

The 1990/91
Research Plan of Whale Resources
in
The Antarctic

The Government of Japan

June 1990

1. Introduction

Japan has implemented the feasibility studies in the two successive years in 1987/88 and 1988/89 on the basis of the plan revised from "Program for the Research on the Southern Hemisphere Minke Whale and for the Preliminary Research on the Marine Ecosystem in the Antarctic" submitted to the IWC in 1987. After the feasibility studies for two years, Japan commenced the research program in Area IV in 1989/90.

The research for 1990/91 is the 2nd year of the program with no changes from the long-term program made in 1987 (which was amended in 1989).

The research plan for 1990/91, as clearly described in the objectives of the plan on the following page, aims at the estimation of the biological parameters necessary for the management of the minke whale stocks in the Antarctic, and the ascertainment of the role of the whales in the marine ecosystem in the Antarctic. In particular, through continuous monitoring by the research over a long period, it aims at the collection of information relating to the stock size, natality, mortality and the change in stock size, which are indispensable for the management of the Antarctic minke whale stocks.

The research is expected to improve the knowledge useful for practical solution on the various problems associated with the utilization of the whale resources arising from uncertainties of the existing biological knowledge.

2. Objective (no change from the previous one)

1. Estimation of the Biological Parameters Required for the Stock Management of the Southern Hemisphere Minke Whale

The primary objective of the program is to estimate the age-specific natural mortality rate by samples through stochastic sampling carried out in combination with systematic sighting surveys. The program is also designed to estimate the stock size and its changes, including the monitoring recruitment, required for stock management, and the reproductive parameters and their changes based on the same samples.

2. Elucidation of the Role of Whales in the Antarctic Marine Ecosystem

The program includes as its another objective elucidation of the roles of whales in the Antarctic marine ecosystem. The most important component of this objective is the collection and analysis of data on the prey-predator relationships among krills, fishes and squids, and whales.

The description above has been based on the original research plan (SC/39/04) with some amendment made in the research plan in 1989/90 season (SC/41/SHMi 13). It is the same with the description made in the communication to the IWC from the Government of Japan in October, 1989 for circulation, entitled 'Japanese response and reconsideration on Japanese scientific research proposal for special permits.'

3. Number, sex, size and stock of the animals to be taken

Three hundred (300) minke whales with allowance $\pm 10\%$, the same as in the proposal of the last year, will be sampled. Samples are to be collected without predetermination of sexes. Samplings are to be made in Area V including all region of the Ross Sea.

4. Opportunities for participation in the research by scientists of other nations

Opportunities for participation in the research by foreign scientists are available as described in the research proposal presented to the IWC last year (SC/89/04 and SC/41/SHMi 13), which is as follows:

Opportunities for Participation by Foreign Scientists

Opportunities for participation in the research cruises under this program will be given to any scientists to the extent allowed by accommodation and other logistic consideration, provided that such participation does not cause inconveniences in the implementation of the program. The selection of the participants are to be finalized by the Whale Research Coordinating Committee which will consider the various conditions such as accommodation and others for determination.

Conditions for Participation

i) Costs:

Costs for participation, travel expenses to and from the port of boarding the research vessel, meals on board the research vessel, and any special instruments required by the participant will be borne by the participant.

ii) Indemnification and insurance for casualty or personal injury on board the research vessels:

The Institute of Cetacean Research and the crew of the research vessel or research team will not be held responsible for any casualty or personal injury to the participants resulting from the participant's negligence or force majeure.

iii) Cancellation of participation:

Any participants who are found to have intentionally sabotaged in the course of implementation of the researches and thereby impaired the execution of such researches shall be cancelled of their participation in this program.

5. Possible effect on conservation of the stock

Estimates based on the sightings data obtained for the minke whale stock in Area V are as follows (Anon, 1989):

<u>Total population</u>	<u>CV.</u>	<u>Year surveyed</u>	<u>Survey mode</u>
133,382	0.219	80/81	Closing
303,284	0.179	85/86	Passing
211,150	0.178	85/86	Closing

By applying Hitter Program (de la Mare, 1987) using these three estimates above to obtain the stock level for 1990, assuming the constant carrying capacity of this stock during long years, each result shows that current population level is more than 90% of the initial level,

approximately at an unexploited level.

