

# ■ Japanese Whaling and the Language of Science

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## Abstract

This article analyses the publications resulting from Japanese whaling research over the last decade to ascertain what findings have resulted, what value these findings have and whether the findings, if valuable, could be researched in other ways. The Institute of Cetacean Research in Japan funds the whaling. The discussion will revolve around what the Institute says that it is doing with the whaling programs and what the research papers actually conclude.

**Keywords:** Japanese whaling, International Whaling Commission, scientific whaling, moratorium on whaling, whaling research results

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In 1987 the International Whaling Commission (IWC) imposed a moratorium on commercial whaling. This was prompted by the decline in whale populations but also the widely held view in different countries that it is morally unacceptable to kill whales.<sup>1</sup> In the same year Japan set up a “scientific whaling” program, killing whales from the Southern Ocean and taking them on board research vessels. This work is funded by the Institute of Cetacean Research (ICR), which is authorized by the Japanese Government.

The right to kill whales for scientific research is accepted by the IWC. Proposals are reviewed by the Commission but it is the member state putting in the proposal that decides on whether or not to issue a permit to whale. Japan has issued itself permits to kill about 1,000 whales a year from 1987 to the present. The Commission cannot stop the issuing of permits but it can comment on the practice. It has for many years asked Japan to stop issuing permits or to change their program so that non-lethal means are used. Pressure from outside the Commission is mounting. In 2002 in an open letter to the *New York Times*, twenty-one scientists declared that they “believe Japan’s whale ‘research’ program fails to meet minimum standards for credible science” (Briand *et al.*). Captain Paul Watson from the Sea Shepherd Conservation Society stated in 2009 that “The Japanese ‘researchers’ have not published a single peer reviewed scientific paper on their observations or discoveries” (Sea Shepherd Conservation Society 2). In an open letter to President B. Obama in 2010, Ric O’Barry from the Earth Island Institute claimed that the Japanese whaling in the Southern Ocean is “bogus scientific research” and “an illegal front for commercial whaling.” This letter was endorsed by eleven organisations representing two and a half million members (O’Barry 4).

These are strong statements, no doubt supported with conviction. However I don’t believe that there has been any detailed analysis presented in the public arena to back such claims. As I will show there definitely are peer-reviewed scientific papers emerging from the Japanese whaling programs in the Southern Ocean appearing in respectable journals. They seem to constitute credible science and non-bogus research, yet what is actually studied diverges significantly from the aims of the research presented by the Japanese Government to the IWC. If the research programs are primarily about science then why would there be such a consistent divergence? I try to address this question towards the end of this article.

The Japanese Government seek to justify some whaling around their coast on cultural grounds, e.g. the killing of thousands of dolphins on a yearly basis out from the town of Taiji. This is not a rationale they put forward for the whaling in

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<sup>1</sup> For a discussion of this view, see Russell, *Who Rules the Waves* 105-20.

the Southern Ocean which is supposed to be justified by the scientific research. In a document headed “The Position of the Japanese Government on Research Whaling” (5) it is stated that: “The purpose of Japan’s program [in the Southern Ocean] is to conduct scientific research.”

This article analyses the publications resulting from the Japanese whaling research over the last decade to ascertain what findings have resulted, what value these findings have and whether the findings, if valuable, could be researched in other ways. The discussion will revolve around what the Institute of Cetacean Research says that it is doing with the whaling programs and what the research papers actually conclude. The analysis will look at whether the body of work examined could be said to constitute science or whether the language of science hides another agenda. The texts studied are listed in Appendix 1 by year of publication, following the Institute’s notification of these papers. Full details are provided in the Reference list.

### **Japanese Scientific Whaling**

The focus of this study is on Japanese research on whales in the Southern Ocean as this is the main area where the Japanese are whaling. Also most of this whaling is conducted in a whale sanctuary so it attracts international concern. The research is called JARPA (Japanese Whale Research Program under Special Permit in the Antarctic) and JARPAII. JARPA took place from 1987 to 2005; JARPAII from 2005 til the present. Since 1987 there have been critics of these programs from inside the IWC and outside as indicated above. In 2007 a Resolution was passed in the Commission “asking Japan to refrain from issuing a permit for JARPAII by 40 votes in favour, 2 votes against and 1 abstention” (IWC Information). The criticisms have been that the research results do not warrant the killing of whales. However the Japanese delegates were unmoved by these attacks. The researchers returned home early in 2011, citing interference from environmental activists. During 2011 it has been unclear whether Japan would issue itself permits in the future especially given the tragic loss of life and environmental devastation of 2011. However late in the year newspaper reports announced that Japan will continue whaling in 2011/2012 with a funding boost of \$27 million (Willacy). Even if these reports turn out to be inaccurate it is still important to examine the texts which have emerged from the JARPAs as cultural documents. What do they tell us about how whales are viewed? How do the discussions about whales in the published research papers relate to the aims of either the IWC or the ICR?

## A Whale Is a Being or a Specimen?

Part of the function of the moratorium on whaling was to recognize that many people around the world viewed whales as complex, sentient beings worthy of respect. Recent neuroscience has detected spindle cells in the brains of humans and great apes in areas that are regarded as “important in reactions that require rapid emotional judgements, such as deciding whether another animal is in pain and the feeling of whether an experience is pleasant or unpleasant” (Bekoff and Pierce 29-30): in other words quite high level cognitive skills. Now they have been discovered in whales and furthermore whales have “three times more spindle neurons than humans” (Bekoff and Pierce 30). Lori Marino, a cetacean expert from Emory University says that this finding “is consistent with the growing body of evidence for parallels between cetaceans and primates in cognitive abilities, behaviour and social ecology” (qtd. in Bekoff and Pierce 30).

