Whatever approach is taken, it is clear that a great deal remains to be learned about this species in the Southern Hemisphere.

What is evident is that most of the populations have responded extremely well to the protection afforded by the IWC since 1963. Over the next decade we may see a substantial number of the populations return to their estimated pre-whaling abundance. That being said, other populations, such as those around Fiji and the Arabian Sea remain small and highly vulnerable to environmental perturbation or anthropogenic activities.

The overall Comprehensive Assessment, and the eventual recovery patterns of the populations, may also provide a unique insight into how the Southern Ocean ecosystems have changed over the past century. During this period, humpback whales and many other whale and seal populations have moved from high abundance, to near absence and are now on differential recovery

trajectories. This volume is an important ‘stock take’ along these recovery trajectories.

This Special Issue of the *Journal of Cetacean Research and Management* contains the Report of the Workshop in Hobart and peer-reviewed papers, many of which were originally presented to the Workshop and have since been updated. The papers are arranged in a section about general biology and feeding grounds, followed by sections specific to each breeding stock. These papers in large part represent our current state of knowledge on the status of Southern Hemisphere humpback whales.

The editors acknowledge the many colleagues who undertook the review of the papers submitted for publication in this volume. Manuscript review is a time-consuming task, but it is also vital for maintaining the high quality of the work published by this Journal. Reviewers included Scott Baker, John Bannister, Jay Barlow, Peter Best, David Borchers, Trevor Branch, John Brandon, Mark Bravington, Phil Hammond, Jeff Breiwick, Doug Butterworth, Carole Carlson, Justin Cooke, Greg Donovan, Jaume Forcada, Phil Hammond, Scott Kraus, Jeff Laake, Jack Lawson, Christina Lockyer, Tony Martin, David Matilla, Sally Mizroch, Simon Northridge, Charles Paxton, André Punt, Steve Reilly, Jooke Robbins, Vicky Rowntree, Len Thomas, Koen Van Waerebeek, Paul Wade, Hal Whitehead, Judy Zeh and Alex Zerbini.

The Editors also acknowledge the support provided to the Workshop in Hobart by the Government of Australia, by the organising personnel at the Australian Antarctic Division and by the Commission’s administrative and publications staff, especially Andrea Cooke, Stella Duff, Jemma Jones, Helen Sharp and Elaine Shield. Their support led to the successful outcome of the Workshop as well as for the publication of this volume.

This Special Issue is dedicated to the memory of Dr. Geoff Kirkwood. Dr. Kirkwood was one of the primary leaders in the field of population modelling within the IWC Scientific Committee and a former Chair of the Revised Management Procedure Working Group and of the IWC Scientific Committee.

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Alex Zerbini, Greg Donovan

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