(input parameters: $M=0.086$, $MSYL=0.6$, $MSY \text{ rate}=1\sim 4\%$, $t_{m50}=7$)

The minimum estimate among these three estimates, the stock estimate is 133,382 for 1980/81, MSY 849 with the MSY rate of 1%, and 3,392 with the MSY rate of 4%.

Under these circumstances, it is clear that the proposed sample size of 300, that is a 0.2% or far less than the estimated total population would not give any adverse effects to the conservation of the stock.

6. Outline of the 1990/91 survey

i. Number of Vessels

One factory ship (research base)
Three sighting-sampling vessels
Two sighting vessels*

ii. Survey period

From November, 1990 to April, 1991

iii. Stratification of the research area and research cruise-track

Schematic stratification of the research area and the research cruise-track are the same as in 1989/90 survey.

iv. Samples/data to be collected

a. Sighting data (including other whale species than minke whales)

b. Biological samples/data

Stock identity, age, maturity, breeding, nutrition, distribution of heavy metal, hormone, and parasites.

*These two vessels are used for this program after the end of IDCR survey.

c. Weather, oceanography, and environment

Environmental factors such as weather, sea ice, water temperature, marine debris, heavy metal contamination in sea water and atmosphere.

d. Biopsy and satellite telemetry (as feasibility studies)
Shooting test for attachment of the satellite telemetry transmitter to the whale body is planned on the shipboard.

7. Comments on the criteria for review by the IWC/SC

Japan has analyzed the points raised in the review by the Scientific Committee of the Japanese Research Program which has been appended to "Japanese Response and Reconsideration on Japanese Scientific Research Proposal for Special Permits". The same document is appended hereto.

It can be noted that statistical accuracy in the estimates of reproductive parameters such as the birthrate are relatively high (c.v. is 10% or less) in the Japanese research. It can be said that the Japanese research is capable of estimating the present stock size and rate of population increase and/or its yearly change, so that it is obvious that the Japanese research is contributive to the stock assessment and the management of the population.

APPENDIX

The Review by the 41st IWC/SC and Japan's View to it Based on the Criteria Set Forth by the IWC

(in Japanese response and reconsideration on Japanese
scientific research proposal for special permits)

The 41/IWC/SC gave a review on the Japanese research proposal submitted to it in consideration of the items namely the proposal, objectives, methodology and effect of catches on the "stock". The following are the main discussion points, the comments by the members of the SC, on these points, and Japan's viewpoints in response to them.

2.1. The Proposal

The IWC/SC agreed that the Japanese research proposal has clearly stated the items given by the criteria of scientific permits (Rep. int. Whal. Commn. 39, 1989. Annex 0) such as the number of minke whales to be taken, sex and stock, the opportunity for participation by foreign scientists, and the effects of the catches to the stock. However, two comments were made on the description of the research objectives, criticizing that objectives were spread over several documents and different in all those documents, and the other pointing that there is no explicit explanation on how the research objectives could be achieved.

(i) Clarification of the objectives

The comments by members of the IWC/SC

Horwood, Holt, Lankester and Tillman noted that the objectives of the programme for which catches will be taken in 1989/90 are given in SC/39/0 4,

SC/41/SHMi13 and two working papers presented to the meeting (Annex P1). They believed that these working papers gave substantial additional aims to the previous documents and were more explicit in some respects. However, since the objectives are spread over several documents and are different in all those documents, they considered that the objectives of the research were inadequately specified. Following this comment, Ohsumi responded that the documentation presented explicitly stated the objectives.

Japanese view

Descriptions for research objectives given in the document (SC/41/WP3) which are extracted from the original Japanese research proposal (SC/39/04), together with the objectives in the amended research proposal are listed below (for the detailed explanation, see IWC/41/4).

1. Estimation of the Biological Parameters Required for the Stock Management of the Southern Hemisphere Minke Whale

The primary objective of the program is to estimate the age-specific natural mortality rate by samples through stochastic sampling carried out in combination with systematic sighting surveys. The program is also designed to estimate the stock size and its changes, including the monitoring recruitment, required for stock management, and the reproductive parameters and their changes based on the same samples.

