

Review of JARPA research objectives and update of the work related to JARPA tasks derived from the 1997 SC meeting

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ABSTRACT

The Government of Japan conducted the JARPA survey since the 1987/88 austral summer season under the Article VIII of the International Convention for Regulation of Whaling, as a long-term project. The last survey of the JARPA was completed in the 2004/05 season. With the progress of the JARPA, the objectives of the project evolved from two in the original plan to four after the 1995/96 season. These additional objectives were not an alteration of the original plan, but rather were a development of the original plan. The IWC Scientific Committee held a midterm workshop in 1997 to review JARPA data and results. During its 1997 Annual Meeting, the Scientific Committee discussed the report of the workshop and identified several future tasks to be addressed in the program. A reasonable progress was made on most of these tasks.

KEYWORDS: Scientific Permits, Antarctic, Antarctic minke whale

INTRODUCTION

The Japanese Whale Research Program under Special Permit (JARPA) was started in 1987/88 under a special permit issued by the Government of Japan based on the Article VIII of the International Convention for the Regulation of Whaling (ICRW). JARPA was a long-term research program and was completed at the 2004/05 austral summer season.

Two pillars of objectives were created for the JARPA project in 1987 (Government of Japan, 1987a), and they had evolved since then. The development of these objectives was described by Ohsumi (1997). This paper review briefly the objectives of JARPA project based mainly on Ohsumi (1997).

At the midpoint of the JARPA, the IWC Scientific Committee (SC) held a workshop to review data and results from JARPA in May 1997 (IWC, 1998a). During the 1997 SC Meeting, results of the workshop were discussed and several tasks were identified to address outstanding issues (IWC, 1998b). Furthermore in 2006 the SC made some additional requests regarding JARPA survey design and abundance estimation of both Antarctic minke and humpback whales (IWC, 2006). Progresses on these tasks are reported in this paper.

BACKGROUND OF THE JARPA PROJECT

Major disputes had continued in the SC during years from late 1970s to middle 1980s over the certainty of biological knowledge and research methods of whale populations. The IWC adopted the moratorium of the commercial whaling, which came into effect from the 1985/86 season, at the 34th Annual Meeting in 1982 based on the alleged grounds that the scientific knowledge was uncertain and therefore an effective management was not possible. However, the SC did not recommend such a moratorium at that time.

Every member country of ICRW has a duty to undertake scientific research in order to achieve the objectives of ICRW which are to “ensure proper conservation and optimum utilization of the great natural and renewable resources represented by whale stocks”. However, the enforcement of the moratorium on the commercial whaling lost the opportunity to collect data for the review of the decision, although countries with interest in the resumption of whaling must gather scientific information based on new researches to dissolve the uncertainty which was the base of the moratorium decision (Nagasaki, 1995). The employment of lethal method was essential to collect data and materials from whale resources as examined by Ohsumi (1995) for such work.

The JARPA project was planned to collect data and materials for increasing the scientific knowledge which would solve the uncertainty problems, which were used to justify the moratorium of commercial whaling in the IWC.

THE ORIGINAL OBJECTIVES OF THE JARPA

Two original research objectives were defined in the JARPA project, which were submitted as Document SC/39/O4 (Government of Japan, 1987a) to the 1987 SC Meeting (IWC, 1988a). These objectives were the following:

Objective 1. Estimation of biological parameters to improve the stock management of the Southern Hemisphere minke whale;

Objective 2. Elucidation of the role of whales in the Antarctic marine ecosystem.

The Antarctic minke whale (*Balaenoptera bonaerensis*) was selected as the target species for the Objective 1, because it was the most abundant baleen whale species in the world. It is also the most likely target species of future commercial whaling. Because of the large abundance of this species, no negative impact on the stocks was expected from scientific catches.

The main reason for the failure of the SC to recommend an agreed catch limit for the Antarctic minke whale stock in 1980s was that its members were not able to reach agreement on the value of natural mortality coefficient and its age-specific patterns.

Considering such background, the Objective 1 was set up to estimate the age-specific natural mortality coefficient through stochastic sampling, which was carried out in combination with systematic sighting surveys. The program was also designed to estimate the stochastic changes in stock size required for stock management, and the reproductive parameters and their changes based on the same samples (Government of Japan, 1987a).

The reason for the establishment of Objective 2 was based on the consideration that the most important need to understand the Antarctic ecosystem was the collection of data on the prey-predator relationship among krill, fish, squid and whales. The global scientific interest in the Antarctic ecosystem had been growing, as reflected in the creation of the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR).

The plan of original research program was submitted and reviewed during the 1987 SC Annual Meeting (IWC, 1988b).

