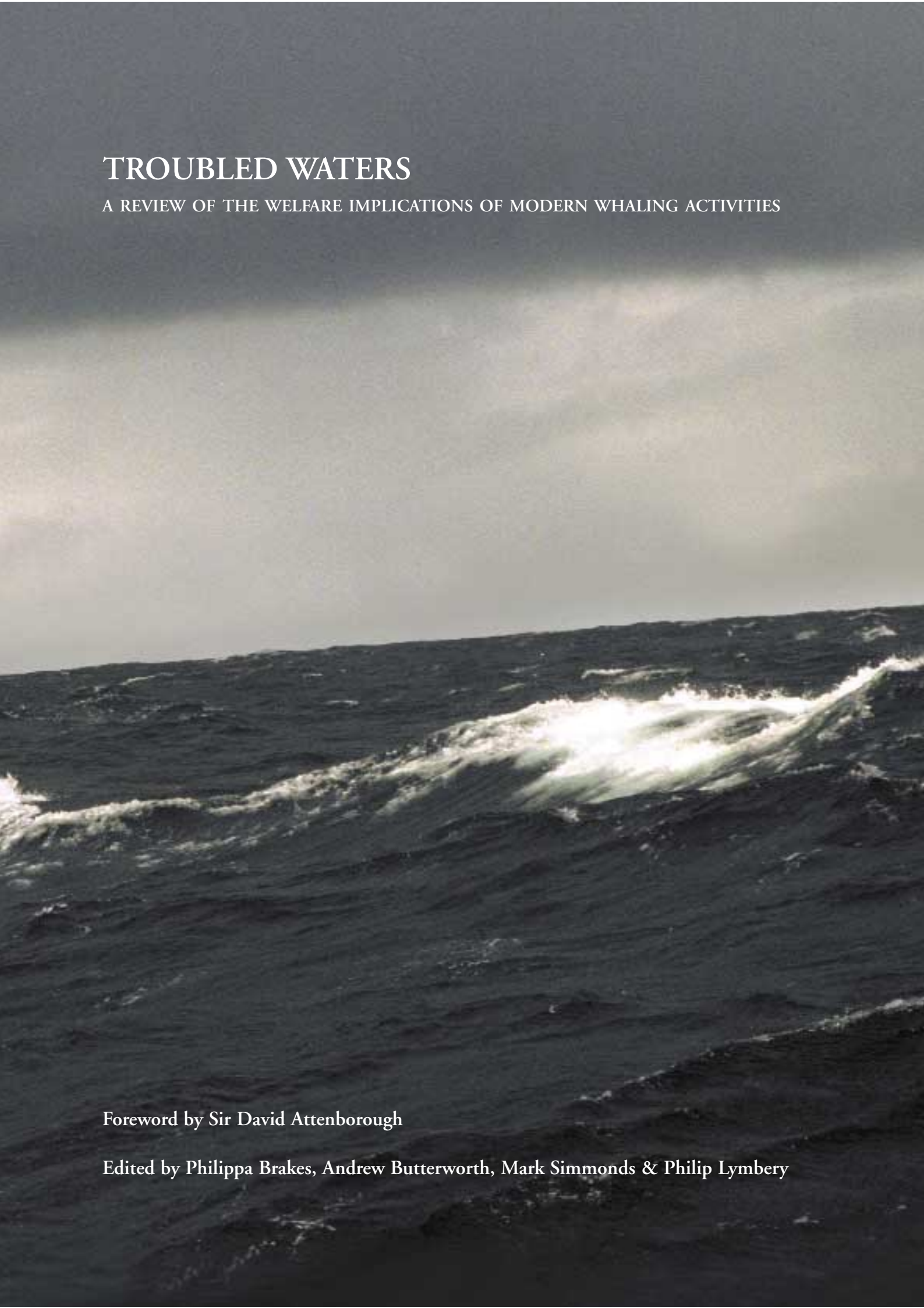

TROUBLED WATERS

A REVIEW OF THE WELFARE IMPLICATIONS OF MODERN WHALING ACTIVITIES

Foreword by Sir David Attenborough

Edited by Philippa Brakes, Andrew Butterworth, Mark Simmonds & Philip Lymbery

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A REVIEW OF THE WELFARE IMPLICATIONS OF MODERN WHALING ACTIVITIES

A report produced on behalf of a global coalition of animal welfare societies led by the World Society for the Protection of Animals (WSPA).
www.whalewatch.org

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Contents

Foreword

Whales are highly evolved animals with all the sensitivities that that statement implies. They have a complex social life. They call to one another across the vast expanses of the oceans. They are the largest animals that have ever existed, far larger than any dinosaur. There is nothing in the body of a whale, which is of use to us, for which we cannot find equivalents elsewhere.

The following pages contain hard scientific dispassionate evidence that there is no humane way to kill a whale at sea. Dr Harry Lillie, who worked as a ship's physician on a whaling trip in the Antarctic half a century ago, wrote this: *"If we can imagine a horse having two or three explosive spears stuck in its stomach and being made to pull a butcher's truck through the streets of London while it pours blood into the gutter, we shall have an idea of the method of killing. The gunners themselves admit that if whales could scream, the industry would stop for nobody would be able to stand it."* The use of harpoons with explosive grenade heads is still the main technique used by whalers today.

I hope you will read the following pages and decide for yourself whether the hunting of whales in this way should still be tolerated by a civilized society.

Sir David Attenborough, November 2003.

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Section One

Introductory Section

1 Executive Summary

This review examines the welfare implications of the methods currently used to hunt cetaceans (whales, dolphins and porpoises) for commercial, special permit and Aboriginal Subsistence Whaling (ASW) purposes. The welfare implications are assessed and the question raised as to whether whaling could be conducted in a reliably humane manner. The report calls on the International Whaling Commission (IWC) to urgently address the severe welfare problems attendant in modern whaling activities.

The welfare implications of modern whale killing methods

- **The physiological adaptations of cetaceans to the marine environment have significant implications for whale welfare during whaling operations.** Adaptations for diving may make it difficult to determine when these animals are dead. Their sheer mass, complex vascular systems and specific anatomical features may also impede efforts to kill them swiftly and humanely.
- **In general, current killing methods are not adequately adapted for the species being killed.** Morphological features such as size, blubber thickness, skeletal structure and location of vital organs significantly influence the efficacy of a particular killing method. These differences may effect the course of projectiles through the body, as they travel through different thicknesses of blubber and muscle and encounter bone and vital organs at specific locations. Such factors may also vary between individuals of the same species, according to age, sex and season. During whaling operations, where accuracy is often poor, these specific characteristics may greatly increase the margin for error and influence the time to death (TTD) and associated suffering.
- **Lack of due consideration to species specific killing requirements may be a major contributory factor in protracted times to death** and may be a particular cause for concern where larger species, such as fin and sperm whales, are killed using methods developed for the much smaller minke species.

Commercial and special permit whaling

- **The main killing method used during commercial and special permit whaling is the penthrite grenade harpoon** fired from a cannon mounted on the bow of a ship. The harpoon is intended to penetrate about 30 cm (12 inches) into the minke whale before detonating. The aim is to kill the animal through neurotrauma induced by the blast-generated pressure waves of the explosion. However, if the first harpoon fails to kill the whale, then a second penthrite harpoon or a rifle (minimum calibre 9.3mm) is used as a secondary killing method.
- **Despite the similarity of the killing methods used, there are marked differences in reported killing efficiency between Japan and Norway**. According to Norwegian data, in 2002, 80.7 per cent of minke whales were killed instantaneously. During the 2002/2003 Japanese minke whale hunt in Antarctica, only 40.2 per cent of whales were recorded as killed instantaneously.
- Recent data show that, for commercial and scientific whale hunts, the average time to death is over two minutes.