The papers coming out of the Japanese research programs are at odds with this perspective. Whales are described as “samples” (Ohiski *et al.* “Pathological and Serological” 127) or “specimens” (Yunoki *et al.* 151). When whales are killed, this action might be spoken of as simply “harvesting” (Sasaki *et al.* 77) even “human-induced harvesting” (Mori and Butterworth 219); “capturing” (Suzuki, “Plasma and Pituitary Concentrations” 1128) or “sampling” (Pastene *et al.* 1) or the slaughter of whales might be described as “taking” them (Konishi *et al.* “Decline in Energy” 1510) or “depleting them” (Mori and Butterworth 219; Tamura and Konishi 7). In this language the capacity of whales to suffer is denied. Yet it cannot now be seriously doubted. D’Amato and Chopra write:

When whales are harpooned and dying, their characteristic whistles changed dramatically to a low monotone. In contrast, in the normal healthy state, their whistles are beautiful birdlike sounds with trills and arpeggios, glissandos and sitar-like bends in the notes. This change is clearly analogous to the transformation in human expression from talking (or singing) in the normal state to crying when in pain. Additionally, there can be little physiological doubt that whales feel pain; indeed, the real question is whether they perceive acute pain to an even greater degree than humans. This latter possibility is evidenced by the far wider range of skin sensations apparently registered by the complex cerebral cortex of the whale. (D’Amato and Chopra 24-25)

The whales in the Japanese research are killed by harpoons. This is noted in many of the research papers in a mantra which goes: “All whales used in the present study were killed by explosive harpoons . . . and a large-caliber rifle was the secondary method when required.”<sup>2</sup> There is no mention here of the pain and suffering incurred. Two researchers are working on improved methods for killing

<sup>2</sup> See for instance, Ikumi, *et al.* 285.

whales (Ishikawa and Shigemune, 2008) but this work is simply concerned with improving harpoon technology. None of the papers discuss the desirability of conducting non-lethal research even though such methods are strongly advocated by the IWC.

## **Objectives of Scientific Whaling Research**

The IWC issues guidelines for whaling under the scientific permit with the central clause being “whether the research is essential for rational management, the work of the Scientific Committee [of the IWC] or other critically important research needs” (“Scientific Permit Whaling”). Clearly there is room for debate here on the language. In particular, what is meant by “rational management” and what would count as “critically important”? These questions continue to be raised in the IWC. The Commission does not have a solely conservation focus although some delegates would like to move it in that direction. The resumption of commercial whaling is always a possibility and the 2006 IWC report allows that in the future it might be the case that minke whale numbers in the Southern Hemisphere could be caught “without increasing the depletion risk” (“Scientific Permit Whaling”).

The Japanese whaling programs have specific lists of objectives changing from JARPA to JARPAII. In the first program the objectives were: “a) estimation of biological parameters to improve the stock management of the Southern Hemisphere minke whale; b) elucidate the role of whales in the Antarctic marine ecosystem; c) elucidation of the effect of environmental change on cetaceans; and d) elucidation of the stock structure of Southern Hemisphere minke whales to improve management” (“Research Results”). The JARPAII objectives are “a) monitoring the Antarctic ecosystem (whale abundance trends and biological parameters; krill abundance and the feeding ecology of whales; effects of contaminants on cetaceans; cetacean habitat); b) modelling competition among whale species and future management objectives; c) elucidation of temporal and spatial changes in stock structure; and d) improving the management procedure for Antarctic minke whale stocks” (“Research Results”).

## **Research Results**

Appendix 1 below contains a list of all the peer reviewed papers emerging from JARPA and JARPAII since the year 2000. I compared the content of these

papers against the stated objectives and a remarkable result was obtained. I have provided headings to describe the actual nature of the research published and the research papers falling under these headings are noted. I have listed these papers by year to highlight when the main body of research was conducted.

### ***Minke Whale Biology and Physiology:***

#### *Minke Whale Reproductive Physiology: In Vitro Fertilization Studies*

Asada *et al.*, 2000; Wei *et al.*, 2000; Asada, 2001a; Asada *et al.*, 2001b; Suzuki *et al.*, 2001; Ikumi *et al.*, 2004; Fukui *et al.*, 2004; Fujihira *et al.*, 2004; Muranishi *et al.*, 2004; Anemiya *et al.*, 2004; Iwayama *et al.*, 2004; Iwayama *et al.*, 2005; Fujihira *et al.*, 2006; Kobayashi *et al.*, 2006; Nagai *et al.*, 2007; Asada *et al.*, 2007; Pastene *et al.*, 2010.

#### *Other minke whale reproductive physiology*

Mogoe *et al.*, 2000, Urashima *et al.*, 2002; Tetsuka *et al.*, 2004.

#### *Other whale biology and physiology*

Suzuki *et al.*, 2002; Ohishi *et al.*, 2003; Konishi, 2006; Yunoki *et al.*, 2008; Oshishi *et al.*, 2008; Konishi *et al.*, 2008.

### ***Genetics Studies:***

Pastine *et al.*, 2002; Abe *et al.*, 2002; Hayashi *et al.*, 2003; Nishida *et al.*, 2003a; Nishida *et al.*, 2003b; Nikaido *et al.*, 2005; Sasaki *et al.*, 2005; Iwanami *et al.*, 2006; Nikaido *et al.*, 2006; LeDuc *et al.*, 2007; Nishida *et al.*, 2007; Onbe *et al.*, 2007; Pastene *et al.*, 2007; Fujise *et al.*, 2010.

#### *Whale Population Studies:*

Kasamatsu *et al.*, 2000; Matsouka *et al.*, 2005b.