2. Elucidation of the Role of Whales in the Antarctic Marine Ecosystem

The program includes as its another objective elucidation of the roles of whales in the Antarctic marine ecosystem. The most important component of this objective is the collection and analysis of data on the prey-predator relationships among krills, fishes and squids, and whales.

(ii) Explanation on how the research objectives could be achieved.

Comments by members of the Scientific Committee

De la Mare, Holt, Tillman, Chapman and Lankester noted that the programme implied that the estimates of biological parameters could be used to estimate parameters of direct management interest such as MSY, MSYL and RY. They suggested that it is not sufficient to say that the research is directed towards the rational management of a stock, but that the proposal needs to show how the research will answer questions which need to be solved. Accordingly, regardless of whether age dependent mortality could be reliably estimated or not, the proposal did not show that the whole problem of estimating the relevant management parameters constituted a feasible objective.

Japanese view

The comments quoted above could be understood how the biological characteristics estimated from the result of the research could function in the rational management. However, this question is irrelevant to this item, which is the review of the description of the objectives and not the way in which the objectives could be achieved.

However, the way in which the objectives of the Japanese research could be achieved is clear. Fig. 1 of 41/SHm13 Annex 1 clearly indicates the flow of the information obtained by the research, including the relationship of stock-recruitment, their density dependency and the prediction of recruitment. The methodology for estimating these biological characteristics such as the estimation of age-dependent natural mortality coefficient (M_a) for example, have been already discussed. Even if there were some items on this subject which have been left unexplained, these would not show any radical departure from discussion or considerations on them by many scientists studying ecology or marine resource management.

Japanese views on these comments are described in subsequent sections.

2.2. Objectives

The result of the review on this item can be summarized into three kinds of views; one is the view totally denying the usefulness of the research objectives in the area of stock assessment and management, another

is the view partially recognizing the necessity and rationale of the research with certain conditions, and yet another is the view fully recognizing the need of the research. In addition, there was a question as to the conflicting relation between the Japanese research objectives and the alternative management procedure currently being developed by Japanese scientists. The following are the Japanese response to these questions.

(i) The view denying the Japanese research objectives

Because the IWC/SC is currently developing the management procedures that do not require such biological parameters as r , M , MSY and $MSYL$, and because of the time constraints imposed on the 1990 Comprehensive Assessment, the Japanese research neither contributes to the progress of the Comprehensive Assessment nor provide information essential for the future rational management.

Comments by members of the IWC/SC

Tillman (Annex P2) examined the objectives of the proposal in light of the Committee's recent work in preparation for the Comprehensive Assessment. In summary, he noted that the Committee's development of new management procedures which did not require a priori estimates of net recruitment, natural mortality rate, MSY or MSY level, in conjunction with the unresolved issues over what information can be obtained from catch at age data, led him to conclude that the proposed research catch will neither contribute information which is essential for the future rational management of these stocks nor contribute to progress on the Comprehensive Assessment. Chapman, de la Mare, Holt, Cooke, Arnbom, Lyrholm, Swartz, Lankester and Perrin associated themselves with the views expressed by Tillman in Annex P2 and with his conclusion.

Japanese view

The Special Meeting of the IWC Scientific Committee held in April, 1986 clearly defined what was meant by the Comprehensive Assessment (Rep. Int. Whal. Comm. 37, 1987.p.147)

6.1 Definition of a comprehensive assessment

Given the above, the Committee agreed that comprehensive assessment can be considered as an in-depth evaluation of the status of stocks in the light of management objectives and procedures. This could include examination of current stock size, recent population trends, carrying capacity and productivity.

In order to achieve this the Committee agreed that it would need to:

- (a) review and revise assessment methods and stock identity; review data quality, availability requirements and stock identity;
- (b) plan and conduct the collection of new information to facilitate and improve assessments;
- (c) examine alternative management regimes.

As discussed later in thereport, the Committee sees the carrying out of the Comprehensive Assessment as an iterative process, with considerable interaction between results from (a), (b) and (c).

