The case for and against destructive sampling

Cadiz, Spain, Saturday 19th March 2011

Background
During the ECS Conference in Istanbul (2009), some members of the Society expressed ethical concerns about a paper using data from scientific whaling operations. Currently the Society's position is that research would only not be eligible to be considered for presentation at ECS conferences if it contravened national laws and regulations in the country where the research took place. Thus, results from scientific whaling which complied with relevant national regulations would be considered. Some members have asked the Council to develop a policy or guidance to address similar concerns that may arise in the future and present this to the membership at large.

Destructive sampling of marine mammals for scientific purposes remains a very controversial issue. Questions frequently posed include: does the science derived from killing marine mammals justify that action? Will the killing of a few individuals aid the conservation of many? What information can be gained from destructive sampling, and would alternative approaches provide equivalent information?

The workshop covered different aspects of human-derived lethal/invasive sources of research data, such as hunting or culling. It was divided into two sessions: the first session considered philosophical and legal issues relating to animal ethics, and the second focused upon scientific aspects. Invited speakers addressed the various issues from different perspectives, and the presentations were followed by a debate.

Arne Bjørge acted as Chair of the workshop.

Workshop outline

Session on legal and ethical aspects
Arne Bjørge: the legal basis for, and development of, whaling for scientific purposes
Laila Sadler: issues surrounding the ethics of scientific whaling.

Session on scientific aspects
Gisli Vikingsson: research programmes based on special permit takes of cetaceans in Icelandic waters. Implications for conservation and management of whales.
Luis Pastene: results of the Japanese whale research programmes and the utility for the management and conservation of large whales.
Russell Leaper: Whales and whaling: critical questions for management and conservation.

During the discussion different opinions were expressed on the use of invasive methods in research of cetaceans. While not coming to a final conclusion on the acceptability of

lethal or invasive methods in general, the workshop concluded that it would be of value to the ECS to implement a procedure for assessing the acceptability of science that includes killing or other invasive procedures on marine mammals.

The Workshop participants agreed that particular attention should be devoted to abstracts presenting data that have originated from research with possible ethical concerns, including invasive or destructive research.

Final recommendations

- **The submission process for abstracts to the ECS (including posters, presentations and papers) will be refined to include a "tick box" for authors to indicate whether their research includes invasive or lethal methods.**

- **Abstract reviewers will have to notify the Society if they think an abstract should be considered more closely, on the grounds of ethics. Every notification to the Society will be considered in detail by the Science Advisory Committee. Decisions on whether to accept an abstract will be taken on a case by case basis by the SAC.**

- **The SAC will try and meet every year during the ECS annual Conference to cover invasive methods, and consider best practice guidelines relevant to different techniques. When feasible, workshop reports will be published as ECS SPECIAL PUBLICATION SERIES. The Science Advisory Committee will, together with ECS Council, draft Guidelines of Acceptability, defining what is meant by "invasive" and outlining what scientific practices and procedures the Society will deem acceptable in general terms. These guidelines will take into account discussions regarding ethical issues, animal welfare and sustainability criteria at an international level, in addition to national guidelines and regulations which differ between countries.**

The legal basis for, and development of, whaling for scientific purposes

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The legal basis for scientific whaling

When it became clear in the 1930's that the large whale resources in the Antarctic were overexploited (see Fig. 1), the international community agreed to develop an international regulation of whaling. In 1937 the first International Regulation of Whaling was adopted. However, this regulation had little practical implication because the paucity of whaling due to the world war II.