#### *Feeding Patterns:*

Murase, 2002; Mori and Butterworth, 2006; Tamura and Konishi, 2009.

#### *Killing Methods:*

Ishikawa and Shigemune, 2005; Ishikawa and Shigemune, 2008.

#### *Whale Contamination:*

Kunito *et al.*, 2002; Honda *et al.*, 2006.

## Do the Research Results Fit the JARPA AND JARPAII Aims?

Some of the papers listed by the ICR were incorrectly placed under the JARPA programs. One paper did not relate to whales: Yabuki *et al.* Rosenbaum *et al.* report on a genetic study of right whales but not under the JARPAs. Watanabe *et al.*'s article is about whales in the North Pacific Ocean. Matsouka *et al.* write about a sighting of pigmy right whales but not in Antarctic waters. The paper by Rock *et al.* is not about whales in the Antarctic. Branch *et al.* are non-Japanese researchers reporting on blue whales and this research is not part of the JARPA programs. All these papers are incorrectly listed as part of the Japanese programs conducted by the ICR.

There are 55 papers in the ICR list of results of the JARPA programs. In 2010 ten 2-page reports appeared in a Japanese fisheries publication along with a slightly longer one. They are listed as "peer reviewed publications". However these reports are in-house summaries of previous research and for this reason are excluded from the following analysis. If we remove the 6 papers just mentioned in the previous paragraph that leaves 49. I want to now turn to the question of whether the research fits the objectives of the programs. There is in fact a significant mismatch. The *in vitro* fertilisation studies form the bulk of the research articles. Yet this research direction has nothing to do with the ICR objectives for the JARPAs as stated above. These studies involve attempts to extract eggs and sperm from minke whales which are then commonly frozen. Later, attempts are made to produce a fertilized embryo using different maturation media. Below I will consider the value of this research independently from whether or not it meets the JARPA aims as it could be argued if this is an important research direction then perhaps the aims should be changed. At this point however I will remove the 17 papers on *in vitro* fertilization from consideration. This leaves 32 papers.

One of the other studies on whale reproductive physiology involves the weighing of male minke whale testes (Mogoe *et al.*). The stated aim is to gain information on the reproductive biology of male mature southern minke whales to get "reliable estimates of biological parameters for the management of the whale population" (Mogoe *et al.* 560). This language makes it appear as if the study is definitely relevant to the aims but there is no indication of what management options would relate to testicular weight. The Urashima *et al.* study concerns only two minke whales (and a Norwegian beluga whale). The researchers found that the minke whales had lactose in their milk and the beluga did not. There was a large variation in lactose between the two minke whales. This sample is too small to draw any conclusions. The Tesuka *et al.* study is on the size of ovaries in minke whales and their colour and whether they were smooth or wrinkled. They found

that the older the animal the heavier the ovaries. This result is completely unsurprising and has no obvious practical significance. Nor do the authors relate this finding to the differences in the appearance of the ovaries. The latter results may be of “interest” in a theoretical sense that we are finding out more about how a whale functions but the research projects under JARPA have not had mere interest as a rationale. The rationale goes no way towards justifying the killing of the 94 whales used in this study. These three studies then cannot be said to match the JARPA or JARPAII objectives. We are then left with 29 papers.

What about the papers on whale biology or physiology? The Suzuki *et al.* paper “The Characteristics of Adrenal Glands” is a glandular and hormonal study of cetaceans which is not related to the aims of the Japanese whaling programs. The Ohishi *et al.* study “Pathological and Serological Evidence” is about whether or not minke, sperm and Bryde’s whales have anti-bodies to the *Brucella* infection. While this could be of relevance to the objectives as the disease has serious consequences for whales, the researchers are primarily interested in the consequences for humans who eat or have contact with infected animals. It is noted that *Brucella* has been isolated in some domestic animals and found to “cause abortion in their host which results in huge economic losses” (Ohishi *et al.*, “Pathological and Serological Evidence” 126). The implied relevance of the study in the article is that if there is *Brucella* in whales this will have economic consequences. However the eating of whale meat in Japan only occurs because of the supply of whales from the scientific programs. Whales cannot be traded across countries because of the Convention on International Trade in Endangered Species. Nowhere is it listed in the aims of the JARPA research to assess the eating quality of the whales. The study by Oshishi *et al.* “*Brucella* infection” is on the same topic and the motivation for it is even clearer. The authors claim that the *Brucella* disease needs to be monitored to ascertain if there are implications for consumption of, or contact with marine mammals (Oshishi *et al.*, “*Brucella* infection” 5).

Konishi in “Characteristics of Blubber Distribution” looks at the body condition of 2,816 mature male minke whales and 1,635 non-lactating pregnant females killed under the JARPA program. He found that blubber thickness varied but patterns of blubber distribution were similar between sexes. The author claims that studies of body condition are important in monitoring the health of animal populations. However to assess the health of animals by killing them seems to be an extreme approach. Not only were 4,451 mature whales killed but fetuses were killed also. Possibly to smooth over this tragedy the author notes, “As reproduction is one of the most important factors deciding the body condition, fetal length, which implied the conception date, was also included in the analysis of pregnant females” (17). While it is conceivable that this research could have

relevance to “improving stock management,” the first JARPA aim, the author does not say how.