Secondary killing methods

- **The common use of secondary killing methods, such as the rifle, during whaling operations reflects the inefficiency of primary killing methods.** The IWC has not established any formal criteria for determining when to apply secondary killing methods, and the decision, including which method to use, rests with the hunter.
- **The primary objective of any secondary killing method should be to kill immediately, or render insensible to pain, an already wounded and compromised cetacean.** The data available indicate that rifles may often be inadequate as a secondary killing method, often requiring many shots to achieve a kill.

Aboriginal Subsistence Whaling (ASW)

- **Killing methods used during ASW hunts are recognised to be less accurate and efficient than those used in commercial whaling operations,** resulting in longer times to death (TTD), lower instantaneous death rates (IDRs), and higher 'struck and lost' rates. Data from ASW hunts for the period 2000-2002 show an IDR of 0-17 per cent, an average TTD of 9-57 minutes, and a maximum TTD of 25-300 minutes. The number of whales struck and lost per hunt varied from zero to 26 animals.
- **For some ASW hunts, the IWC sets a limit on the number of whales that may be landed, rather than a 'strike limit'.** This means that ASW hunters are often able to land the maximum number of whales permitted, but strike and lose an unlimited number in addition.

Criteria for assessing time to death

- The IWC criteria for determining the time to death in hunted cetaceans are; relaxation of the lower jaw; or no flipper movement; or sinking without active movement. **A review of these criteria by a group of scientists and veterinarians with expertise in welfare, physiology, and anatomy, concluded that they were not adequate to determine precisely the point of death.** Cetaceans are adapted for diving, and consequently have developed mechanisms for storing oxygen in their tissues. Thus they may survive, but have the potential to experience pain over a longer period than indicated by the current IWC criteria. Therefore, current data on time to death and instantaneous death rate, which are based on these criteria, are incredible. Moreover, these criteria are not used in an inclusive fashion, further reducing the credibility of these data.
- Without robust and practical methods of accurately measuring time to death and insensibility in the field, it will remain difficult to assess comprehensively the full welfare implications of various killing methods.

'Struck and lost' whales

- **The failure to land whales that are struck and injured ('struck and lost') by whaling operations is a severe welfare problem.** Struck and lost cetaceans may incur a wide range of injuries, including haemorrhage, significant nervous tissue damage and/or damage to internal organs. Depending on the extent of injury, these wounds may prove debilitating or possibly fatal. Injuries may lead to infection, restricted mobility, ankylosis of shattered joints and eventually muscle or limb atrophy. Struck and lost cetaceans may suffer an inability to feed, socialise or reproduce.

The potential stress effects on whales of pursuit during whaling operations

- **Whaling operations can impose a degree of physical and psychological stress upon a pursued cetacean before any killing method is deployed.** Such stress factors may be significant for cetaceans that are struck and eventually killed, but also for those that evade capture. From first sighting, the elements of the pursuit, such as the approach, duration, speed and distance covered, may affect morbidity and mortality, even amongst animals that successfully evade being struck.
- **The degree of exertion imposed on whales during pursuit may fall outside the species' adaptive range.** Whalers depend on achieving a minimum distance between themselves and whales for successful harpooning. This range is likely to fall below the distance that would naturally be maintained by wild cetaceans. Pursuit, as part of whaling, therefore has the potential to induce stress, which may reveal itself in a series of lethal and sub-lethal pathologies.

Weather, sea condition and ship motions affecting accuracy in whaling

- **The combination of visibility, sea state, ship motion and marksmanship are likely to impact significantly on the ability of a whaler to reliably kill a whale instantaneously.** If weather, sea conditions or the motion of the vessel do not allow for a properly aimed shot, then there is a significant risk of a poorly placed harpoon or bullet causing an extended time to death and associated suffering.

Euthanasia of cetaceans

- **The meticulous nature of the methods developed for the euthanasia of stranded cetaceans and the conditions under which these methods are applied, contrast significantly with the often inferior circumstances and substandard methods used during whaling operations.** Whalers attempting a fatal shot with a harpoon or a rifle, often from a considerable range, need to overcome a number of significant factors that hinder accuracy. The significance of these variables and the inadequacies of the methods used are reflected in the poor instantaneous death rates and average times to death during all whaling operations.

Other welfare considerations

- **The complex social behaviour of cetaceans may mean that the killing of one cetacean from a social group may have a significant effect on others.** This is especially likely if the strong maternal bond between mother and calf is broken. There is also growing evidence of culture in some cetacean species. Therefore, consideration should be given to the impact of whaling operations on the welfare of remaining individuals in the social groups.

Comparison with the commercial slaughter of other species

- Basic principles that must be addressed to protect the welfare of animals at slaughter have been identified for livestock animals. These principles, the determinants of high welfare slaughter methodology, are:

  pre-slaughter handling facilities which minimise stress;
  use of competent well-trained, caring personnel;
  appropriate equipment, which is fit for the purpose;
  an effective process which induces immediate unconsciousness and insensibility, or an induction to a period of unconsciousness without distress; and,
  guarantee of non-recovery from that process until death ensues.

These principles can be used to compare the welfare potential of humane livestock slaughter practices with current whale killing methods. There are a number of factors inherent in current whaling methods which diminish the potential for high welfare:

whalers often must attempt a fatal shot, either with a harpoon or a rifle, at considerable range and in variable weather conditions;

there is no method for non-invasively securing cetaceans before a killing method is applied during whaling operations;

whaling operations can impose physical and psychological stress upon the animal pursued before any killing method is deployed;

in general, whale killing methods are not well adapted for the specific anatomical requirements of the different species taken, further hindering the potential for a swift kill.

The effect of these variables, as shown by reported data, is that whale hunts can have protracted average times to death, and poor instantaneous death rates.

It can be concluded that **current whaling operations have low welfare potential, and a propensity to cause severe pain and suffering to hunted cetaceans.**

Legal and ethical considerations

- **There is a notable lack of regulation to protect the welfare of whales within the IWC.** There are no regulations designed to 'avoid excitement, pain or suffering', no maximum pursuit times, no limit on the number of weapons or bullets that can be used on one animal, no upper limit on the acceptable time to death, no specific requirement for the rate of instantaneous kills, and, in many hunts, there is no limit on the number of animals that can be struck and lost.
- **Special Permit or 'scientific' whaling proposals are not subject to an independent ethical review process prior to their commencement.** Furthermore, there is no evidence that the principles of 'Replacement', 'Reduction' and 'Refinement' prescribed for animals used in scientific research, are applied to special permit whaling carried out in the name of science.
- **The emerging international customary law of animal protection is well illustrated in the case of cetaceans. Cetaceans,** and whales in particular, often have a special legal status that reflects the highly migratory nature and unique life cycles of these species. In the future, it is possible that existing international treaties, such as the IWC and the Convention on International Trade in Endangered Species (CITES), will be modified by emerging customary law and amended to adopt improved animal welfare protection measures.

Overall conclusion

Modern day whaling activities give rise to serious animal welfare concerns. A number of factors inherent in current whaling practices render it unlikely that truly humane standards could ever be achieved. On grounds of animal welfare alone, therefore, all whaling operations should be halted.