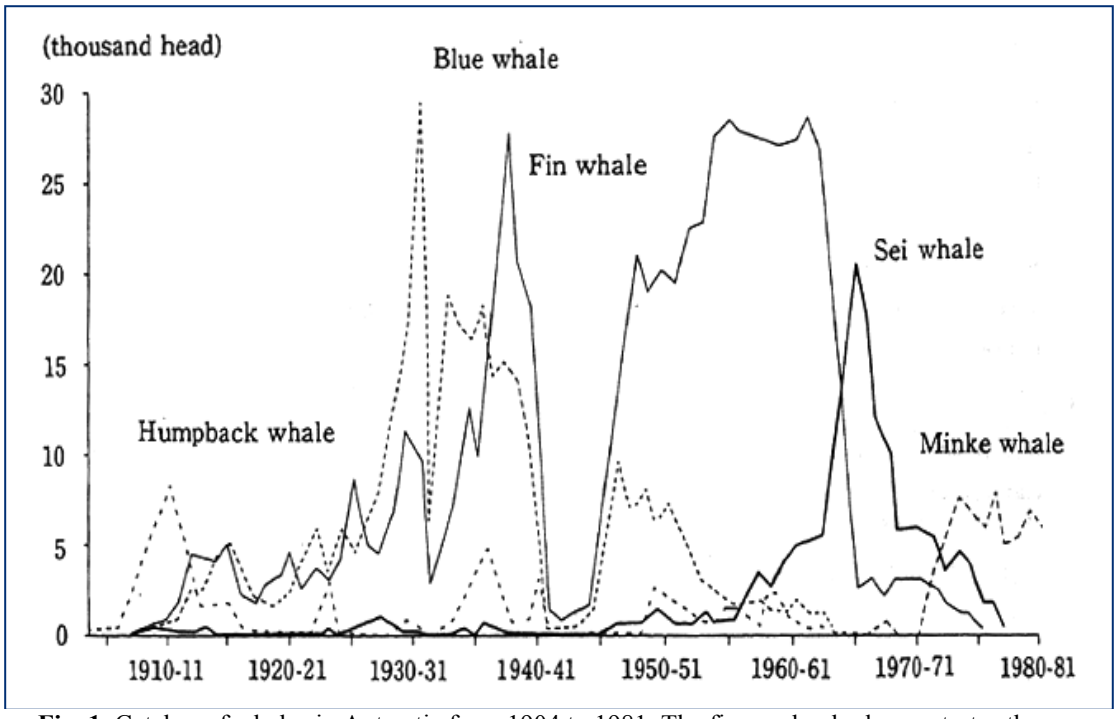

Fig. 1. Catches of whales in Antarctic from 1904 to 1981. The figure clearly demonstrates the sequencial overexploitation of humpbacks, blue, fin and sei whales.

The first International Agreement for Regulation of Whaling (1937) had a paragraph on Special Permits for scientific whaling:

> **"Article 10**
> Notwithstanding anything contained in this Agreement, any contracting Government may grant to any of its nationals a **Special Permit** authorising that national to kill, take and treat whales for purposes of scientific research."

When the allied nations came together to continue the efforts to manage whaling after the world war II, the International Convention for Regulation of Whaling (ICRW) was agreed and ratified in 1946. This convention was the legal basis for the establishment of the International Whaling Commission (IWC) and its Scientific Committee (IWC SC).

The International Convention for Regulation of Whaling (1946) included the same possibility as the 1937 agreement for its members to issue permits for scientific whaling. This is known as Article VIII of the ICRW:

> **"Article VIII (1)**
> Notwithstanding anything contained in this Convention any Contracting Government may grant to any of its nationals a **Special Permit** authorizing that national to kill, take and treat whales for purposes of scientific research subject to such restrictions as to number and subject to such other conditions as the Contracting Government thinks fit, and the killing, taking, and treating of whales in accordance with the provisions of this Article shall be exempt from the operation of this Convention.
> Each Contracting Government shall report at once to the Commission all such authorizations which it has granted. Each Contracting Government may at any time revoke any such **Special Permit** which it has granted.
>
> **Article VIII (2)**
> Any whales taken under these **Special Permits** shall so far as practicable be processed and the proceeds shall be dealt with in accordance with directions issued by the Government by which the permit was granted."
>
> **"Article VIII (4)**
> Recognizing that continuous collection and analysis of biological data in connection with the operations of factory ships and land stations are indispensable to sound and constructive management of the whale fisheries, the Contracting Governments will take all practicable measures to obtain such data."

Paragraph 1 of Article VIII authorize Member Governments of the IWC the right to issue Special Permits for scientific whaling, but obliges the governments issuing such permits to report to IWC.

Paragraph 2 of Article VIII instructs that whales taken under Special Permits should be processed and utilized. This is the legal basis for processing and marketing of products from scientific whaling.

Paragraph 4 of Article VIII states clearly that scientific whaling should not replace the continuous collection and analysis of biological data from commercial whaling operations. It therefore seems clear that Article VIII was not originally intended for large scale scientific whaling that continues over several years. This is possibly the reason why continuous, large scale scientific whaling operations are very controversial within the IWC.

The development of scientific whaling since 1946

The first Special Permit for scientific whaling was issued in 1954 for a small number of humpback and right whales. In the period 1957 to 1978 a number of Special Permits were issued (Fig. 2). In particular sperm whales were targeted (in 1963, 1965, and 1972) but a wide variety of large whales were taken, but usually in a small number and the Special Permit had a limited duration. Ten nations (Table 1) issued 54 Special Permits in the period 1954-1985. Also IWC Member Nations that currently are strongly opposing the recent Special Permits.