The study by Yunoki *et al.* is into the lipid content in the outer skin of whales. It is unnecessary to kill whales to make such a study as whales slough off their outer skin during close encounters with each other or strong movements on the surface of the ocean such as boisterous slapping. It is possible for researchers to collect this skin with a sieve. Such a method is commonly used in Hervey Bay, Australia whale research conducted by the Oceania Project. The Konishi *et al.* study published in 2008 (“Decline in Energy Storage”), is initially described as using 4,702 whales from 1987 til 2005 to measure the annual trend in energy storage (blubber thickness and fat weight, which is the blubber weight plus visceral fat) over this period. The conclusion is that there is a decrease of approximately 9% in blubber thickness and fat weight over this period. This study could have relevance to the JARPA objectives but the authors do not draw that out. Also “fat weight was available from only 740 whales and fewer than 4,702 were used to measure blubber thickness” (1511). It is disingenuous then to say that 4,702 whales took part in the study. With the small sample size, numerous short-term or long-term factors could be involved. Nothing definitive can be concluded. So even though the research might look as though it meets the JARPA aims, it fails to do so. For different reasons then these 6 studies cannot be held up as matching the JARPA or JARPAII objectives. This leaves 23 studies.

The 14 genetics studies mainly focus on phylogenetic relationships between whales, looking at questions such as which whales are closely related to others and the evolutionary tree that should be constructed. While of theoretical interest these studies do not relate to the objectives of whaling in the Southern Ocean and could be conducted by non-lethal means. So another 14 studies should be taken off the list, leaving nine papers. These are on whale populations, feeding patterns, killing methods and contamination studies. The two papers on killing methods should be rejected as not fitting the aims of the JARPA research. However the other categories do look relevant. Some of these studies are based on non-lethal research, so while possibly relevant to the aims, they cannot be used to justify lethal research: the paper by Kasamatsu *et al.* focuses on whale sightings and the one by Murase is about baleen whales and krill, their food source, using echo sounders to detect krill and sightings of whales. The report in Matsouka *et al.* (“Abundance Increases”) concerns increases in baleen whales based on sightings; Mori and Butterworth attempt to build a theoretical model for krill-predator dynamics.

Now there are 3 articles which are relevant to the JARPA objectives and involve lethal research. The first is a study by Tamura and Konishi on minke and

their food source. It involves 6,777 Antarctic minke whales killed in the JARPAs from 1987 til 2005. The feeding habits of the whales were investigated based on “quantitative” information on prey species and freshness of stomach contents in order to estimate the amount of prey consumed by the whales (Tamura and Konishi 13). The study is flawed as the feeding patterns of minke whales are known to vary. For many months of the year when migrating out of the Antarctic waters, little if any feeding occurs. The number of days spent feeding in the Southern Ocean also varies. So estimating stomach contents on one day may not give a good basis for annual consumption. Once the whales are part of the study they cannot be re-assessed as they are dead. Although not explicitly stated it seems that this study is really focussed on krill, the food source for the minke whales. Krill are spoken of as “resources” and the authors mention “the krill surplus from the depletion of baleen whales” (Tamura and Konishi 21). The reference here is to the commercial whaling that has been discontinued. “Krill surplus” is a most peculiar phrase (what are they surplus to?) that could in the future be used to argue for further human exploitation of krill. However whether or not there is a “krill surplus” cannot be ascertained at present. The only studies carried out on krill populations have been limited hydroacoustic ones which involve an estimation in very limited areas and whether those areas are representative of wider feeding grounds or not can only be a guess. So the Tamura and Konishi study could be relevant to JARPA aims but it has serious methodological weaknesses. The other two studies are by Kunito *et al.* and Honda *et al.* The first study reports on the contamination load in the skin and liver of 180 whales. It is already known that skin biopsies are adequate ways of monitoring contamination and these biopsies can be taken from free-swimming whales (see for instance, Gauthier and Sears). So it was not necessary for the Kunito study to kill whales to test the livers. A similar point can be made about the Honda study.

Thus the bulk of the articles listed by the ICR as results of the two JARPA studies do not fit the aims of these research projects. For the few that do, they are so poorly constructed that they must be dismissed. This throws suspicion over what is really going on with the supposed scientific research.

### **Is the Japanese Whaling Research Scientific?**

There is no question that there is research output from the whaling, though it is meagre compared to the research effort that includes taking boats to the Southern Ocean, enduring harsh conditions, the financial expense of the voyages and facing international condemnation. Does it matter that the aims of the ICR

are not met? From a political point of view it does. The ICR presented these two sets of aims to the IWC. Although it is not the role of the IWC to reject scientific whaling, nevertheless if the Japanese Government wishes to stay as a member of the IWC it would not want to appear duplicitous. It may well be the case that many member nations of the IWC have taken Japan at their word about the aims of the research and do not realize that the output does not match the aims. As the opposition to Japanese whaling grows within the Commission (and there are signs that this is happening), this situation is bound to be exposed.

If Japan listed a different set of aims that more clearly reflected the research activity then condemnation of the activities would increase. This is because such aims would not be primarily concerned with management strategies, the work of the Scientific Committee of the IWC or other “critically important research needs”, the criteria for acceptable scientific whaling according to the IWC. Some basis is given to the view that the Japanese whale researchers use the language of science to describe their activities but the agenda is one other than what is described in their objectives. The bulk of the studies are on whale biology or physiology, which require the killing of whales. If we look at the JARPA and JARPAII objectives listed above it is clear that nearly all could be pursued by non-lethal means: whale sightings, skin biopsies, echolocation studies of whale food (krill), collection of environmental data and so on.

The IWC allows that animal remains from the whaling research can be sold (to avoid wastage). So if the Japanese want to market whale meat and they have research on-going that requires dead animals, then this is a back door way of continuing with whaling despite the moratorium. Thus Japanese scientific whaling could then be viewed as commercial whaling, framed with the language of science to give it justification.

Is this dismissing the studies too quickly? Are they appropriately called scientific? A response could be: of course the research results from the whaling programs constitute science. They would not be published in peer reviewed scientific journals if this was not the case. There are bound to be many research programs that fail to meet their broad objectives yet succeed in producing valuable detailed results in other areas.