2 A background to whaling

Philippa Brakes, *Marine Consultant, c/o WDCS (Whale and Dolphin Conservation Society), Chippenham, UK.*

An introduction to the history of whaling

In the age of modern technology and communication, it is difficult to imagine the lives of the earliest whalers, or the perils that they faced setting sail into unknown waters in search of their quarry. Humans from many regions of the globe have long been exploiting cetaceans (whales, dolphins and porpoises) for the food, oil and 'whale bone' (baleen) they yield. Some aboriginal peoples, such as the Inuit, of Greenland, arctic Asia and North America have an extensive history of whaling. Even Neolithic people from the coast of Denmark, are believed to have consumed cetaceans as a supplement to their predominately shellfish diet, through opportunistic takes of stranded cetaceans (Harrison 1988). As far back as 1100 BC, it is believed that the Phoenicians operated shore-based whaling for sperm whales in the eastern Mediterranean (Sanderson 1956). However, it was not until the 1600s that the true 'industry' of whaling, as we now know it, began to evolve. By this time, the pursuit of whales was being executed beyond the reach of coastal communities and out into the deep-sea regions. Long range whaling was first undertaken by the Basque whalers, who had been catching northern right whales in the Bay of Biscay since the early 1100s.

By the 1700s the Basques were travelling across the Atlantic to exploit the concentrations of whales found around the Grand Bank area of Westfoundland and the English, Dutch and Germans were exploiting the right whales they had discovered around the coast of Greenland. The most popular method for catching whales at this time was to harpoon the animals with a multi-barbed harpoon from a small catcher boat. The whale was then 'played' on the rope attached to the harpoon, which was slowly fed out as the whale attempted to escape. The aim was to exhaust the injured whale and then, as the opportunity arose, further wound it using a hand thrown lance. The lance was tipped with sharp blades, which were designed to sever a major blood vessel and induce death through blood loss.

The advent of ship based 'tryworks' (brick ovens in which blubber could be rendered into valuable oil) during the 1760s, increased the economic efficiency of whaling operations and intensive exploitation proliferated across the globe during the following centuries, as various whale populations were discovered and utilised. It was not until the 1870s that it became possible to exploit the faster moving rorqual whales, such as the blue, fin and sei whales. This was brought about by the almost simultaneous advent of the motorised whale catcher and an explosive harpoon that could be fired from a cannon.

These innovations facilitated the exploitation of the dense numbers of whales that occurred in the Antarctic, due to the springtime bloom in productivity in this region. These first forays into Antarctica were led by the British and Norwegians but, by the 1930s, the Japanese and Germans were also whaling in Antarctica. The advent of more efficient means of catching whales brought

about a crash in whale stocks, as one stock after another was over-exploited. This led to a period of 'pelagic whaling', which was conducted wherever whales stocks of harvestable size could be located (Johnsen 1947).

Economics were then, as today, the main driving force for all whaling activities, other than aboriginal subsistence whaling. The favoured species at any given time in history, has been determined according to a delicate balance between, the popularity (and, therefore, value) of the material yielded by the species and factors associated with how easy the species was to locate and kill. It is important to note that for the greater part of the history of commercial whaling, oil was the single most important product. The consumption of whale meat was often a by-product of this industry.

In the late 1930s and early 1940s, the International Council for the Exploration of the Sea began to recognise that the futures of many whale species were not guaranteed, in particular, right and gray whales were in danger of over exploitation, and the humpback whale was in danger of extinction. In 1946, the International Convention for the Regulation of Whaling (the ICRW) was agreed and created the International Whaling Commission (IWC). This body was charged with regulating whaling on a multilateral basis for the first time, thus endeavouring to ensure the conservation of whales.

A brief history of whale killing methods

One of the oldest and most widespread methods used for capturing and killing whales is called the harpoon-line-float technique (Mitchell *et al.* 1986). Harpoons are used to attach a number of lines and floats to a whale, in order to impede its movement through the water. This method is still used as the primary means for securing, slowing and locating whales in a number of Aboriginal Subsistence Whaling operations (chapter 6).

Before the advent of explosive harpoons, a lance was used as the main method for killing a whale that had been arrested using the harpoon-line-float technique. However, when larger and stronger species, such as the sperm whale, were hunted, the boat from which the harpoon-line-float method had been administered was used as an additional anchor. The whale would then have to pull the boat, as well as the floats and line, through the water while attempting to escape. The purpose of this was to exhaust the animal, which could then be killed using a lance when it was forced to rest at the surface.

In addition, the primitive method of herding smaller cetaceans into bays or onto shallow beaches where they could then be slaughtered, was popular in Japan, the Faroe Islands, Orkney and Shetland. This practice may have been common in Japan as far back as the 10th century and records of drive hunts in the Faroe Islands date back to 1584 (Hoydal 1986).

The first major technological advance in whale killing was the advent of mechanically propelled harpoons. This enabled the harpoon to cover an increased range, and with greater impact than had previously been possible with hand thrown harpoons. Investigations into methods for mechanically delivering harpoons began in the mid-1700s (Bond 1753). By the second half of the 1800s, a wide variety of explosive whaling weapons were under trial, many ingenious in design, but often of questionable efficiency (Mitchell *et al.* 1986).

A harpoon gun mounted on a swivel was in use from 1731. However, this initial design was hindered

by the weapon's enormous recoil, which meant that the sails of the vessel had to be lowered before it could be fired. The modern deck-mounted cannon which fires a harpoon tipped with an explosive grenade, however, owes its origins to a design by the Norwegian, Svend Foyn (Johnsen 1940). Other methods for killing whales, which have been investigated over the past century, include: electrocution, drugs, nets and gas injections (Mitchell *et al.* 1986). None, however, have managed to supplant the explosive harpoon for commercial operations, although in Japan the recorded capture of whales in nets has increased dramatically since 2001 when it became possible to sell bycaught whales (chapter 6).

The black powder[1] explosive grenade was designed to attach to the head of the cannon-fired harpoon. The harpoon has a number of barbs or claws, which are released by a spring mechanism when the harpoon comes into contact with the whale's body. This helps the harpoon to 'grip' the tissues and prevents 'pulling through' as the whale struggles, or is hauled aboard. The grenade is packed with explosive 'black powder' and is detonated by a fuse, which operates on a time delay. For maximum wounding, the grenade should explode when it is in the body of the whale. However, Øen noted from studies of the use of this killing device during the Norwegian minke whale hunt, that 87 per cent of these harpoons passed straight through the whale's body (Øen 1983). In such cases the detonation of the grenade would occur outside the body, greatly limiting its impact. Øen surmised that the reason for this was that the original black powder harpoon was designed for much larger whale species and that it was difficult to adjust the explosive and the triggering device to the relatively small size of the minke whale (Øen 1999). Consequently, when this device was introduced into the Norwegian hunt during the late 1920s, Norwegian whalers used the grenade housing, but without the explosive, creating, essentially, a cold grenade (Øen 1995). This empty housing was gradually superseded by a pointed iron head, with no explosive – the modern cold harpoon.

Beside the difficulties encountered in transferring the device between species, there were also economic drawbacks to the black powder explosive harpoon. The explosion often spoiled a large amount of meat, particularly in smaller species, such as the minke. A comparison of meat spoilage between the explosive harpoon and the cold harpoon was conducted for the 1982/1983 Soviet Antarctic hunt. It showed that, for minke whales, the explosive harpoon resulted in an average spoilage of 547kg (6.6 per cent). In comparison, meat spoilage for minke whales killed using the cold harpoon was only 60 to 70 kg (less than 1 per cent) (Golovlev 1984). Thus there was also an economic incentive to use the cold harpoon instead of the explosive harpoon.