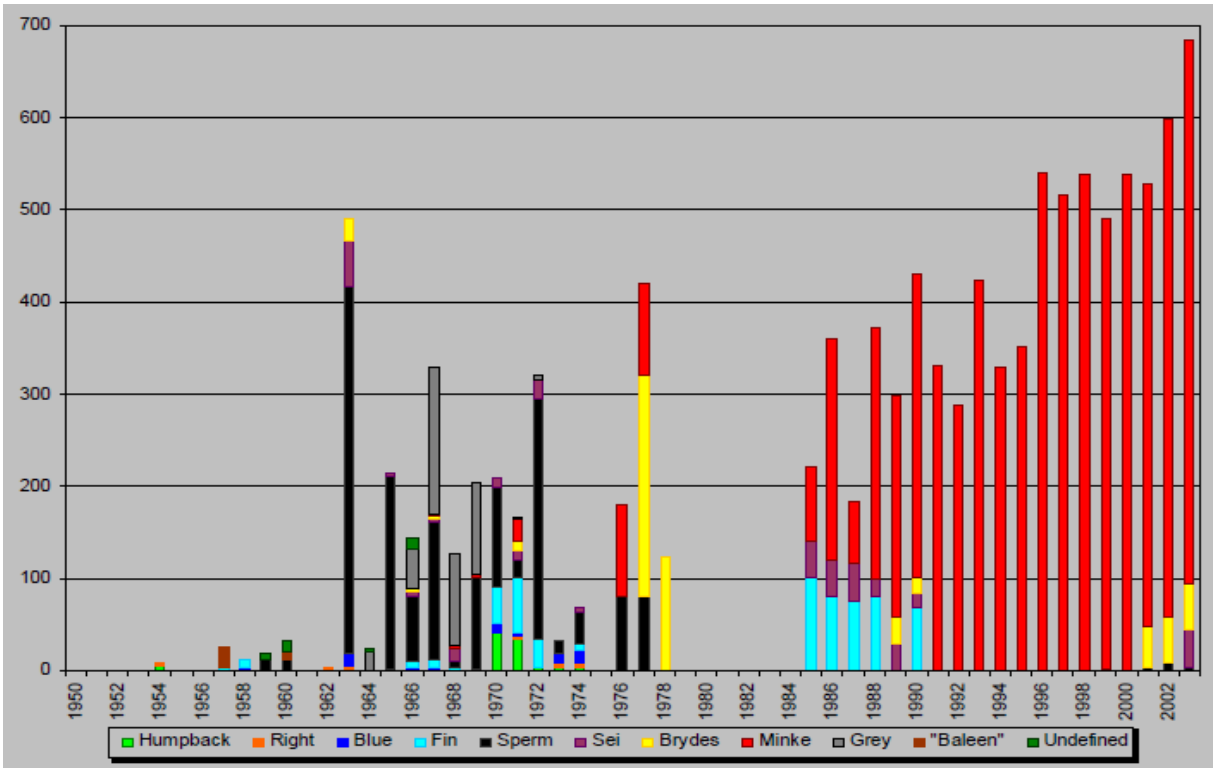

Fig. 2. Special Permits for scientific whaling issued by IWC Member Nations 1954-2003

Table 1. Number of Special Permits for scientific whaling issued by IWC Member Nations in the period 1954-1985.

Australia	4	Norway	2
Canada	5	South Africa	4
Japan	13	UK	3
Netherlands	3	USA	9
New Zealand	1	USSR	10

In 1982 the IWC decided that there should be a pause in commercial whaling on all stocks from the 1985/1986 season onwards. This pause is often referred to as the moratorium on commercial whaling, and it is still in place today. The moratorium

entailed a change in the use of Article VIII. Iceland, Japan and Norway have issued Special Permits for scientific whaling. The programmes in Norway and Iceland were limited in duration and number of whales, and have ended. However, the two Japanese programmes (JARPA II in Antarctic and JARPN II in the North Pacific) are continuous without a defined year of ending. Annual sample sizes of JARPA II once the full-scale research program commenced in 2007/8 were 850 (+ or – 10% allowance) minke whales, 50 humpback whales, and 50 fin whales, however at the request of the United States, Japan suspended its take of humpback whales under JARPA II and to date none have been taken under this phase of the research program. The annual quotas for JARPN II are 100 minke, 50 Bryde's, 50 sei and 10 sperm whales.

International or domestic control of whaling?

Until the moratorium started in 1985/86 the quotas for commercial whaling were advised by the IWC SC and decided by the IWC. Therefore the quotas were under international control. After the moratorium quotas have been set by national governments (pursuant to the Article VIII of ICRW (Japan), or under legal objection to the moratorium (Iceland and Norway). Therefore, the current whaling is under domestic control by some member governments.