A survey of the journals that have taken the research papers is interesting (see Appendix 1). Twelve out of the 55 papers are written in Japanese, reports of fisheries institutes, conference proceedings papers and others in the *Japanese Journal of Zoo Wildlife and Medicine*, in *Zoological Science*, a publication of the Zoological Society of Japan and in *Mammal Study*, produced by the Mammalogical Society of Japan. In addition, there are 11 recent short reports in the *Japanese Society of Fisheries Oceanography* and 2 in *Bulletin of the Society of Japanese Fisheries*.

All of these Japanese publications are small and “in-house,” not easily accessible outside of Japan, and the papers carried by them do not form part of the mainstream scholarly debates. If the ICR wants to convince the international community that its research is important, and the fact that it publishes a list of the papers published in peer-reviewed journals suggests that it does, then researchers should be focussing their publication efforts on more mainstream journals.

There are only 5 papers in marine management journals. The overwhelming number of papers are in biology or physiology journals with the *Journal of Reproduction and Development* carrying 6 papers and the journal *Zygote* publishing the same number. The rest of the papers are spread over 11 different biology or physiology publications. The papers outside of biology, physiology or management occur in 11 different journals. This survey reinforces the point made above that the Japanese whaling research is primarily focussed on biology and physiology. It also leads to the view that the research writings are scientific. These are reputable journals; surely they would not agree to publish papers that did not have scientific standing? I accept that argument. However the question can still be asked whether the science produced from the whaling programs justifies the killing of whales in Antarctic waters.

### **Is Japanese Whale Science Worthwhile?**

To answer this question I want to focus on the key research direction of the two programs: the *in vitro* fertilization (IVF) studies. If an animal species faces extinction then IVF may be a way of keeping the species alive. The Japanese research is on Antarctic minke whales. There are disputed figures on the size of this population but there is general agreement that the minke does not face extinction. It might be thought that IVF studies on the minke whale are useful for *in vitro* research on other whales that do face extinction such as the blue whale, but this is not suggested in any of the research papers. Whether the minke whale is threatened or not, there is something paradoxical about killing whales in order to develop a technique which will ensure species survival.

Despite the many studies on IVF of minke whales by the Japanese researchers, the success has been very limited. Rarely and at best, they have been able to develop an embryo to an 8 cell stage, which is not very far in the maturation process. After this point the chances of a successful pregnancy are much higher than earlier (Fullick) (and that is with artificial insemination). No development to the blastocyst stage has been observed. A blastocyst is a hollow ball of cells formed after the fertilization of an egg. Most of the studies have been done with

frozen eggs and sperm, as they are collected in the Antarctic on a vessel where research is difficult. There have been suggestions that the failure rate is because of the freezing/thawing process. However one study used an incubator on a research vessel and had no greater success (Iwayama *et al.*, "Attempt at *In Vitro* Maturation").

There seems to me to be a very good reason for the failures in the programs. However this is not discussed in the research papers. In order to begin with the research, eggs need to be extracted from female whales. Whales are captured and killed, and then their sex and their maturity is ascertained. It is difficult to tell the difference between male and female whales on the surface. So many male whales have been killed that are not needed in this program. Some are used for the extraction of sperm. Immature whales may be captured as it is difficult to tell from the surface the difference between immature and mature whales in Antarctic waters. This is because minke whales are born some months before in the northern reaches of their migration many hundreds of kilometres away at around 10-30 degrees south. So by the time a calf is in the Southern Ocean it is already quite large. Also as a result of the seasonal changes in reproductive activity, it has been estimated that about 88.8% of mature female minke whales in the entire Antarctic area are pregnant (Kato 935). Research on other species shows that IVF is not likely to have a high success rate if the animals are pregnant (Torner *et al.* 977). Immature female minke whales are also used and again there is a problem. Research on other species has shown that eggs extracted from immature animals are unlikely to mature by *in vitro* techniques (Revel 115). So there are reasons why the research effort on IVF using minke whales from the Antarctic is bound to fail. Why then proceed with it? Minke whales in other waters may be much more difficult to use as research subjects as they are likely to be within the waters of non-Japanese nations and nations such as Australia that reject the claim that Japan needs to kill whales for research.

The question is still left hanging: why proceed with the research at all? To push this further we can ask: what could ever be achieved by IVF studies on minke whales? None of the papers suggest that the aim is artificial insemination, which is the usual outcome of IVF studies on other species. There are apparently insurmountable difficulties with using such a technique with minke whales. The females may be 8.5 meters long. Attempting to capture a free-swimming whale to inseminate her would most likely lead to her death. Whales could be kept in captivity if it is possible to capture them without killing them, an unlikely result. Even in captivity the possibility of inseminating a whale with a fertilized egg seems remote. If artificial insemination is not contemplated, full term IVF is an even more difficult outcome to imagine even if we are thinking well into the future. The fetal minke whales reach a body length of 2.6-3.0 metres (Muranishi *et al.*

125). A test tube is not going to be adequate. A holding tank for the developing fetus would be needed but then an enormous amount of maturation fluid would have to be used. So the likelihood of ever being able to employ IVF technologies on minke whales is very slim. Thus although the research may be viewed as scientific, where is it heading? There is no clear answer to this, which brings us back to the point that perhaps it is simply a way of getting whales onto the commercial market.

There is another angle on much of the research under consideration which I would like to briefly take up. This concerns the use of what I term “shadow statistics”—statistical techniques which cast a shadow over phenomena rather than providing illumination.