The International Whaling Commission, however, banned the use of the cold harpoon in commercial whaling operations, for all species other than the minke whale, during the 1980 annual meeting (chapter 5). This decision took effect for the 1980/81 pelagic and 1981 coastal seasons. The ban on the use of the cold harpoon in commercial operations was extended the following year to include minke whales. This took effect from the 1982/83 pelagic and 1983 coastal seasons[2]. Banning the use of the cold harpoon, which spoilt less of the meat, but resulted in protracted times to death, provided the impetus for the development of the penthrite explosive harpoon, the device which is still, with some modification, in use in modern commercial and 'special permit' whaling operations (chapter 6).

Penthrite was chosen because it was more effective than the traditional 'black powder' used in the original explosive harpoon, and destroyed less of the meat. The aim of this device is to kill the animal

through neurotrauma induced by the blast-generated pressure waves of the explosion (Knudsen and Øen 2003). In order for a rapid death or rapid loss of consciousness to be achieved, however, the correct region of the body must be targeted and the grenade must detonate at the correct depth within the body[3].

Modern whaling activities

Whaling activities undertaken by contracting governments of the IWC are subject to the constraints of the ICRW and its operating rules contained in the schedule to the treaty. However, takes (hunts or kills) of small cetaceans (small whales, dolphins and porpoises), that are considered by some contracting governments to be beyond the auspices of the IWC, do occur and remain largely unregulated. These include the annual take of pilot whales and other species in the Faroe Islands; the killing of whales caught in nets around Japan and Korea (chapter 6); the hunting of beluga and narwhal (and also occasionally orcas) in Greenland; the hunting of beluga, orca and various dolphin species in Russia; the takes of various dolphin species in Peru and, more recently, the killing of stranded whales in the Solomon Islands. Japan also hunts various other species, such as the Baird's beaked whale and the Dall's porpoise. These 'small cetacean' takes are not considered by Japan, and other contracting governments, to be within the competence of the ICRW (chapter 7) and consequently they do not provide data to the IWC on the methods used to kill these animals or on the times to death[4]. In addition, at least two countries that hunt whales are not parties to the IWC. Canadian Inuit hunt bowhead whales, and sperm whales are killed in Indonesia.

Modern vessels and equipment have allowed longer trips to be made into more treacherous conditions in search of diminishing whale populations. Today, using satellite navigation systems and other modern communication technology, whalers can now position fix upon a whale, or notify another vessel in the vicinity of a whale heading in its direction. Multi-directional hydrophones can be used to locate a whale precisely, and changes in click frequency from a surfacing sperm whale can be used to tell whale watchers when, and roughly, where, these animals might appear. The same techniques can also be used to locate whales for slaughter.

Developments in modern technology, which have provided more efficient means for finding and processing whales, have not been accompanied by equal leaps forward in the efficiency of the methods used to kill these animals. The Norwegians have led the development of killing technology in recent years. Although some improvement is apparent in the efficiency of Norwegian hunts, assessing the extent of these improvements will be problematic until the debate concerning criteria for accurately measuring death in cetaceans is concluded (chapter 11). The application of more advanced technology in the future, may be able to offer increases in the 'efficiency' of whaling operations. However, it appears unlikely that the range of welfare problems and the potential for animal suffering associated with whaling will be reduced significantly in the foreseeable future (see chapters 8 & 9). Chapter 12 describes welfare standards of whaling in comparison with international expectations for the killing of livestock species for commercial purposes.

The main incentive for whaling today, as in the past, remains economic. The only exception being aboriginal subsistence communities for which a genuine need has been proven (chapter 6). Despite the international moratorium on whaling[5], Norway conducts commercial whaling in the North Atlantic under a reservation to the moratorium. Other contracting governments wishing to conduct whaling are able to do so, by granting themselves exemption through self-certified 'special permits'.

Japan currently whales in the Antarctic (within the Southern Ocean Sanctuary) and in the Eastern North Pacific under special permit and in August 2003, Iceland initiated it's own special permit whaling programme (see chapters 6 & 13).

In recent years, campaigns against whaling have often been labelled by pro-whaling factions as emotional or unrealistic. There is a common belief amongst this group, that those campaigning against whaling do so because of a belief in a unique and intrinsic value to whale species. These arguments however have been used as a distraction for preventing the whaling industry from being called to account for its often appalling welfare record (chapter 6).

Whaling nations have sometimes claimed that they are treated unfairly because people appear to value whales more highly than, for example, farm animals. This 'value' debate is not fundamental to the requirement of whales to be treated humanely since, at present their slaughter does not approach the basic standards required for slaughter of terrestrial livestock species killed for food (chapter 12).

The IWC currently assesses the humaneness of a whale kill only in terms of the time it takes to kill the animal, the 'time to death' or TTD. This time is measured from the application of the primary killing method, until the time when the whale is judged to be dead, according to the IWC criteria for death. There is currently much controversy over the accuracy of the IWC criteria for determining death[6] (Butterworth *et al.* 2003) and there is considerable doubt remaining regarding the accuracy of any data on TTD or instantaneous death rates (IDR) presented to the IWC (chapter 11).

The approach of measuring only the time it takes to kill each whale, does not provide any means of evaluating the kill in a more qualitative manner. For example, by relating each kill to the extent of the injury caused and thus for each animal attempting to determine the cause of death. Japan and Norway both collect *post mortem* data on at least some of the whales killed during whaling operations. However, there is no binding obligation to provide these more detailed data and consequently they are not regularly made available for wider review.

Kirkwood *et al.* (1994) note that in assessing the welfare of free-living wild animals, a number of factors should be taken into consideration, including: the nature of the harm caused, its duration, the number of animals affected and their capacity for suffering. The current evaluation of the welfare of whales killed during whaling operations offered by the IWC is TTD. However, TTD does not encompass either the nature of the harm caused or have any mechanism for determining the capacity for suffering in the species taken.

Pain and suffering

The concept of welfare is based principally on the notion of pain and suffering. Pain is associated with physical stimulation and suffering is associated with both the physical and psychological well being of the individual. In many countries legislation protects animals from pain and undue suffering, particularly at the time of slaughter (chapter 12). The 'experience' of pain to an individual animal can only be truly determined by rigorous scientific investigation. Welfare assessments are common practice for animals that are killed for food or research purposes. 'Special permit' whaling purports to fall into the latter category, but also falls under the category of animals killed for food, since the meat of these animals is usually sold commercially. Therefore, it is judicious that similar welfare assessments should be conducted for, and rigorous standards applied to, the three main

categories of whaling: commercial, special permit (or 'scientific') and aboriginal subsistence whaling.

Since most animals are unable to communicate the extent of their pain or suffering, this has necessitated the development of several methods for evaluating animal welfare. These methods include measuring motor reflexes, neuroendocrine responses and monitoring changes in behaviour. Pain is also often accompanied by increased heart rate and blood pressure changes. In the last decade behavioural changes have been used extensively in the assessment of pain in animals (Otto 1997). Therefore it is not inappropriate to apply an evaluation of potential pain and suffering to the methods employed to pursue, capture and kill whales during whaling operations (chapter 9).