The only quotas currently set by the IWC (and therefore under international control) are for aboriginal subsistence whaling in Greenland, USA, Russia and St Vincent and The Grenadines.

The Ethics of Lethal Animal Research

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Ethics is all about determining a moral course of action – about assessing right and wrong. In the context of lethal animal research, it examines the question:
Should these animals die for science?

Some people believe that animals should not experience pain, suffering or death for scientific research. However society requires the use of animals for its wider benefit, for example in the development of pharmaceuticals. How should these animals be treated? There is mounting evidence that animals have the capacity to suffer, from the discovery that fish perceive pain to the discovery of complex social systems in some cetaceans (e.g. sperm whales), and even intelligence in octopus. We need to acknowledge that animals have an intrinsic value, and not simply see them as commodities or resources to be exploited without consideration. Society's attitudes are changing.

Recent legislation has been adopted to guide EU member states on the use of research animals: *the European Directive 2010/63/EU on the protection of animals used for scientific purposes*. Scientists have had to become more accountable, and to justify their use of the animals and the techniques they apply.

The ethical framework within which scientific studies are now reviewed is termed "The 3 Rs" (see below) – Replacement, Reduction and Refinement. Typically, this is assessed by an animal care and use committee associated with a research institution. Such a committee is composed of a range of people, not just scientists, to represent the views of wider society when considering the validity of a particular research proposal.

Replacement

In the planning of any scientific study, researchers must first consider alternatives to the use of animals. For example, cell cultures may provide alternatives for testing drugs; DNA can be collected by biopsying an animal rather than killing it to take tissue; Dietary studies may be carried out by collecting faeces and examining the DNA of prey species (or other biomarkers) rather than killing the animal to analyse gut content.

Reduction

Ethical review includes assessing the number of animals required to carry out a research study. It would be unethical to use more animals than required to produce a significant result. Carrying out a power analysis helps to determine how many samples are enough and real time analyses can indicate when sufficient samples have been taken.

Refinement

Scientists must refine their procedures to minimise pain and suffering to research animals. For example, applying analgesia to eliminate or reduce pain before taking a biopsy, or anaesthetising an animal before carrying out a traumatic procedure, are more ethically acceptable methods than proceeding without limiting pain. Such extra stages may complicate an experiment or increase cost, however ethically they are deemed necessary.

Entrenched in the 3 Rs is the understanding that if an animal is to be used in research, the researcher must plan their study so as to minimise suffering.

Species-ism

Whales, dolphins and pinnipeds are widely regarded as charismatic mega-fauna. People value them highly simply because of what they are. Should this influence an ethical consideration of research carried out on them? It should not. However evidence in cetaceans of pain perception, complex social structures and the capacity to suffer, should be fundamental considerations in the assessment of research proposals on cetaceans.

What is unethical?

There are complex ethical issues associated with cetacean research. Not only do the 3 Rs require consideration in study design and implementation, but potential political and economic influences need to be subject to ethical review also.

"Using" more animals than you need to: This accusation of unethical practice is particularly levelled at special permit (scientific) whaling (though has even been raised in the context of whale watching), where many thousands of whales have been killed to address a limited number of questions.

Collecting data but never publishing: if animals have been used in research that is not published, it is possible that more animals will be used by researchers unaware of the first study, to carry out the same experiments.

Potential political and commercial conflicts:

- Is there a potential conflict if researchers profit financially from the results of lethal research? Will this encourage the taking of more animals than is required scientifically?
- Is it unethical to kill a species in the wild (nominally for research) if that population is a resource for other researchers?
- Is it unethical to kill a species in the wild (nominally for research) if that population is a resource used by small island nations for commercial whale watching activities?

- Is it unethical to carry out lethal research (on whales) if it is in contravention of international management recommendations or is a threat to their conservation?

These are the sorts of questions that may be considered in an ethical review, in addition to the 3 Rs.

The ECS should ensure that any research it accepts satisfies the requirements of an ethical review:

- the science has value
- the researcher has applied the 3 Rs (Replace, Reduce, Refine) to avoid undue suffering
- the research conforms to applicable international conventions, is devoid of political influence, and raises no conservation concerns.

The ECS is a scientific society. If it is to form a position on whale killing for research it must use sound ethical principles for its assessment (rather than letting personal beliefs or "species-ism" play a part). An ethical review of the science of special permit (scientific) whaling needs to ask the fundamental question: Are there feasible alternative techniques that would reduce pain and suffering?

Cetaceans and pinnipeds are sentient animals, aware of objects and individuals around them, and can feel pain. They have the ability to suffer. Therefore all researchers studying them have a duty to conduct their research ethically.

Research programmes including special permit takes of cetaceans in Icelandic waters.