### Japanese Research and Shadow Statistics

The language of statistics is used in many of the research papers and there are some common problems. One is to attempt to draw a conclusion from inadequate sample sizes. For example, in the Asada *et al.* study (“Improvement on In Vitro Fertilization”), sperm is taken from only one whale, injected into female minke whale eggs and different maturation fluids are then tried out. The sperm qualities of this single male minke whale are assumed to represent the sperm qualities of the species. This may be an unjustified assumption. The same problem occurs in the study by Wei *et al.* where the sperm of one minke whale is injected into bovine eggs and conclusions are drawn about the percentage success rate of this procedure using minke whale sperm generally. Whatever the result, it may be a feature of the sperm of this particular male which may not be at all representative.

In another study seven female minke whales are examined to assess concentrations of fluids in different sized oocytes (germ cells in the maturation stage). There were differences in some measures (e.g. cholesterol) but not in others (e.g. progesterone) (Nagai *et al.*). The authors stated that “These results offer new information concerning whale reproductive physiology, especially for improvement of *in vitro* oocyte maturation and related technologies in whales” (Nagai *et al.* 1265). Not only are the findings generalized to all minke whales, they are generalized to all whales. This is illegitimate. In addition, all the whales used in the study were in the second trimester of the gestation period, which could have an effect on oocyte composition. Oocytes taken from these whales at other times or other non-pregnant whales may produce different results.

The Fukui *et al.* study used two Antarctic minke whales to draw a conclusion about sperm motility in the species. Actually the base is even lower as the

sperm of one of the whales was so damaged by the freezing process that it could not be used and only small samples from the second whale were available.

Another issue is the use of the mean when there are large individual differences. The mean can be understood roughly as the norm or the average. This could be illustrated thus: Take 5 people and ask how many children they have. Say the answers are:

Person A: 3; Person B: 3; Person C: 2; Person D: 12; Person E: 0

The mean number of children that these people have is  $20/5 = 4$ . Yet no one had 4 children and using the mean as a measure covers up the fact that D had 12 and E had none. The mean is an obscuring measure when the differences between the sample are large: a shadow statistic. The Mogoe *et al.* study for instance makes use of the mean when reporting testicular weight in male minke whales, even though the researchers note that there are large individual differences.

A further problem is to do with making a comparison between two lots of phenomena when only one side is measured, and the second side is simply guessed. This occurs in a study of hormone levels in minke whales killed in the Antarctic (Suzuki *et al.*, "Plasma and Pituitary Concentrations"). The authors conjecture that the reproductive hormonal levels are lower in the animals studied than the levels that would occur when the animals are out of the Antarctic waters. However this cannot be studied as then the whales are in areas where killing cannot take place.

A related problem is the development of a statistical model to represent relationships between phenomena when the data fed into the model are unreliable. This occurs in the very ambitious study by Mori and Butterworth where an attempt is made to provide a model of the krill-predator dynamics in the Antarctic ecosystem. In particular they feed into this model what is known about the changing populations of krill feeders, such as the drop in numbers of humpback and blue whales and seals due to commercial hunting in the twentieth century. It is a lengthy and complex study hedged with all sorts of caveats on the results. However the basic assumptions about krill numbers in different historical times are insufficiently justified.

To estimate the effects of predators on krill numbers we need to have some reliable information on krill populations during different decades when there are lots of prey around and when there are not. To guess what the krill populations were like in 1900 is simply that, a guess. Even recent estimates of the size of the krill population in Antarctic waters vary wildly between 14 and 700 million tonnes (Miller and Hampton). The real danger with the Mori and Butterworth study is

that the researchers are judging the krill numbers from their estimates of the predator population sizes. This would be a completely circular argument. It is a shame that the statistical weaknesses of this study cloud the whole issue of prey/predator relationships because knowledge of such relationships is vital to understanding the population health of both prey and predators and the ecosystem dynamics as global warming brings changes to the Antarctic ecosystem. Another odd feature of this paper is the failure to look into the effect of the Japanese krill fishery, which was very wide-ranging around 1990 (Everson). This leads to a suspicion that there is an attempt to ignore the impact of human predation on krill.

The papers discussed in this section are just a sample of the ones containing methodological weaknesses. They were accepted by a range of journals including: *Theriogenology*, *Zygote*, *Journal of Reproduction and Development*, *Marine Mammal Science* and *CCAMLR Science*. It is a puzzle why these papers went through to publication as there is no independent reason to be critical of the journals. I note however that there have been no publications since 2007 in peer-reviewed journals in the main research area: *in vitro* fertilization of minke whales. Also in 2008-2010 there have only been three articles in peer-reviewed journals outside of Japan, and nine out of the 12 publications within Japan during this period are two page reports in fisheries journals.

Looking at one paper in isolation would not be a basis for criticizing the JARPAs but when this body of research is taken as a whole and patterns of weak methodology emerge, a further ground for suspicion of the scientific research emerges.

## Conclusion

The research output from the Japanese whaling programs is scientific. It is couched in the language of science. The papers have the structure of scientific articles with sections on materials and methods, results and discussion. The papers appear in peer-reviewed scientific journals. The impracticality of the main research program, IVF studies of minke whales does not rule the work out as unscientific as much of science is impractical. Nor is the use of shoddy methodology in many papers enough to call them unscientific. Unfortunately such weaknesses are not uncommon in some other sciences.

Yet something is wrong with this body of work. The research effort is not justified by the scientific results. As the research enables the placement of whale meat on the market there is commercial gain and it is likely that this gain has been behind the scientific whaling programs from the beginning. Sales of whale meat

have been waning. In 2006 the *Tokyo Times* reported that there was a glut of whale meat on the market. It is being fed to school children and to dogs. There was also an “unheralded ‘buy one get as many as you want free’ offer” to get rid of cans of whale meat (“Whale for Sale”). There has been a drop in the research output since 2008, perhaps reflecting this market situation.