It is intended that this text will provide a definitive guide to the many issues relating to the welfare of cetaceans during hunting operations. The main focus will be on the hunting of larger whales, but for completeness and comparative purposes consideration will also be given to 'small cetaceans' (chapter 7). The aim of the review is to illustrate, using contemporary scientific, legal and ethical principles, the true scale of the welfare problems associated with whaling activities in the 21st Century.

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Footnotes

1 Black powder is a mechanical mixture of sulphur, saltpetre and charcoal (Øen 1995).

2 Article III, paragraph 6, International Convention for the Regulation of Whaling 1946.

3 Knudsen and Øen (2003) noted that an oblique shot to one minke causes a detonation in region B (between the rear of the brain and the pectoral flippers) in the muscle tissue, with an exit wound in front of one of the pectoral flippers. Despite being closer to the brain than other detonations, this blast did not cause skull fracture (except of the ear bones), as some energy may have been lost to the water.

4 The Faroe Islands is the only exception, providing some details on the methods used, but no regular data on time to death.

5 Article III, paragraphs 10d and 10e of the ICRW.

6 Relaxation of lower jaw or no flipper movement or sinking without active movement (Anon 1980).

3 An introduction to animal welfare

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Animal welfare as a scientific discipline incorporates applied aspects of ethology, bioethics and the concepts of suffering and well-being (World Veterinary Association 2000). Welfare, including health, has many different aspects and is defined by both the physical and psychological state of an animal, including how it feels (Webster 2003). The welfare state of an animal can be described as good or high if the individual is fit, healthy and free from suffering.

Scientists have defined the term 'suffering' in animals to mean a "*wide range of unpleasant emotional states*" (Dawkins 1980) including fear, frustration and pain. 'Pain' has been defined as an aversive sensation and feeling associated with actual or potential tissue damage (Broom 2001; Iggo 1984). Physiological, behavioural and learning responses show that feelings of pain exist in many types of animal (Broom 2001), including mammals, birds and other vertebrates (Melzack and Dennis 1980).

Animals may suffer due to disease, injury, fear, or the frustration of basic needs. A 'need' is defined as a requirement fundamental in the biology of the animal, to obtain a particular resource or respond to a particular environmental or bodily stimulus (Broom & Johnson 1993). If a need is not provided for then there will be an effect on physiology or behaviour. One important basic need is that an animal should not suffer at the time of its death.

The Five Freedoms were developed by the UK's Farm Animal Welfare Council and are used in many countries as a useful measure by which to assess animal welfare. Although originally devised to assess welfare in farming systems, they can equally be applied to animals in other situations, e.g. working, companion, laboratory, entertainment, and wild animals. The Five Freedoms (FAWC 2003) are:

- Freedom from hunger and thirst
- Freedom from discomfort
- Freedom from pain, injury and disease
- Freedom from fear and distress
- Freedom to express normal behaviour

The Five Freedoms are a useful 'checklist' by which to identify situations which compromise good animal welfare – that is, any situation that causes fear, pain, discomfort, injury, disease, or behavioural distress.

Welfare is a consideration of living, not dead, animals. Death is not a welfare issue in itself, although death may indicate poor welfare, for example, in the case of mortality resulting from disease. Although death itself is not a welfare issue, the manner of death is relevant. For example, the method of killing can cause either instantaneous death, or pain and distress prior to death.

Protecting the welfare of animals involves the prevention of unnecessary animal suffering, and thereby ensuring a good quality of life and a humane death. The key difference between conservation and animal welfare is that conservation focuses on species and populations, whereas animal welfare focuses on the individual animal and its suffering.

In recent years, methodologies have been developed for assessing animal welfare scientifically (e.g Fraser and Broom 1990). The scientific study of animal welfare has reached a stage of maturity at which firm conclusions can be drawn on whether or not an animal is suffering in particular circumstances (Baxter 1994). Major concerns for animal welfare arise from animal husbandry, handling and killing practices with low welfare potential i.e. those that fail to meet the behavioural and physical needs of the animal and thereby have the potential to cause pain or suffering.

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4 Whales – individuals, societies and cultures

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The mammalian Order Cetacea encompasses all the species of whales, dolphins and porpoises. There are two main groups of living cetacean: Mysticeti (baleen whales) and Odontoceti (toothed whales).

Mysticeti (baleen whales)

The Mysticeti includes all the 'filter feeding' whales, which use baleen plates hanging from the roofs of their mouths to filter small prey species from mouthfuls of ocean water, or to skim planktonic species near the sea surface. Mysticete whales range in size from the blue whale (*Balaenoptera musculus*) to the pygmy right whale (*Caperea marginata*), which grow up to 27 metres and 6.5 metres, respectively, although the longest blue whale (and indeed the largest living creature ever recorded) measured over 33 metres (Jefferson *et al.* 1993). There are currently ten (or 13) species of baleen whale according to which particular author or organisation is referenced. For example, Rice (1998) and the Society for Marine Mammalogy consider there to be at least two species of Bryde's whale: the 'true' Bryde's whale (*Balaenoptera brydei*) and Eden's whale (*Balaenoptera edeni*). However, the International Whaling Commission currently only recognises one species of Bryde's whale, referring to all such whales as *Balaenoptera edeni*.

In addition, minke whales have recently been split into two species by most (but not all) authorities: the Antarctic minke whale (*Balaenoptera bonaerensis*) and the 'common' or 'northern' minke whale (*Balaenoptera acutorostrata*). There may actually be a third minke whale species, the 'pygmy' minke whale, which is found in the southern hemisphere, but is genetically distinct from the Antarctic minke whale (Best 1985; Arnold *et al.* 1987; Wada *et al.* 1991). This latter whale is the target of a substantial and economically valuable whale-watching industry off the coast of western Australia (Hoyt, 2001), and although animals have been seen carrying harpoon scars (IWC, 2003), probably caused by 'scientific whaling' operations for Antarctic minke whales, it is not yet known whether, indeed, these whales constitute a new species of minke whale.

The term 'great whales' was used for the large species listed on the schedule of the 1946 International Convention for the Regulation of Whaling (ICRW), which established the International Whaling Commission (IWC). All species of the Mysticeti, except the pygmy right whale, are considered to be 'great whales'.

Toothed whales (Odontoceti)

Toothed whales range in size from the sperm whale (*Physeter macrocephalus*) to the vaquita (*Phocoena sinus*), which grow up to 18 metres and 1.5 metres, respectively (Jefferson *et al.* 1993). There are currently between 69 and 73 species of toothed whale, again depending on the author or authority referenced.

Several species of toothed whale have been the target of historical commercial whaling activities, notably the sperm whale and several beaked whale species, e.g. the northern bottlenose whale (*Hyperoodon ampullatus*) and the Baird's beaked whale (*Berardius bairdii*), which is still hunted in Japan. Many of the smaller toothed whale species are the subject of commercial hunts today, notably the Dall's porpoise (*Phocoenoides dalli*); over 10,000 are harpooned every year off the coast of Japan (EIA 1999).

The sperm whale is considered to be a 'great whale' and is, therefore, the only toothed whale listed in the schedule of the ICRW. The remaining toothed whales are termed 'small cetaceans' which is rather misleading, as several toothed whales are actually larger than some of the mysticete 'great whales'. For example, minke whales rarely grow larger than 9 metres (the maximum being 10.7 metres; Jefferson *et al.* 1993). In comparison, northern bottlenose whales (*Hyperoodon ampullatus*), Arnoux's beaked whale (*Berardius arnuxii*) and killer whales (*Orcinus orca*) grow to similar sizes (up to 9.8 metres; Jefferson *et al.* 1993), whilst Baird's beaked whales can grow even larger (up to 12.8 metres; Jefferson *et al.* 1993).