Ivashin believed that a fuller definition should eventually be informulated and that this might best be achieved at the 1986 Scientific Committee meeting.

According to the definition quoted above, the Comprehensive Assessment (CA) is to: a) review and revise assessment methods and stock identity; b) plan and conduct collection of new information to facilitate and improve assessments; c) examine alternative management regimes. And the Committee sees the carrying out of the Comprehensive Assessment as an iterative process, with considerable interaction between the results from (a), (b) and (c) to make in-dpeth evaluation of the population. It is understood from this definition that the CA is a task without time limits. On the other hand, however, IWC/SC is urged to undertake as its course of duty a comprehensive assessment by 1990 which has been adopted contingent to the moratorium for all commercial whaling. In this context, we need to consider Comprehensive Assessment under the time limits and without the constraints of time separately.

In consideration of the latter without time constraints, no logical contention is possible against the Japanese research for the reason that it cannot satisfy the time limit. According to the definition of the CA quoted above, it is an in-depth evaluation of the whale stocks including the present stock size, dynamics of the population in the recent years, carrying capacity of the environment and biological productivity. Accepting that the CA consists of these components, it is evident that the Japanese research will contribute to the Comprehensive Assessment.

Furthermore, the comments on the Japanese research contending that it does not contribute to the CA because the alternative management procedure currently under development require almost no apriori information such as r , M , MSY and $MSYL$, are short-sighted with the focus only on the "management procedures currently under development" in disregard of the future prospect of the management procedures in the next generation. As described in the definition of the CA above, the IWC/SC is charged with a task to repeatedly examine the alternative management procedures for better management. In this context, the Japanese research in every respect has reason enough to contribute to the CA. There is no rationale for any contention that the research does not contribute to the Comprehensive Assessment.

The comments by some members of the SC quoted above do not only deny the contribution by the Japanese research to the CA, but also to the rational management of whale stocks. As it has been stated in the report of the Commission (IWC/41/4 p.59), there was a case in which a considerable improvement was made by incorporation of certain biological parameters in a management procedure which does not require apriori biological parameters. Contribution by Japanese research to the CA in 1990 were considered under the agenda item for the Comprehensive Assessment at 41/IWC/SC. Those are listed in Annex which illustrates that the Japanese research is greatly contributive to the Comprehensive Assessment.

- (ii) The view partially recognizing the necessity and rationale of the research with certain conditions.

The comments by members of the IWC/SC

Horwood noted that SC/41/SHM13 reiterated that the main objective of the overall programme as outlined in SC/39/0 4 was the

estimation of age-specific mortality rates, since this had been the main reason for failures to agree catch limits. In 1987, he and others (Rep. int. Whal. Commn 38;56,145) had disagreed with this interpretation, considering that the problem was one of estimating replacement yields. On this basis he did not consider it met any of the criteria on objectives given in Annex o (Rep. int. Whal. Commn 39:154). He noted further, however, that this year, an additional objective has been introduced (SC/41/SHMI13), the estimation of recruitment of one year old whales in absolute terms. If such an exercise could be successfully accomplished, that is, the estimation of absolute levels of mortality and age-specific mortality rates, together with absolute recruitment, then he considered it would contribute to research needs of the Scientific Committee, and would contribute information of substantial significance to rational management. Because of the time scale of the programme it could not contribute to the Comprehensive Assessment. He noted that the value of the programme would nevertheless depend upon a potentially successful methodology.

De la Mare and Harwood commented that because the information gained from the research constituted only ancillary data for management then it was unnecessary to collect such data independently of a management procedure. Data sufficient for the ancillary uses specified in Annexes F and G could be collected during the normal course of whaling operations.

Japanese view

The comment that the success of the Japanese research would depend on the methodology applied to it is correct. Japan intends to proceed on the research by incorporating the views expressed in constructive criticisms and comments by scientists interested in the improvement of methodology, as it has been doing so in the past.