A special meeting of the SC was held to consider the feasibility surveys of JARPA. At the meeting, Japan submitted Document SC/D87/1 to conduct a preliminary research in 1987/88 to test the feasibility of the original plan (Government of Japan, 1987b). The Government of Japan decided to conduct the feasibility study in Area IV in 1987/88 and in Area V in 1988/89 (Government of Japan, 1988).

START AND CONTINUATION OF THE FULL-SCALE JARPA SURVEY

After detailed examination of results from two feasibility studies, the following improvement of the original plan was made for the full-scale survey starting in 1989/90. It should be noted that the two original objectives were kept:

- (1) To include monitoring of recruitment among the main subjects of the study;
- (2) To short the interval between the sampling years;
- (3) To conduct surveys using the line transect method.

This research plan was submitted to the 1989 SC Annual Meeting (Government of Japan, 1989). Thus, the full-scale JARPA survey had been conducted with two research objectives, from the 1989/90 to 1994/95 (Government of Japan, 1989; 1990; 1991; 1992; 1993 and 1994).

The IWC SC completed the Revised Management Procedure (RMP) in 1992. The RMP was different from population dynamics models used by the SC previously. Japanese scientists re-considered whether or not the first objective should be modified. Biological parameters were still being useful to understand the population dynamics of minke whales (e.g. pregnancy rate and age at maturity), and therefore important for the management of whale resources. Further, there was some possibility to estimate MSYR based on catch at age data, which is an important parameter used in the implementation of the RMP. Biological parameters were also useful for the elucidation of stock structure as biological markers. For these reasons, the Government decided to maintain the objective 1.

DEVELOPMENT OF RESEARCH OBJECTIVES

The third objective of JARPA was added in 1995/96 (Government of Japan, 1995), in response to the Commission's resolution regarding to environment and pollution (Resolution on research on environmental change and whale stocks in 1994 and Resolution on promotion of research related to conservation of large whale stocks in the Southern Ocean in 1994).

This third objective was:

Objective 3. Elucidation of the effect of environmental change on cetaceans.

The Objective 3 had been already included in the original Objective 2 in previous surveys, so that the Objective 3 should be regarded as a ramification from the Objective 2.

The 1996/97 research plan of the JARPA established the fourth objective (Government of Japan, 1996). It was as follows:

Objective 4. Elucidation of the stock structure of the Southern Hemisphere minke whales to improve stock management.

This objective was already included in the original Objective 1, from the beginning of the JARPA project (Government of Japan, 1987a) and samples for this purpose were collected from the start of the JARPA. However, with the development of the JARPA survey, this part had become gradually important and suitable to be established as an independent objective. The identification of biological stock including the definition of the range of distribution of a whale stock in Areas IV and V was important for the estimation of biological parameters of the minke whales. The Objective 4 was also important for the implementation of the RMP to the Antarctic minke whales.

Since the 1996/97 season, the four objectives had been kept unchanged (Government of Japan, 1997; 1998b; 1999; 2000; 2001; 2002; 2003 and 2004).

Thus, a development of objectives had occurred during the long-term research program.

WORK TO ADDRESS OUTSTANDING ISSUES

The SC identified additional work to address outstanding issues of JARPA during the 1997 Annual Meeting (IWC, 1998b). Furthermore some requests were made during the 2006 SC meeting to better clarify the JARPA survey methods and for revising bias in abundance estimate of Antarctic minke and humpback whales (IWC, 2006). The rest of this document reports the progress made on these tasks by Japanese scientists. Details of some of these tasks can be found in the original documents submitted to this meeting.

The list of these tasks was as follows (IWC, 1998b):

1. Abundance estimate

- (i) Development method to correct bias of abundance estimate

2. Stock structure

- (i) Stock definition
- (ii) Statistical analysis of mtDNA data considering the inclusion of school size as a covariate
- (iii) Pilot study on nuclear DNA analysis on JARPA minke samples
- (iv) Effort to obtain biological materials for genetic analysis from low latitude areas of the Southern Hemisphere
- (v) External morphology/morphometry analysis

- (vi) Examination of possible stock boundaries (geographical and temporal) in Areas IV and V
- 3. Biological parameters
 - (i) Segregation study
 - (ii) Recalculation of biological parameters by biological stocks
- 4. Marine ecosystem and environmental change
 - (i) Meso-scale survey plan
- 5. Matters requested in the 2006 SC Meeting

At the 50th and 51st IWC/SC Meetings, progress made in each of these tasks was presented (Government of Japan, 1998a; Fujise and Ohsumi, 1999). Since then further progress had been achieved as shown below.

Task 1 (i) (Bias in abundance estimates)

Plan and progress on this work have already been presented to previous SC Meetings (Clarke and Borchers, 1997; Clarke *et al.*, 1998).

