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Contribution of JARPA to the management and conservation of large baleen whales

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INTRODUCTION

The Japanese Whale Research Program under Special Permit in the Antarctic (JARPA) started with two feasibility surveys in the austral summer seasons 1987/88 and 1988/89 under the Article VIII of the International Convention for Regulation of Whaling. The full research program started in 1989/90 and was completed in 2004/05.

The two original research objectives of JARPA were the following:

(1) Estimation of biological parameters to improve the stock management of the Southern Hemisphere minke whale, and
(2) Elucidation of the role of whales in the Antarctic marine ecosystem.

Subsequently, as part of the natural evolution of the program and in response to developing requirements, two further objectives were added:

(3) Elucidation of the effect of environmental changes on cetaceans, and
(4) Elucidation of the stock structure of the Southern Hemisphere minke whales to improve stock management.

Objective (1) of JARPA was the main one and it was established considering the data required by the New Management Procedure (NMP), the procedure to manage commercial whaling used by the International Whaling Commission (IWC) until the adoption of the moratoria. Biological parameters related to growth such as birth rate, natural mortality and age at sexual maturity, were required under the NMP to establish catch limits. The IWC Scientific Committee (SC) completed the Revised Management Procedure (RMP) in 1992. Unlike the NMP this procedure needs only reliable and periodic data on population abundance and accurate catch data. The question was whether or not information provided by JARPA could still providing important information for management of baleen whales under the RMP. To respond to this question it is necessary to explain about the *Implementation Simulation Trials* (*ISTs*), which is one of the major works of the RMP.

The *ISTs* are conducted to guarantee the performance of RMP prior to the actual application of RMP to calculate a catch limit of whales for commercial purposes. The *ISTs* showed satisfactory robustness under a wide variety of simulations test when applied to a model of a single isolated baleen whale stock. However it is important to

investigate how this robustness is maintained in situations of multiple stocks and mixing, and this is investigated through the *ISTs*. The main purpose of the *ISTs* then is to allow a sustainable exploitation of whale resources by avoiding depletion of individuals stocks. The *ISTs* are specific to species/areas. Therefore the hypotheses on stock structure and their plausibility are important, as those are the basis for the establishment of *Small Areas*, on which catch limits are calculated.

Although the *ISTs* are based on 100-years projection periods the RMP includes the requirements that *Implementation Reviews* be conducted every 5 years. The aim of such review is to check that research conducted since the original Implementation does not reveal that hypotheses used in previous *ISTs* were not sufficiently broad to encompass reality or are not longer considered plausible (Punt and Donovan, 2007).

JARPA objective (4) on stock structure above can provide important information if the IWC decides to conduct an *Implementation Review* for Antarctic minke whales under the RMP. It is also considered that biological parameters calculated under objective (1) were still being useful in the context of the RMP. For example MSYR data is important for the *ISTs*, and this parameter can be estimated based on catch at age data obtained by JARPA. In more general terms biological parameters are still being useful to understand the population dynamics of Antarctic minke whales, and therefore important for the management of whale resources.

The JARPA has also provided information useful for management and conservation on other large whale species that are not target of the RMP. For example JARPA has conducted systematic sighting surveys and data obtained in these surveys have been used to estimate abundance in large whale species. Because sighting surveys are conducted in different years in a same area, abundance information can be used to investigate the abundance trends of species that were heavily exploited in the past. JARPA has also collected biopsy samples from these large whales, which have been used in DNA studies on stock structure. Information on stock structure is important for an adequate interpretation of abundance and abundance trends.

Data collected and results obtained under the JARPA program were reviewed by the IWC/SC in a workshop held in December 2006 (IWC, 2007). The objective of this paper is to summarize the information collected by JARPA that is, or can be, useful for management. This is summarized for both information collected from the Antarctic minke whale useful for the RMP e.g. information collected under Objectives (1) and (4) (stock structure; abundance estimates; MSYR and other biological parameters), and information collected from other large whale species that are not target of the RMP (stock structure and abundance of humpback whales). This information was presented and discussed at the IWC JARPA review workshop (IWC, 2007).

Results of JARPA related to Objectives (2) and (3) and their implications for management are given in separate papers.

RESULTS

Stock structure of Antarctic minke whale
The IWC/SC conducted a comprehensive assessment of the Antarctic minke whales in 1990. On that opportunity genetic and non-genetic analyses on stock structure based on

samples and data from past commercial whaling were presented. These analyses failed to detect unambiguously any biological stock of the Antarctic minke whale in the Antarctic feeding grounds.