Adaptations to a marine environment

Sperm whales can dive more than 2 kilometres deep (Heezen 1957; Watkins *et al.* 1993) and can hold their breath for up to two hours (Watkins *et al.* 1985; Kooyman 2002). Baleen whales can also hold their breath for long periods; whilst normal dive times rarely exceed 7 to14 minutes for the two species, blue whales and bowhead whales being pursued by whalers have dived for up to 50 minutes and 80 minutes, respectively (Stewart 2002). Being air breathing mammals, diving to such depths and for such durations require considerable anatomical and physiological adaptations.

Cetaceans have the ability to utilise 90 per cent of the inhaled oxygen in their lungs, compared to 4-20 per cent in terrestrial mammals. This means that, when resting, cetaceans need to respire less often: only one to three breaths per minute, compared to 15 breaths per minute in humans. This extraction of oxygen is assisted by cetacean blood volume, which is two to three times that of terrestrial mammals (Ponganis 2002). Therefore, more oxygen can be taken up by the haemoglobin contained in red blood cells. This extra blood volume is partially distributed by a supplementary blood circulation system, the *retia mirabila*. One part of this network, the thoracic rete, supplies the cetacean brain with a regular flow of blood – it should be noted that this blood supply to the brain in cetaceans has no measurable pulse, unlike in humans, where the pulse in the carotid artery is frequently measured as a sign of life (Ponganis 2002).

Cetaceans also have as much as nine times the amount of myoglobin (a substance similar to haemoglobin, but which has a greater capacity for binding with oxygen and is found in muscles) than terrestrial mammals, allowing for a much greater uptake and storage of oxygen in muscle tissue (Ridgway and Johnston 1966; Ridgway *et al.* 1984). In fact, up to fifty per cent of the oxygen required by cetaceans during dives may be stored in muscle tissue (Schlolander 1940). Cetacean

lungs actually collapse due to increasing pressure during a dive, meaning they do not rely on air in the lungs for the required oxygen (Kooyman 2002). In addition, muscle and other marine mammal tissues can withstand much higher concentrations of the by-products of cellular respiration (carbon dioxide and lactic acid), with some vessels closing off to prevent or restrict these waste products from being circulated in the animal's body until the dive is terminated (Elsner 1999).

Moreover, marine mammals have the ability to divert their blood flow away from non-essential organs during dives, while maintaining a blood flow to essential organs such as the brain (Elsner 1999). Other organs slow down, requiring less oxygen to function. One such organ is the heart, which can be reduced to 20 to 50 per cent of the normal rate (a process called *bradycardia*), to as few as four or five beats per minute (Slijper 1962).

These various adaptations have implications for whaling activities. For example, for species adapted for extended dives, harpoon wounds to the thoracic cavity and lungs, which might be lethal in a terrestrial mammal, may allow the brain and other vital organs to continue functioning in the absence of inspired oxygen (Wills and Bob 1995). Also, a reduction in metabolism, a reduction in blood flow to all but essential organs such as the brain, and a virtual cessation of breathing might erroneously be taken as indicators of death, when in fact brain function may continue (Wills and Bob 1995) (chapter 11).

Age and reproduction

Most baleen whales breed every two to three years. The minke whale species are an exception and may give birth annually. Baleen whales give birth to a single calf after a long gestation period, typically around 12 months in duration. Many do this in warm water breeding grounds (although tropics-dwelling Bryde's and Eden's whales and resident humpback whales (*Megaptera novaeangliae*) in the Indian Ocean have different breeding patterns due to their non-migration). The young can be nursed from six months to a year before weaning. Most species reach sexual maturity at eight to ten years of age, although the minke whales reach maturity about two years earlier, and bowhead whales (*Balaena mysticetus*) five years later. Information on total longevity in baleen whales is sparse, but blue whales can live up to 80 or 90 years (Sears 2002) and evidence is mounting that bowhead whales may live well over 150 years (e.g. Rugh and Shelden 2002).

While the reproductive rates of the toothed whales vary between species, or are largely unknown (as in many beaked whale species) reproduction in sperm whales is relatively well documented: females reach sexual maturity at about nine years of age and give birth to a single calf every five years and reach physical maturity at approximately age 30; males become sexually mature between ten and 20 years of age, although it should be noted that the young of the sperm whale can suckle for up to 13 to 15 years, showing a long period of dependency; males do not usually breed until their late twenties, and reach physical maturity at approximately 50 years of age (Whitehead 2002a).

Generally speaking, cetaceans are among the longest lived and most slow breeding of animals, meaning that they are poorly adapted to replenishing their populations.

Social behaviour

Mother-calf pairs

One of the most important social bonds in cetaceans is that between a mother and her calf. A cetacean calf may stay with its mother for up to a decade, or throughout its life in some species, and learns important life skills, such as foraging and social behaviour, during this period. Dolphin mother-calf pairs communicate with unique whistles, which they use particularly if the animals become separated (Sayigh *et al.* 1990; Smolker *et al.* 1993).

Male parenting

Baird's beaked whale males live longer than females, resulting in an excess of mature males in the population. It has been suggested that this has led to a social system where males provide significant parental care, looking after calves once they have been weaned, protecting them from predators and possibly teaching them foraging skills (Acevedo-Gutiérrez 2002). This type of paternal care is very unusual in mammalian species, including cetaceans. For most cetacean species, paternal care is absent, although kin-selected male care-giving behaviour (known as alloparental care) has been observed in some small cetaceans (e.g., killer whales: Heimlich-Boran and Heimlich-Boran 1994; Baird 2002).

Co-operative foraging

Cetaceans frequently form groups and co-operate and co-ordinate, for example, when foraging. Co-ordinated herding of prey allows cetaceans to catch larger, and greater quantities of, prey. In humpback whales in the North Pacific, groups of up to 22 whales will simultaneously swim to the surface from beneath a school of shoaling fish – the individual whales maintain specific locations and orientations with respect to the prey and one another. This action is usually led by one whale and is preceded by a vocal signal when the co-ordinated behaviour initiates, with another call issued just prior to simultaneously surfacing (D'Vincent *et al.* 1985). In addition, humpbacks will also swim around a school of fish, releasing a stream of bubbles from their blowholes. The targeted fish will not pass through this curtain of bubbles, which effectively becomes a net trapping the fish.

These behaviours are complex, requiring considerable awareness of other animals and their locations and actions, as well as requiring learning to perfect the techniques involved – all indices of intelligence. In addition, the use of non-living objects, such as bubbles, as an aid to capture prey could be considered tool-use (another indicator of intelligence), which is defined as "*the external employment of an unattached environmental object to alter efficiently the form, position or condition of another object, another organism, or the user itself*" (Beck 1990).

Although less well-studied, other baleen whale species demonstrate some co-ordinated feeding behaviour, e.g. pairs of blue whales lunging at prey and right whales swimming in staggered formations, side by side (Würsig 1988). Female and immature sperm whales also form co-ordinated feeding groups, with animals spread out in a line, perpendicular to their direction of travel (Whitehead 2002a).