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A brief account is given of research on cetaceans conducted by the Icelandic Marine Research Institute (MRI) under the so called Special Permit (SP) procedure in accordance with Article VIII of the Convention of the Internationan Whaling Commission (IWC) which authorizes member nations to sample whales for scientific purposes. Over 200 such special permits have been issued by 10 member states, most often by Japan followed by the USA. Iceland has conducted two research projects that include special permit takes, in 1986-1989 and 2003-2007.

The term "destructive sampling" used in the heading for this workshop (meaning the killing of animals for scientific research) has for a long time and continues to be, the primary method used by marine biologists for advancing scientific knowledge in their field. Thus, every year billions of vertebrates are killed for fisheries related research all over the world. This practice is widely recognized as the most efficient and cost-effective method to assess the status of stocks i.e. from demographic parameters as well as species interactions in marine ecosystems from stomach content analysis. For whales, our present knowledge on their general biology is to a large extent based on scientific examinations of dead carcasses conducted in conjunction with the whaling industry during the last century. Concomitant with diminishing access to fresh whale carcasses towards the end of the 20th century, new research methods were developed that do not rely on traditional biological dissections. These include i.a. photo-identification, satellite telemetry and genetic analyses of skin biopsies and have provided valuable new insights into cetaceans biology, particularly in the field of animal behaviour.

In both Icelandic SP research projects, a combination of lethal and non-lethal methods was applied. The methodological choice was based on the likelihood to successfully address the individual research objectives. A fundamental prerequisite for all lethal takes was that they would not pose any threat to the populations concerned, and that best available humane killing methods were used.

The first Icelandic SP research programme involved takes of a total of 292 fin whales and 70 sei whales over a period of four years (1986-1989). Research objectives included studies on the biology (age reproduction etc) of the species, feeding ecology and energetics, distribution and abundance, CPUE relationships, stock structure (genetics, morphometry, radio tagging, photo-id), pathology and population modelling. To date, publications based on this programme include 52 peer-reviewed papers, 11 published but not peer-reviewed articles, 61 unpublished scientific papers and reports (i.e. IWC, ICES, NAMMCO) and one PhD thesis. Among interesting finding were the first genetic

documentation of hybridization among large whales (fin and blue whales), temporal changes in biological parameters (age at maturity, fecundity etc) and their relations with food availability and energetics and the first reliable estimates of absolute abundance of cetaceans in the Central North Atlantic.

The latter research programme included takes of a total of 200 common minke whales during 2003-2007. The programme was designed as a pilot study with multiple objectives including evaluation of the feeding ecology of the species in Icelandic waters (diet composition, energetics, multispecies modelling etc.) , stock structure (genetics, satellite telemetry etc.), biological parameters (age at maturity, fecundity etc.), parasites and pathology and pollutant concentrations in tissues. One aspect of the programme, particularly relevant for the discussion at this workshop, is evaluation of some recently developed non-lethal research methods by comparison with the more traditional methods. This includes comparing the results on diet composition from stomach content analysis with those from analysis of fatty acid and stable isotopes from the outermost layer of the blubber, the latter being a proxy for a biopsy sample. Similarly, concentrations of various pollutants in the "biopsy" are compared to those in different tissues and organs.

The results of this latter programme are only partial and preliminary at this stage, but a formal evaluation of the programme is expected to take place within the IWC in 2012/2013. The study confirmed a wide spectrum of prey size for minke whales varying from krill (1g) to cod of up to kg in weight. Overall sandeel was the most common prey, followed by herring, krill, haddock, capelin and cod. Pronounced spatial and temporal variation was found in the diet of minke whales. Sandeel was particularly dominant off southern and southwestern Iceland while the diet appeared more diverse off northern Iceland. Compared to a small study 20 years earlier, the proportion of gadoids and other large bony fish species was much higher in the present study with correspondingly less contribution of krill and capelin to the diet. During the course of the sampling period the proportion of sandeel in the diet decreased while herring, gadoids and krill increased. These changes are consistent with indices of abundance for these fish species in Icelandic coastal waters. Throughout the study period (2003-7) capelin abundance was low in this area. Recruitment of sandeel failed to a large extent in 2005 and 2006, consistent with a decrease in prevalence of this species in the minke whale stomachs. The increased incidence of herring and haddock in the latter part of the study period is also consistent with information on abundance of these species.

The satellite tracking part of the programme has given the first indication of wintering areas for minke whales summering in Icelandic waters. Thus, a minke whale tagged in August 2004 off Iceland was tracked to the waters off west Africa in December.