The far greater cost of the Japanese whaling programs has been borne by the whales. There have been thousands of deaths over the decade. The ICR do not publish exact figures but their quotas involved killing thousands. The death of a single whale is terrible. The ethical obligation to protect whales should be paramount. One dominant view in animal ethics propounded by Peter Singer incorporates the idea that if an animal has needs and interests and hence a capacity to suffer then there is a moral requirement to take that suffering into consideration in our actions towards those animals (Singer). The capacity of whales to suffer was mentioned above. Yet this is not a consideration in the Japanese whaling programs. I discuss these issues further in Russell (“Ethical Obligations”).

The problem then with Japanese whaling in the Southern Ocean is not whether it produces science or not. Rather it is that the science which is produced often contains serious flaws in methodology; it overlooks ethical considerations and it fails to fit the aims that the IWC lays down for acceptable scientific whaling research.

**Appendix 1: Peer reviewed papers emerging from JARPA and JARPAII from 2000 to present as recorded by the Institute of Cetacean Research (ICR, Research Results 2011). See Works Cited for full details.**

**2000**

Asada, M., *et al.* “*In Vitro* Maturation and Ultrastructural Observation of Cryopreserved Minke Whale (*Balaenoptera acutorostrata*) Follicular Oocytes.”

Kasamatsu, F., *et al.* “Interspecific Relationships in Density among the Whale Community in the Antarctic.”

Mogoe, T., *et al.* “Functional Reduction of the Southern Minke Whale (*Balaenoptera acutorostrata*) Testis during the Feeding Season.”

Rosenbaum, H.C., *et al.* “World-wide Genetic Differentiation of *Eubalaena*: Questioning the Number of Right Whale Species.”

Wei, H. and Fukui, Y. “Fertilizability of Ovine, Bovine or Minke Whale (*Balaenoptera acutorostrata*) Spermatozoa Intracytoplasmically Injected into Bovine Oocytes.”

**2001**

Asada, M., *et al.* “Improvement on *In Vitro* Maturation, Fertilization and Development of Minke Whale (*Balaenoptera acutorostrata*) Oocytes.”

Asada, M., *et al.* "An Attempt at Intracytoplasmic Sperm Injection of Frozen-thawed Minke Whale (*Balaenoptera bonaerensis*) Oocytes."

Suzuki, T., *et al.* "Plasma and Pituitary Concentrations of Gonadotropins (FSH and LH) in Minke Whales (*Balaenoptera acutorostrata*) during the Feeding Season."

## 2002

Abe, H. and Goto, M. "The Application of Microsatellite DNA for Determining Population Structure of Minke Whale."

Kunito, T., *et al.* "Using Trace Elements in Skin to Discriminate the Populations of Minke Whale in Southern Hemisphere."

Murase, H., *et al.* "Relationship between the Distribution of Euphausiids and Baleen Whales in the Antarctic (35°E-145°W)."

Pastene, L.A., *et al.* "The Utility of DNA Analysis for the Management and Conservation of Large Whales."

Suzuki, M., *et al.* "The Characteristics of Adrenal Glands and its Hormones in Cetacean."

Urashima, T., *et al.* "Chemical Characterization of the Oligosaccharides in Beluga (*Delphinapterus leucas*) and Minke Whale (*Balaenoptera acutorostrata*) Milk."

## 2003

Hayashi, K., *et al.* "Sequence Variation of the DQB Allele in the Cetacean MHC."

Nishida, S., *et al.* "Polymorphic Analysis of Cetacean MHC—A Case Study on the Minke Whales."

Nishida, S., *et al.* "SRY Gene Structure and Phylogeny in the Cetacean Species."

Ohishi, K., *et al.* "Pathological and Serological Evidence of *Brucella*-infection in Baleen Whales (Mysticeti) in the Western North Pacific."

## 2004

Amemiya, K., *et al.* "Acquirement of Oocyte-activating Factor in Antarctic Minke Whale (*Balaenoptera bonaerensis*) Spermatogenic Cells, Assessed by Meiosis Resumption of Microinseminated Mouse Oocytes."

Fujihira, T., *et al.* "Comparative Studies on Lipid Analysis and Ultrastructure in Porcine and Southern Minke Whale (*Balaenoptera bonaerensis*) Oocytes."

Fukui, Y., *et al.* "Validation of the Sperm Quality Analyzer and the Hypo-osmotic Swelling Test for Frozen-thawed Ram and Minke Whale (*Balaenoptera bonaerensis*) Spermatozoa."

Ikumi, S., *et al.* "Interspecies Somatic Cell Nuclear Transfer for *In Vitro* Production of Antarctic Minke Whale (*Balaenoptera bonaerensis*) Embryos."

Iwayama, H., *et al.* "Effects of Cryodevice Type and Donor's Sexual Maturity on Vitrification of Minke Whale (*Balaenoptera bonaerensis*) Oocytes at Germinal Vesicle-stage."

Muranishi, Y., *et al.* "Relationship between the Appearance of Preantral Follicles in the Fetal Ovary of Antarctic Minke Whales (*Balaenoptera bonaerensis*) and Hormone Concentrations in the Fetal Heart, Umbilical Cord and Maternal Blood."

Tetsuka, M., *et al.* "The Pattern of Ovarian Development in the Prepubertal Antarctic Minke Whale (*Balaenoptera bonaerensis*)."