Japan, however, finds it impossible to accept the comments contending that the information obtained from the Japanese research would only be of ancillary value to the stock management. The authors of these comments should be aware of the need of predictions on unexpected changes in population which are inevitable in the dynamics of living resources, and of the importance of continuous monitoring of the population. None of the management procedures currently under development seems to incorporate the measure against such unexpected changes caused by environmental factors, etc. The occurrence of such changes and their magnitude can only be monitored by constant observation; such information cannot be ruled out as

being of ancillary value to stock management. They also asserted that such information could be available through the data from commercial whaling; in that case they should furnish evidence that there is no need of collection of information during the period in which commercial operations are suspended.

(iii) Relationship between the Japanese research program and the management procedure currently developed by Tanaka and Sakuramoto.

Comments by members of IWC/SC

Tillman and Holt commented that they found the statement in Annex P3 regarding the relationship of the Japanese research catch to the development of new management procedures to be completely contrary to the premise of the procedure being put forward by Sakuramoto and Tanaka. They pointed out that the description of the Sakuramoto and Tanaka procedure given in Annex E indicated that it does not use a population model of any kind and does not require estimates of the MSY rate, the MSY level or replacement yield. They observed that an inconsistency therefore existed between the objectives of the Japanese proposal for a scientific catch and the development of the Sakuramoto and Tanaka management scheme. They concluded that, if the Commission chose this scheme as a basis for the future rational management of whale stocks, then the Japanese research catch would in no way contribute information which would be essential for the future application of that scheme.

Japanese view

The point made by Tillman and Holt quoted above contending that collection of biological parameters necessary for stock management by the Japanese research would be completely contrary to the premise of the management procedure put forward by Sakuramoto and Tanaka is considered unreasonable. Because of the present circumstances, under which agreed collection of biological parameters by IWC/SC are not available, the alternative management procedures currently being proposed are developed without regard to such parameters. Collection of information on these parameters to enhance the effectiveness of such management and would be a natural process of scientific approach to management based on biology.

Furthermore, the Japanese scientists are considering a scenario for a management procedure with even higher precision incorporating use of information such as M_a , and yearly recruitment (N_{ly}).

2.3. Methodology

Some members of the IWC/SC who had been skeptical about the Japanese research has stated that the estimation of M_a would be possible as the result of the improvement made on sampling methodology of the Japanese research. However, they still questioned on the methodology for estimation and analysis and the statistical accuracy.

○ Precision of estimation of M_a and R_y (RY rate)

Comments by members of IWC/SC

Horwood, Holt, Tillman, Lankester and de la Mare noted that in the past two years, questions had been raised over the ability to collect a random sample and to estimate trends in age dependant mortality. Subsequent studies fhave shown that improvements have been made in sampling methodology (SC/41/SHMi 3,3), substantially reducing many of those major concerns. As regards the estimation methods, it was recognized last year (Rep. int. Whal. Commn 39:37) that trends in age specific rates could be estimated with adequate sample size, and this is confirmed by current studies (SC/41/01, 15). Even in these studies though, a functional form has to be fitted instead of rates calculated for each age, for reasonable sample sizes. However, the above studies (SC/41/01, 15) show that although a trend or functional shape could be adequately fitted, the important estimation of the absolute levels of mortality can be achieved only with a large variance. In addition, to estimate any replacement rate or yield, the estimated recruitments must be multiplied by those estimated mortality rates, and variances calculated. This exercise has not been done but clearly any estimated replacement yields would have enormous variances, of impractical value.

Japanese view

It is evident that the precision of estimation of M_a to be

obtained by current sample size would not be entirely satisfactory to the level required and that the accuracy of RY (or RY rate) obtained from these information, would be less than that of Ma. However, Japan believes that the methodology used in Japanese research are practically the best scheme under the present circumstances.

We believe that the precision of estimation would be improved to the satisfactory level by increasing sample size fper year and iterative sampling by continuous research.

(ii) Methodology for analyses of MSY and MSY level and other parameters.

Comment by members of IWC/SC

They further noted that other techniques have considered the use of catch-at-age and other data to determine recruitment and mortality rates simultaneously (e.g., SC/41/0 16, 17, plus many other published studies). Such recruitment rates have not been successfully obtained, and at least one current Japanese approach (SC/41/0 16) is still under development. No methodology has been specified for the estimation of MSY rates and MSY level.