The implication of this for management was that the SC in 1993 "agreed that for *Small Areas*, as defined in the Draft Specifications for the calculation of Catch Limits in a RMP for baleen whales, 10 degree longitudinal sectors represented the best present option although this might require revision as more information is obtained".

The total JARPA samples obtained in the Antarctic feeding grounds of Areas IIIE, IV, V and VIW were used in genetic (mitochondrial DNA and microsatellites) and non-genetic (biological parameters and morphometric) analyses on stock structure. Results were presented to the JARPA review workshop and the conclusion of the workshop was as follow: "Based on the analyses of the genetics and morphometric data presented, it agreed that there at least two stocks of Antarctic minke whales present in the JARPA research area. The data also suggest an area of transition in the region around 150º-160 ºE across which there is an as yet undetermined level and range of mixing" (IWC, 2007). The review workshop recommended several additional analyses to refine this hypothesis.

Therefore JARPA has established a plausible hypothesis on stock structure in the JARPA research area based on a new and comprehensive data set. It is clear that the new information do not support the *Small Areas* definition of 10 degree longitudinal sectors agreed by the SC in 1993. Based on the results by JARPA this definition of *Small Areas* in the Antarctic should be revised if the IWC decides to conduct an *Implementation Review* of this resource under the RMP.

Abundance estimates of Antarctic minke whale
Abundance estimation of Antarctic minke whale was made based on sighting data obtained by JARPA in 16 austral summer seasons. Results were presented for Areas IV and V as well for the two stocks hypothesis presented to the review workshop. There is no agreement yet on the abundance of Antarctic minke whales in the JARPA research area. The review workshop recognized that considerable progress has been made in addressing the issues related to abundance and trends and provided that the recommendations offered in the workshop are followed, the SC should soon be able to agree estimates. The abundance estimates will be valuable for any future *Implementation Review* under the RMP (IWC, 2007).

MSYR and other biological parameters estimates for Antarctic minke whale
Estimations on several biological parameters were presented to the review workshop according to the two stock hypothesis presented at the review meeting. These parameters were length and age at sexual maturity, length and age at physical maturity, size at age (i.e. generation of a growth curve), percentage of matured females pregnant, foetal sex ratio (male %) and mean litter size. All these parameters are important for models of population dynamics.

JARPA also provided estimates of natural mortality using two different approaches. The confidence intervals of natural mortality obtained by one of these approaches spanned a wide range (e.g. it had low precision). The other approach (ADAP-VPA) spanned a narrower confidence interval but this estimation relied in part on commercial age data

where some problems were identified (IWC, 2007). This later approach also provided estimations of MSYR according to the stock hypothesis presented to the review workshop. However these estimations also relied in part on the commercial age data.

Stock structure of the humpback whale
JARPA has obtained a substantial number of biopsy samples of humpback whales, which has been used in genetic analyses on stock structure based on mtDNA and microsatellites. The analysis involved a total of 411 samples. Results suggested that humpback whales in Areas IIIE, IV, V and VIW belong to different stocks. The review workshop welcomed this study and suggested that DNA data in the feeding ground should be analyzed together with available DNA data from the breeding grounds.

Abundance estimates of humpback and other large whale species
Systematic sighting surveys conducted under JARPA have allowed the estimation of abundance and trends in other large whale species such as humpback, fin and blue whales. The review workshop agreed that a large dataset on distribution and abundance for these species has been accumulated by sighting surveys conducted under JARPA. Regarding humpback whales the review workshop agreed that the abundance estimates provided represented useful steps forward in working towards acceptable estimates of abundance (IWC, 2007)

CONCLUSIONS

JARPA has generated extensive data that has contributed or potentially can contribute for management and conservation of Antarctic minke and other large whale species in the research area.

The IWC review workshop agreed that "The results from the JARPA program, while not required under the RMP, have the potential to improve management of minke whales in the Southern Hemisphere in the following ways: (1) reductions in the current set of plausible scenarios considered in *ISTs*; and (2) identification of new scenarios to which future *ISTs* will have to be developed (e.g. the temporal component of stock structure). The results of analyses of JARPA could be used in this way perhaps to increase the allowed catch of minke whales in the Southern Hemisphere, without increasing depletion risk above the level indicated by the existing *ISTs* of the RMP for these minke whales" (IWC, 2007).

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