Watanabe, H., *et al.* "Relationship between Serum Sex Hormone Concentrations and Histology of Semiferous Tubules of Captured Baleen Whales in the Tubules of Captured

## Baleen Whales in the Western North Pacific during the Feeding Season.”

**2005**

- Ishikawa, H. and Shigemune, H. “Improvements in More Humane Killing Methods of Antarctic Minke Whales, *Balaenoptera bonaerensis*, in the Japanese Whale Research Program under Special Permit in the Antarctic Sea (JARPA).”
- Iwayama, H., *et al.* “Attempt at *In Vitro* Maturation of Minke Whale (*Balaenoptera bonaerensis*) Oocytes Using a Portable CO<sub>2</sub> Incubator.”
- Matsuoka, K., *et al.* “A Note on a Pigmy Right Whale (*Caperea marginata*) Sighting in the Southwestern Pacific Ocean.”
- Matsuoka, K., *et al.* “Abundance Increases of Large Baleen Whales in the Antarctic based on the Sighting Survey during Japanese Whale Research Program (JARPA).”
- Nikaido, M., *et al.* “Phylogenetic Reconstruction of Baleen Whales and Detection of Their Past Extensive Radiation Event by the SINE Insertion Analysis.”
- Sasaki, T., *et al.* “Mitochondrial Phylogenetics and Evolution of Mysticete Whales.”

**2006**

- Fujihira, T., *et al.* “Developmental Capacity of Antarctic Minke Whale (*Balaenoptera bonaerensis*) Vitri-fied Oocytes Following *In Vitro* Maturation, and Parthenogenetic Activation or Intracytoplasmic Sperm Injection.”
- Honda, K., Aoki, M. and Fujise, Y. “Ecochemical Approach Using Mercury Accumulation of Antarctic Minke Whale, *Balaenoptera bonaerensis*, as Tracer of Historical Change of Antarctic Marine Ecosystem During 1980-1999.”
- Iwanami, K., *et al.* “cDNA-Derived Amino Acid Sequences of Myoglobins from Nine Species of Whales and Dolphins.”
- Kobayashi, T., *et al.* “Contribution of Spermatozoal Centrosomes to the Microtubule-organizing Centre in Antarctic Minke Whale (*Balaenoptera bonaerensis*).”
- Konishi, K. “Characteristics of Blubber Distribution and Body Condition Indicators for Antarctic Minke Whale (*Balaenoptera bonaerensis*).”
- Mori, M. and Butterworth, D.S. “A First Step Towards Modelling the Krill-predator Dynamics of the Antarctic Ecosystem.”
- Nikaido, M., *et al.* “Baleen Whale Phylogeny and a Past Extensive Radiation Event Revealed by SINE Insertion Analysis.”
- Rock, J., *et al.* “A Note on East Australia Group V Stock Humpback Whale Movement between Feeding and Breeding Areas Based on Photo-identification.”
- Yabuki, T., *et al.* “Possible Source of the Antarctic Bottom Water in the Prydz Bay Region.”

**2007**

- Asada, M., *et al.* “Ultrastructural Changes during Maturation and Cryopreservation of Follicular Oocytes of Antarctic Minke Whales (*Balaenoptera bonaerensis*).”
- Branch, T.A., *et al.* “Past and Present Distribution, Densities and Movements of Blue Whales in the Southern Hemisphere and Adjacent Waters.”
- LeDuc, R.G., *et al.* “Patterns of Genetic Variation in Southern Hemisphere Blue Whales, and the Use of Assignment Test to Detect Mixing on the Feeding Grounds.”
- Nagai, H., *et al.* “Follicle Size-Dependent Changes in Follicular Fluid Components and

- Oocyte Diameter in Antarctic Minke Whales (*Balaenoptera bonaerensis*.)”
- Nishida, S., *et al.* “Phylogenetic Relationships among Cetaceans Revealed by Y-Chromosome Sequences.”
- Onbe, K., *et al.* “Sequence Variation in the Tbx4 Gene in Marine Mammals.”
- Pastene, L.A., *et al.* “Radiation and Speciation of Pelagic Organisms during Periods of Global Warming: the Case of the Common Minke Whale, *Balaenoptera acutorostrata*.”

## 2008

- Ishikawa, H. and Shigemune, H. “Comparative Experiment of Whaling Grenades in the Japanese Whale Research Program under Special Permit (JARPA and JARPN).”
- Konishi, K., *et al.* “Decline in Energy Storage in the Antarctic Minke Whale (*Balaenoptera bonaerensis*) in the Southern Ocean.”
- Ohishi, K., *et al.* “*Brucella* Infection in the Western North Pacific and Antarctic Cetaceans: a Review.”
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## 2010

- Fujise, Y., *et al.* “Changes in the Antarctic Marine Ecosystem as Revealed by the JARPA Research: What Has Happened to the Antarctic Minke Whale Stocks?”
- Pastene, L., *et al.* “Population Structure and Possible Migratory Links of Common Minke Whales, *Balaenoptera acutorostrata*, in the Southern Hemisphere.”
- Ten short reports and one slightly longer one were published in Japanese in *Japanese Society of Fisheries Oceanography* and the *Bulletin of the Japanese Society of Fisheries Oceanography*. These reports are not listed here as they summarize earlier research publications.

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## 日本捕鯨與科學語言

### 摘要

本文藉由分析近十年內日本捕鯨研究的相關發表，以查明目前已有哪些相關研究、這些研究有何價值以及這些研究若是真有價值，我們還可以用何種另類方式重新研究。由於日本鯨類研究所(The Institute of Cetacean Research in Japan)資助捕鯨研究，本文的討論也將持續關注此機構如何說明自己與捕鯨研究計畫的關聯，以及此類捕鯨研究論文的實際結論究竟為何。

**關鍵字：**日本捕鯨，國際捕鯨委員會，用於科學研究之捕鯨，捕鯨禁令，鯨魚研究成果