Consequently they considered that it has not been demonstrated that a methodology has been proposed that will lead to the ultimate aim of resolving the problem of the failure of the IWC/SC to recommend an agreed catch limits' by the estimation of replacement rates, and that the proposed mathematical methodology addresses only a part of the total programme.

Japanese view

The methodology for estimation of natural mortality coefficient. is effectively addressed mathematically by SC/41/015 by Tanaka in which the accuracy of estimation was numerically indicated.

Monitoring recruitment, added to the research plan this year as an important research item, are for the recruitment analysis as which is identical to the analysis of Nly (y is year class) indicated in the flow-chart. The aims of the study of Nly are two folds; a) ascertainment of MSY/MSYL, b) observation and prediction of random changes in population. We consider that there is no particular need of description of mathematical

methodology with regard to this matter at the present stage.

The procedure for ascertainment of MSY/MSYL: Juvenile mortality rate M_j is estimated by analyzing the observed N_{ly} and the separately estimated number of births (obtained from the number of parent whales and pregnancy rate). In addition, the number of whales by age class (N_{at}) and N_{ly} will be used as data for analysis of stock-recruitment relation so as to make it possible, in principle, to estimate MSY/MSYL. Different method will be applied for analysis depending on whether or not there are changes of carrying capacity during the period of observation. Procedures for estimation of other parameters: Japan is prepared to explain the Japanese view in response to the comment made on each different parameters. This kind of discussion will be aptly held at the review of the research results.

(iii) Methodology to achieve ultimate research objectives by estimation of M .

Comments by members of IWC/SC

The second paragraph of the comments quoted in the foregoing is relevant to this subject.

Japanese view

We believe that any interested persons would be aware that one of the mainstays of the Japanese research program is the comprehensive study of the biological characteristics of the minke whales, with a particular emphasis on natural mortality coefficient (as well as monitoring recruitment).

As shown in the flow-chart indicated earlier in this paper, number of dead whales can be calculated based on M and N_{at} , and R_Y is obtained from information of N_{ly} so that the biological information vital to the determination of catch limit will be provided.

At the present stage, explanations given above on the procedures for analyses would be sufficient. Details of analytical methods will be discussed in the process of analysis from observed data.

2.4. Effect of catch on the "stock".

At the discussion held in IWC/SC, the word "stock" was used with quotation marks in certain cases. It is understood that "stock" with quotation marks means the exploitable population above age 6. The following is the comment with regard to such a "stock".