Defending and supporting

In addition to co-operating while foraging, cetacean groups may also co-operate in response to predators. For example, sperm whale calves are typically found in groups of approximately ten females. The adults stagger their foraging dives so that the young whales are constantly attended by

an adult (Whitehead and Weilgart 1991). When a predator is encountered (such as a killer whale), the group adopts what is called the marguerite or wagon-wheel formation (Whitehead 2002a). This formation consists of females in a circle, aligned like the spokes of a wheel, with their tail flukes forming the rim and the calves in the centre, or hub, of the wheel (Whitehead 2002a). The females put themselves at risk to protect the other members of the group, in particular wounded animals and calves. The whales will slash their tail flukes at predators (including humans, whom they perceive as predators) who try to attack individuals in the group. An alternative protective arrangement is the 'heads out' formation wherein the animals arrange themselves in a tight rank, with their heads (and, therefore, their teeth) facing towards the predator, with calves, again, in the centre of the formation (Whitehead 2002a).

Although these defensive formations assist the sperm whale to defend itself against natural predators, such as sharks and killer whales, humans unfortunately have used the whale's defensive behaviour to their advantage during whaling activities. Whalers have killed group members one by one, knowing that their fellows would stand by and not leave the sides of injured or stricken animals (Tyack 2002a). Exploiting the bond between mother cetaceans and calves, whalers in St Vincent and the Grenadines have traditionally targeted a humpback calf in order to lure its mother closer to the whaling boat (see chapter 6).

Standing by injured group members is a behaviour that has been observed in many other cetacean species, particularly when attempting to keep a stricken animal's blowhole above the sea surface in order that it can still breathe (Caldwell and Caldwell 1966). There have been many records of cetaceans supporting dead companions, especially calves, long after the animals have died, sometimes for a period of several days. This type of behaviour has been reported in a variety of species, including common dolphins (*Dephinus delphis*), rough-toothed dolphins (*Steno bredanensis*), striped dolphins (*Stenella coeruleoalba*), Pacific humpback dolphins (*Sousa chinensis*) and bottlenose dolphins (*Tursiops truncatus*) (Moore 1955; Brown *et al*. 1966; Lodi 1992; Fertl and Schiro 1994; Parsons 1998).

These collaborative behaviours reflect not only intelligence, but also show that individuals within groups benefit from the presence of the other group members. In addition, individuals may have differing, but complementary, roles. Thus, the removal of any one animal may negatively affect the remainder.

Societies

A society is defined as "*an interacting group consisting of more individuals than parents and their immediate dependent offspring*" (Slobodchikoff and Shields 1988). Several species of cetacean form matrilineal societies, the best-studied being sperm whales, pilot whales (G*lobicephala spp.*) and some killer whales. Within these societies, females spend their entire lives with their natal group (families). Male killer whales, and possibly male short-finned pilot whales (*G. macrorhynchus*), stay with these female groups (that is, they stay with their mothers, sisters, and aunts), but mate with unrelated females from other groups they encounter (thus avoiding inbreeding).

The matrilineal groups of pilot whales and killer whales are particularly interesting; female pilot whales and killer whales may live 20 years beyond the end of their reproductive years (that is, they experience menopause), living past 60 years of age. It has been suggested that this allows old females

to store and pass on information to other group members and perhaps provide alloparental care in the form of babysitting and/or wet nursing (Heimlich-Boran and Heimlich-Boran 1994; Acevedo-Gutiérrez 2002; Baird 2002). Pilot whales (and also sperm whales) suckle calves for 13 to 15 years, indicating a very long period of dependency and close association with their mothers.

Sperm whale females may also form associations that last for decades. These groups appear to assist in the care of young animals, with group members taking the role of babysitters, to allow mothers to take long, deep dives in search of food (Whitehead and Arnbom 1987; Whitehead *et al.* 1991).

It has been suggested that the cultural transmission of learned behaviours to family members is conserved in matrilineal groups: these societies assist in the learning of complex skills essential for survival, as well as ensure these skills are passed onto future generations without being lost or forgotten. Although these societies aid in the transmission of information, they also have the effect of changing mating patterns and hence the genetic evolution of the populations and/or species (Whitehead 1998). Genetic modification as the result of 'culture', such as occurs in these cetacean societies, was previously believed to occur only in humans (Acevedo-Gutiérrez 2002).

Culture

Culture can be defined as behavioural variations between sets of animals that are maintained and transmitted by social learning (Whitehead 2002b) and typically involves components of both teaching and imitation by the animals concerned. It has been suggested that everything of importance in human behaviour is transmitted culturally (Manning and Dawkins 1992). Culture has been identified in several cetacean species, for example, in the eastern North Pacific, killer whale groups were discovered to possess distinct calls that are unique to their group members (Ford 1989, 1991, 2002). In short, like many populations of humans, these cetaceans had unique vocal dialects. Similar dialects have also been found in other species of cetacean (Ford 2002), including the codas of sperm whales (Weilgart and Whitehead 1997) and the songs of humpback whales (Payne and Guinee 1983). These dialects are learned from older members of the group in the matrilineal sperm whale and killer whale, and from other singing males on the breeding grounds of humpback whales; that is, cultural transmission of information rather than ecological or genetic differences account for the geographical differences in vocalisations (Rendell and Whitehead 2001).

Rendell and Whitehead (2001) identified several different ways in which culture was transmitted in cetaceans. The first was a spread of novel and complex behaviours between members of the same generation (i.e. a 'horizontal' transmission of culture), which occurs in humpback and bowhead whales when learning songs from other males (e.g. Noad *et al.* 2000). The second type of cultural transmission was between mother and young (i.e. a 'vertical' transmission of culture); for example, female killer whales teaching offspring how to strand themselves in order to catch the pups of southern sea lions (*Otaria flavescens*) or elephant seals (*Mirounga leonina*) on haul-out beaches (Lopez and Lopez 1985; Guinet and Bouvier 1995). The final pattern of cultural transmission has been described above; a stable group transmission of culture that can be horizontal, vertical or 'oblique' (a non-parent from a previous generation transferring information), e.g. vocal dialects in killer whales (Deecke *et al.* 2000) or sperm whales (Weilgart and Whitehead 1997).

Other apparently culturally transmitted behaviours include bottlenose dolphins placing sponges on their beaks to avoid being punctured by urchins and spiny fish when foraging; bottlenose dolphins,

Atlantic humpback dolphins (*Sousa teuszii*) and Irrawaddy dolphins (*Orcaella brevirostris*) co-operating with humans to school and capture fish; group specific migration patterns and 'greeting ceremonies' in killer whales; and group-specific movement patterns and co-operative defence patterns in sperm whales (Rendell and Whitehead 2001).

Clearly, there is considerable evidence that culture exists in cetacean societies, even in great whale species. Culture was previously considered to be the province only of humans, or at best, higher primates. The exhibition of culture in cetaceans, therefore, adds to the argument that they are, indeed, highly intelligent animals.

Intelligence

At 7.8 kilograms, the sperm whale has the biggest brain of any living animal (Whitehead 2002a). The large brains of cetaceans have led to several studies, which have tried to assess cetacean intelligence by looking at the Encephalisation Quotient (EQ). The EQ is a ratio between the size of the brain and the mass of the animal, with a ratio of 1 meaning that the brain is the size expected for that animal's body (Jerison 1973). Using this ratio, the smaller dolphins have EQs ranging from 3.24 to 4.56 (Jerison 1973), lower than modern humans with an EQ of 7.0. However, the dolphins' EQ is similar to several hominid species beyond the earliest human ancestors (e.g. *Homo habilis* had an EQ of 4.4). However, two issues must be considered here: first, the structure of the cetacean brain is very different from that of humans, due to the cetacean's evolution in, and adaptation to, an aquatic environment (Oelschläger and Oelschläger 2002). Second, these calculations do not take into account the high proportion of a cetacean's mass that is blubber, a tissue that needs little neurological control and, therefore, needs little brain mass dedicated to it. An analogy might be to look at an obese human compared to a normal-weight human – the obese person would have a much lower EQ than the other, but this does not mean overweight people are less intelligent!