Preliminary results from the analysis of pollutant burdens in minke whales show generally low levels in Icelandic waters compared to most other areas. With the exception of HCB, concentrations were consistently higher in the outermost ("biopsy") sample than in the complete blubber section. Biopsies therefore appear not to be representative for blubber concentrations of pollutants, except for HCB. However, this study can help establish formulae to estimate pollutant burden in blubber from biopsies in

the future. On the other hand, biopsies do not appear to be applicable for estimating pollutant burden in muscle and liver.

To conclude, these two research programmes have already made a significant contribution to our knowledge of the biology and ecology of the exploited species, as well as on other protected species in Icelandic and adjacent waters. While some newly developed non-lethal methods have the potential to provide equivalent results with respect to the research objectives (e.g. genetical studies and HCB concentrations from biopsies), others (e.g. diet studies from fatty acid analysis and stable isotopes) still need further evaluation. At present there is no reliable non-lethal method to fulfil the data requirements of multi-species models such as those in use at the MRI (detailed diet composition including age/size of prey), which was the primary objective of the Icelandic minke whale research programme.

Results of the Japanese whale research programmes and the contribution for the assessment, management and conservation of large whales

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Four Japanese whale research programmes have been conducted under the Article VIII of the International Convention for the Regulation of Whaling (ICRW): the Japanese Whale Research Program under Special Permit in the Antarctic (JARPA, 1987/88~2004/05), JARPAII (2005/06 ~), the Japanese Whale Research Program under Special Permit in the western North Pacific (JARPN, 1994~1999) and the JARPNII (2000~). The respective research proposals of these programs have been presented to the annual meetings of the Scientific Committee of the International Whaling Commission (IWC SC) where they have been reviewed following established protocols. Individual papers with research results have been presented to the IWC SC annual meetings and discussed in the relevant sub-committees related to stock assessment and management of whales.

Furthermore the IWC SC has carried out intersessional special workshops focused specifically to review data and results from those research programmes, in 1997 and 2006 for JARPA (IWC, 1998; 2008), in 2000 for JARPN (IWC, 2001) and 2009 for JARPNII (IWC, 2010).

The fundamental purpose of Japan's whale research is to gather scientific data required to establish a management regime for the sustainable use of whale resources. For this purpose some data cannot be obtained by non-lethal means. Japan's research programs are therefore a combination of lethal and non-lethal research components. The lethal component involves the take of a limited number of whales: Antarctic minke whale under the JARPA; Antarctic minke, fin and humpback whales under the JARPAII (the take of humpback whales has been suspended so far); common minke whales under the JARPN; and common minke, sei, Bryde's and sperm whales under the JARPNII.

In this presentation, the key results of JARPA and JARPN/JARPNII, are summarized. The presentation also explains how these results have been used by the IWC SC for stock assessment and management of the whale species involved.

JARPA

Data

In the 18-year period of JARPA biological samples and data (37 items) were collected from a total of 6,777 Antarctic minke whales. In addition, sighting (sighting by species, sighting effort, photo-id and biopsy sampling of large whales), and environmental data (pollutants in samples taken from whales, and the environment, and oceanographic), were obtained. The JARPA review workshop concluded that 'the data set provides a valuable resource to allow investigations of some aspects of the role of the whales within the marine ecosystem and that this has the potential to make an important contribution to the IWC SC work in this regard as well as the work of other relevant bodies such as the CCAMLR' (IWC, 2008).

Results relevant to stock assessment and management (Antarctic minke whales)

Stock structure

Genetic and morphometric analyses showed that at least two stocks occur in the JARPA research area (35ºE-145ºW, south of 60ºS). Data do not support the current IWC management Area division.

Biological parameters

Length and age at sexual maturity, growth curve, percentage of matured females pregnant, foetal sex ratio and mean litter size, natural mortality rate and MSYR (1+) were estimated on the basis of the identified stocks.

Prey consumption

Prey consumption was estimated by sex and maturity classes. The daily prey consumption of krill during the feeding season varied between 2.7 and 4.0% of the body weight.

Trend in biological parameters and body conditions

Recruitment increased over the middle decade of the 20th Century to peak at about 1970, and then stabilized or declined somewhat for the next three decades. Age at maturity (transition phase) declined from the 1940's cohorts to late 1960's cohorts. The blubber thickness (an indicator of body condition) was decreasing for nearly two decades.

Ecosystem modeling

JARPA data (abundance, prey consumption) were used as input parameters in an ecosystem modeling exercise to address the question: can the predator-prey interaction alone explain the observed trend in biological parameters without the need for recourse to environmental change hypotheses? Preliminary results suggested that the observed change can be explained mainly by the predator-prey interaction.