Task 1 (i) had been addressed by a co-operative study between ICR and the University of St. Andrews. Sighting data obtained by JARPA were analyzed using Spatial Modelling (Hedley *et al.*, 1999). Results of the analysis for Area IV were presented to the 2003 SC Meeting (Marques *et al.*, 2003). Results of the analysis for Area V were presented to the JARPA Review Meeting called by Japanese Government (Burt *et al.*, 2005). This task was also addressed by Hakamada *et al.* (2001) using standard methodology and updated by Hakamada *et al.* (2005, 2006a, 2006b).

Task 2 (i) (Stock definition)

During the 1997 Meeting the SC agreed that the lack of the working definition of stocks and sub-stocks is a general problem, not for JARPA alone, and therefore, needs to be addressed by the Committee (IWC, 1998b). The Committee established a Working Group on Stock Definition, in which this particular topic has been discussed annually. However, the Committee has not reached yet to an agreement on the definition of stocks for management purpose.

Task 2 (ii) (School size as covariate in mtDNA analysis)

Analyses considering the inclusion of school sizes as a covariate in the mtDNA survey were carried out by Pastene and Goto (1999). Results were presented during the 1999 SC Meeting (IWC, 2000). These

authors found no significant differences in haplotype frequencies among different categories of school sizes.

Task 2 (iii) (Nuclear DNA)

Studies on stock identity in JARPA based on nuclear DNA markers (microsatellites) started in 1998 and preliminary results were presented to the 1999 SC meeting (Abe *et al.*, 1999). Currently all samples taken by JARPA have been examined with a set of six microsatellites (Pastene *et al.*, 2005; 2006).

Task 2 (iv) (Sample from low latitude)

Results of a survey of biological materials of minke whales from low latitude institutions of the Southern Hemisphere were presented to the 1996 SC Meeting (IWC, 1997). According to those results, apart from the Brazil region, no other comprehensive material of the Antarctic minke whale from low latitude was available. Of interest for the JARPA studies are the materials from low latitudinal areas of the eastern and western side of the Indian Ocean and the western side of the South Pacific Ocean. Later, Japanese scientists were informed of a collection of 200 baleen plate samples of the Antarctic minke whales taken in Durban, South African (western part of the Indian Ocean). These samples were stored in formaline for some decades. Effort is being made to develop suitable genetic techniques to examine such samples.

Task 2 (v) (Morphology/morphometric analyses)

Morphometric analysis on stock structure was conducted using all samples taken by the JARPA (Pastene *et al.*, 2005, Hakamada, 2006).

Task 2 (vi) (Stock boundaries)

Based on the results of the different analytical approaches used in JARPA it was concluded that the single stock scenario can not be applied to Antarctic minke whales in the Antarctic feeding grounds of Areas III-E-VI-W. Results of the stock structure analysis conducted under the JARPA identified two biological stocks in the research area. These two would mix through a soft boundary, which is best placed around longitude 165°E (Pastene, 2006). Estimation of biological parameters in the Antarctic minke whale was conducted using this new definition of stocks.

Task 3(i) (Segregation study)

A study on segregation was conducted in the context of the distribution pattern of minke whales in relation to pack ice edge. Results were reported to the 1999 SC meeting (Fujise *et al.*, 1999).

Task 3 (ii) (Estimation of biological parameters by stock)

Estimations of several biological parameters were conducted by biological stocks (Bando *et al.*, 2006).

Task 4 (i) (Meso-scale survey plan)

Feasibility studies using modern equipment for oceanographic and ecological surveys were planned since the 1998/99 JARPA survey. These equipments included XCTD and CTD (or XBT) for recording vertical thermal and salinity distributions, echo sounding system for examining of the distribution of prey species (such as krill), and EPCS (Electric Particle Counting and Sizing System) for examining the distribution of chlorophyll. Oceanographic surveys have been continued and analyses of these data have been recently completed (Murase *et al.*, 2005a; 2005b). Also specific oceanographic surveys at a meso-scale were conducted to investigate environment of whales by using the research vessel *Kaiyo Maru* in 2004/05 season in the Area V (Naganobu *et al.*, 2006). Several other documents derived from this specific survey are available to this meeting.

Task 5 (Matters requested in the 2006 SC meeting)

Additional explanations of the JARPA survey methods were included in the document on JARPA survey methodology available to this meeting (Nishiwaki *et al.*, 2006). Revised abundance estimates for Antarctic minke and humpback whales are also available to this meeting in Hakamada *et al.*, (2006b) and Matsuoka *et al.*, (2006), respectively, which taken into consideration the suggestions offered by the Scientific Committee in 2006.

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