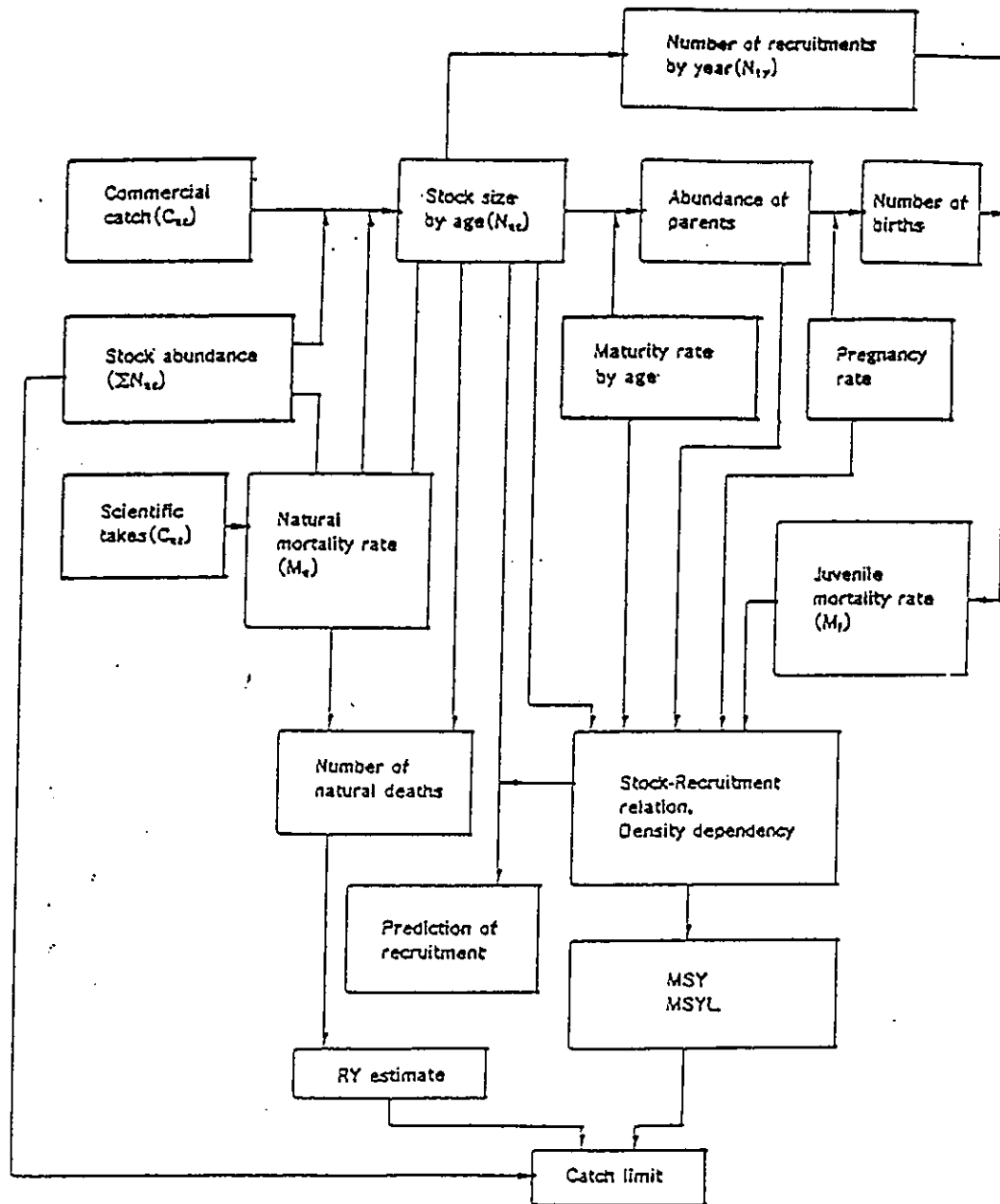
Comments by members of IWC/SC

Holt commented that repeated future catches of 400 whales from Area IV may or may not be below the replacement yield given in Rep. int. Whal. Commn 39: 81-2. However, he noted that the research catches will include a high proportion (up to 30%) of animals younger than the age at recruitment to the commercially exploited stock (6 years). Even if adequate estimates of population parameters were available, a simple calculation of current replacement yield with an age at recruitment of one year, as suggested in SO/41/SHM13, would be quite inappropriate as a response to the questions posed in the guidelines above; the research sampling will have a delayed effect of several years on the "stock", as normally defined, and no attempt has been made to calculate this, either by the Japanese Scientists or by the Committee. Therefore no answer can be given at this time to the question posed, but it would not be correct to assume that the effect will be negligible.

Japanese view

If the ratio of the animals from age 1 to 5 in the population is 30%, then taking 400 samples out of the total population will contain 120 whales from the juvenile population and 280 whales from the takable population. Based on the estimated takable populations of 47,611 and RY rate ranging from 1 to 4%, RY must be 476 - 1,904. If 400 whales are continuously sampled for 5 years, the total catch from the juvenile population is 600 which reduces the takable stock size to 47,000. This reduction is equivalent to about 1.3% reduction in RY. In reality, however, sampling of 400 whales are to be taken place every other year, so that the reduction in RY is must be 0.7%. Therefore, there will be no adverse effects of the sampling under the proposed Japanese research on the "stock".

Fig.1. Flow chart of data and information originated from the survey and analysis on the Antarctic Minke Stock.



NOTE: The items boxed with bold-type lines are materials and estimates directly obtainable from the sampling and sighting survey. The items boxed with fine lines are the information obtained by the analyses of the foregoing estimates and materials.

Notation for the suffix

a;age	t;year
j;age at juvenile	y;year class