JARPN/JARPNII

Data

In the first six-year period of JARPNII biological samples and data (33 items) were collected from a total of 1,221 common minke, 489 sei, 393 Bryde's, and 45 sperm whales, respectively. In addition, sighting (the number of sighting by species, sighting effort, photo-id and biopsy sampling of large whales), pollutants (environmental and in prey species samples) and oceanographic data, were obtained. The JARPNII review workshop by an independent experts panel appreciates 'the notable amount of effort undertaken and the generally high quality of the sampling programme, resultant data and information from JARPNII studies on whale food habit and prey preferences and that these efforts have resulted in valuable datasets that have great potential for concerted analytical work on broad range of topics' (IWC, 2010).

Results relevant to assessment and management (western North Pacific)

Stock structure

The analyses of genetic and non-genetic data collected by JARPN and JARPNII provided the basis for the establishment of four stock structure hypotheses in the Bryde's whales, three in the common minke whales and one in the sei whales.

Prey consumption
Common minke whales feed on several prey species important for fisheries in Japan such as krill, Japanese anchovy, Pacific saury, Walleye Pollock and neon squid. The total annual consumption of Japanese anchovy, mackerels and Pacific saury by the common minke, sei and Bryde's whales were estimated to 774,415t, 140,023t and 43,481t, respectively. These figures correspond to large percentages of the annual catches of those fish resources.

Prey preference
Preys of the common minke, sei and Bryde's whales overlapped but analyses suggested that their trophic niches were different from each other. Sei whales prefer copepod, Bryde's whales the Japanese anchovy, and common minke whale the Pacific saury and Japanese anchovy.

Ecosystem models
JARPNII data have been used as input parameters in the development of different ecosystem models, e.g. Bayesian assessment model (coastal area) and Ecopath with Ecosim (offshore area). The first one is being developed to investigate the effect of consumption of sandlance by common minke whales. The second one is being developed to evaluate the possible impact of whaling on Japan's fisheries resources. Preliminary results were dependent on the assumptions of functional response used.

HOW THIS INFORMATION HAS CONTRIBUTED TO ASSESSMENT AND MANAGEMENT OF WHALES

The IWC SC carries out *comprehensive assessment* of whale stocks. When the assessment is in the context of the RMP (Revised Management Procedure)-a single species management procedure- the process is called *pre-implementation assessment.* Typical information required in these assessments is stock structure, abundance, and life history parameters. The IWC SC has carried out *pre-implementation assessment* of western North Pacific common minke and Bryde's whales and the information provided by JARPN/JARPNII on stock structure, abundance and life history parameters has been fundamental to complete those assessments successfully.

Different organizations including the IWC, have recognized the importance of ecosystem-based approaches to manage fisheries resources. JARPNII has collected information on abundance of whales and prey species, prey consumption by whales (qualitative and quantitative) and prey preferences, which are important input parameters for the development of ecosystem models in the western North Pacific. The output from the modeling exercise will assist in the formulation of ecosystem-based management policies in the future.

In the case of the Antarctic, the new information on stock structure is likely to contribute to the definition of new management areas for the Antarctic minke whale for future *implementations* of the RMP. Information of biological parameters is important for

assessment as these parameters are related to growth. Estimations of the MSYR are useful for the future *implementations* of RMP.

The IWC SC is currently conducting catch-at-age analyses for assessment purposes of the Antarctic minke whale. JARPA catch-at-age data have been fundamental for this exercise.

Ecosystem modeling work has begun to reveal the temporal trends found in some biological parameters. Again, output from this exercise will assist in the formulation of ecosystem-based management policies in the future.

Finally most of the information useful for stock assessment and management (under both single-species and ecosystem-based approaches), such as stock structure, catch-at-age data, whale condition, prey consumption rates and prey preference are unlikely to be obtained by non-lethal means alone.

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Whales and whaling: critical questions for management and conservation

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Article VIII of the International Convention for the Regulation of Whaling allows any member country to issue special permits for whaling which are exempt from International Whaling Commission (IWC) regulations. The decision on how many whales to take of each species is up to the IWC member nation issuing the permits. The IWC and its Scientific Committee can comment on special permit whaling programmes, but there is no requirement to take these comments into account. The use of Article VIII has been controversial throughout the history of the IWC and countries have complained about others using it to get around IWC rules. Special permit catches increased dramatically following the moratorium on commercial whaling which came into effect in 1987, resulting in over 14,000 individuals of nine whale species being taken by Iceland, Japan and Norway between 1986 and 2010.

Most permits issued under Article VIII have been justified on the basis of providing information relevant to management. The case for lethal sampling to collect data for management purposes will depend on what management actions are being considered. A widely held view is that management involves limiting human activities to ensure that environmental impacts are not excessive, e.g. setting catch limits that are believed to be sustainable. An alternative and contrasting view is to take management of whale populations literally and control whale numbers through culling in order to manipulate ecosystems for a purpose such as greater fisheries yields.

The IWC has an agreed method, the Revised Management Procedure (RMP), for assessing the conservation implications of lethal threats to whales (e.g. whaling, bycatch, and ship strikes). The RMP requires information on abundance, population structure and catch history. None of these requires whales to be killed. For some populations, special permit catches have been considerably in excess of what would be considered sustainable under the agreed RMP limits calculated by the IWC Scientific Committee. For example in 2010, the RMP limit for western North Pacific Bryde's whales was five, whereas the special permit take was 50. Although the application of the RMP does not require data obtained by lethal means, it can however be informed by additional information on trends in numbers, reproductive output, survival, response to changes in the environment, and effects of sub-lethal threats (e.g. noise, chemical pollution, or disturbance). The original objectives of Japan's special permit whaling in the Southern Ocean (JARPA) were mainly related to these types of supplementary information relevant to the management of commercial whaling. In 2006 the IWC Scientific Committee held a workshop to review the results of JARPA which had been ongoing for 18 years (1987-2005), and involved the take of 6800 Antarctic minke whales. Following the review, the Committee agreed "*the results from the JARPA programme, while not required for management under the RMP, have the potential to improve management of minke whales in the*

Southern Hemisphere". Although the Scientific Committee noted potential value, it also concluded that even after such a lengthy and extensive programme the potential had yet to be realised in terms of actual results. On population trends the Committee noted that "*Estimates of population trend arising from JARPA are consistent with a substantial decline, a substantial increase or approximate stability*" and on natural mortality rate that "*estimates from JARPA data alone were, at around 0.04, within the plausible range, but the confidence limits (from below 0 to above 0.10) spanned such a wide range that the parameter is still effectively unknown*". In other words, no new insights had been gained on trend or natural mortality rates. On population structure, although the JARPA results indicate that there are likely at least two populations of Antarctic minke whales, the lack of any genetic samples from the winter breeding grounds means that the breeding populations have not been identified. The argument that minke whales need to be killed to obtain genetic samples rather than through biopsies is also not tenable given the success of biopsy sampling elsewhere.

Recent special permit whaling including Japan's JARPNII programme in the North Pacific and Iceland's take of 200 minke whales between 2003 and 2007, have been justified in terms of examining whale stomach contents to provide input data into multi-species models. These models appear in part to have been motivated by perceived competition between whales and fisheries. In 2001 the Government of Japan stated that "*Top predators influence the dynamics of prey species which are the target of commercial fisheries and competition exists between top predators and fisheries*". In 2011 Icelandic IWC Commissioner Tomas H. Heidar, explained Iceland's whaling policy to a European Parliament hearing on fisheries: *"the whales are in competition with our fishermen for food. They are eating the fish stocks and the nutritions that the fish stocks live from. So there is a need to keep some balance and sustainably manage some whale stocks"*. These statements are not consistent with the view of either the Scientific Committee of the IWC or the North Atlantic Marine Mammal Commission (NAMMCO). In 2003, the IWC Scientific Committee agreed that *"for no system at present are we in the position, in terms of data availability and model development, to provide quantitative management advice on the impact of cetaceans on fisheries, or of fisheries on cetaceans*" and in 2009 the NAMMCO Scientific Committee stated "multi-species modelling required in order to address management questions is quite complex and the current multi-species models are not, at this time, sufficient to provide quantitative management advice". There are many sources of uncertainty in multi-species models and little reason to expect that examining the contents of whale stomachs will reduce this uncertainty substantially. The review panel for JARPNII commented that *"the models as developed thus far are not yet at the stage where they can be used to draw even general conclusions and certainly cannot be used to reliably inform management advice*".

In considering whether to consider research results from special permit whaling the ECS will need to consider the context in terms of international agreements and regulations including animal welfare and ethical issues. This may include whether the programme was justified in terms of contributing to management even if the results being presented to the ECS are not related to management issues. For managing human threats such as direct takes, lethal programmes are not required for management using agreed procedures

such as the RMP. The justification that special permit whaling can provide data on whether culling whales will benefit fisheries has also not been substantiated by the results. Given the complexity of the issues, the ECS may wish to adopt a cautious policy in considering research from special permit whaling. In particular it may wish to decline to consider results from programmes where the IWC has passed Resolutions asking the country to reconsider the special permit or the legality of the programme is subject to ongoing legal disputes at an international level. Another reason not to consider results could be where the whaling raises conservation concerns. For example if more whales are being taken than would be allowed under the RMP or there is insufficient information to assess the effects on the population.