The sperm whale and baleen whales do not, however, fare well in terms of EQs. The sperm whale has an EQ of 0.58, the humpback whale 0.44 and the blue whale 0.21 (Jerison 1973). Pro-whalers have thus argued that great whales are not intelligent and should be given no more special status than creatures with similar EQs, such as domestic cows and sheep. However, these EQs do not take into account two important facts: first the weights used in the EQ calculations for the great whales are primarily based on animals caught in whaling activities, where the biggest and fattest would often be targeted, skewing the average body mass used in calculations and hence the EQs. Second, the EQ for the sperm whale does not take into account the large spermaceti organ, which, as a fatty substance like blubber does not require much in the way of neural control, or brain volume, allocated to it, but nonetheless accounts for a sizeable proportion of the animal's mass. Third, the size of the great whales is disproportionably large, an adaptation to their ecological niches. The supportive, buoyant nature of water has allowed the achievement of excessive mass, which was not possible in terrestrial mammals. However, great whales have achieved this increased mass in ways that do not necessarily need an increase in accompanying brain size (Marino 2002). Therefore, in terms of measuring intelligence in the great whales, "*EQ is not an appropriate measure*" (Marino 2002).

If EQs are an inappropriate way to assess intelligence in the great whales, then, perhaps, a better way to assess intelligence is to look at communication: if animals can communicate in sophisticated and novel ways, this implies intelligence (Würsig 2002).

Communication in great whales

The most elaborate and probably best-studied form of cetacean communication in the great whales is the song of the humpback whale. Although other baleen whales also produce complex songs, notably the bowhead and right whales (*Eubalaena spp.*) (Clark 1990), the vocalisations of the humpback whale have received the most scientific, and public, attention. To date, the song of the humpback whale is the most complicated animal song studied and is believed to have a role in competition between males, or in determining mate selection (Tyack 1999). Each humpback whale population has its own specific song; at the beginning of the breeding season all humpback whales in a population sing approximately the same song. As the breeding season progresses the songs of each population change in structure (Payne *et al.* 1983). At the end of the breeding season males stop singing until the following mating season and when they resume singing, their song has the same structure as at the end of the previous breeding season (Payne *et al.* 1983), i.e. the song has been 'memorised' over the intervening period.

As the song evolves through the season it is apparent that each whale is actively learning and incorporating new aspects of the song structure as they are introduced. Although it is at present impossible to assess whether these changes in the song structure are due to 'inventiveness' by the whales, this is a possibility. Certainly the way in which the songs are learnt shows an ability to learn and memorize complex behaviours, and throughout over 30 years of recording these songs they have been shown not to revert to, or repeat, old songs, which suggests that the whales can mentally 'keep track' of a song's evolution (Tyack 2002b); an impressive mental feat.

Sperm whales also have sophisticated calls, in particular 'codas': rhythmic sets of 3-20 clicks in bursts of 0.2-2 seconds. It has been found that groups of sperm whales have group-specific codas (Weilgart and Whitehead 1997), and possibly individually distinct codas (Watkins and Schevill 1977). These codas are learnt within family units and are commonly heard when members of a group rejoin after foraging. It is possible that these codas may help to strengthen social bonds, aid in-group identification or possibly act as a 'greeting' call. It has been suggested that verbal recognition of individuals was a prerequisite for the development of human language (Janik 2000). Sperm whales may have the building blocks for the development of a language as complex as our own.

Communication has also been studied at length in certain small cetaceans, notably bottlenose dolphins and killer whales (e.g. summaries in Tyack 1999 and Dudzinski *et al.* 2002). Some of the most notable types of cetacean communication include the production of alarm and greeting calls (see below). In addition, it as been shown that cetaceans can communicate their individual identity (see below) which, for all intents and purposes, is effectively communicating their individual 'names'. Various researchers have proposed that the complexity of cetacean communication suggests that these animals do indeed possess language and several studies have been conducted to determine whether, in fact, cetaceans possess sufficient linguistic skills to understand or potentially develop language (see below). Sophisticated communication mechanisms have evolved in these species and similar systems may exist in less well-studied species, including some of the other great whale species.

Greeting calls

Clark (1982) analysed the calls of the southern right whale (*Eubalaena australis*) and identified a loud, low frequency (0.2-0.3 kHz) call, which he subsequently identified as a call used to contact other whale groups (Clark 1983). The call was produced while one group of whales was swimming towards another, and the contacted group would then return the call. The frequency of the calls would then increase, as the groups swam together, until they eventually met (Clark, 1983). This 'hello' call between whale groups is interesting and demonstrates an awareness of, and socialising between, whale groups. It is also possible that other calls produced by baleen whales serve as greeting signals (Gordon and Tyack 2002), although this is as yet unsubstantiated.

Alarm calls

A number of vertebrate species, especially primates, produce alarm calls. Many of these calls provide information as to the type of threat, so that group members can respond appropriately (e.g. Seyfarth *et al*. 1980; Cheney and Seyfarth 1985). Alarm calling is often seen as a sophisticated social behaviour, and often an altruistic one. Giving an alarm call could, for example, draw the attention of a predator to the individual giving a call. It appears that cetaceans can be added to the list of animals that produce these signals, as several studies have documented increases in certain odontocete calls, believed to be 'alarm' calls, in response to boat traffic (Findley *et al*. 1990; Lesage *et al*. 1999).

Individual identities

It was Caldwell and Caldwell (1965) who first reported that dolphins produced whistles that were unique to individual animals. These whistles are believed to play an important role in recognition of individual animals, and for all intents and purposes could be considered the 'names' of individuals. These whistles can, among other things, allow individual dolphins to distinguish closely related animals from others (Sayigh *et al*. 1999), much like last or family names in humans. Individual recognition plays an important role in the behaviour of social animals such as cetaceans (Tyack 1986), as it allows animals to identify relatives, form alliances, and aid co-ordinated behaviours such as foraging and repelling competitors or predators. This leads to a much more sophisticated social structure.

Language

Several researchers have investigated the linguistic skills of cetaceans. One of the first studies tried to teach bottlenose dolphins (*Tursiops truncatus*) how to mimic human speech, the idea being that this would be a sign of intelligence (Lilly, 1961). That particular study was a failure, although subsequently beluga whales (*Delphinapterus leucas*) were found to be able to imitate human speech (Würsig 2002) and bottlenose dolphins have been taught to imitate computer-generated sounds (Richards *et al*. 1984).

One of the most well-known, and successful, cetacean linguistic studies was conducted by Herman (1986), who taught bottlenose dolphins a simple sign language and a computer-generated sound language, and using these constructed simple sentences, structured with subject-verb-object. This study determined that, using these artificial symbolic languages, dolphins could understand simple sentences and novel combinations of words but, most importantly, it demonstrated a comprehension of sentence structure (syntax) – an extremely advanced linguistic concept (Herman 1986).

Self-awareness

One of the most compelling pieces of evidence for cetacean intelligence is the demonstration that cetaceans have self-awareness. Several studies in recent years have used a modified test of self-awareness developed for chimpanzees (Gallup 1970). This test involves animals recognising their image in a mirror and, moreover, using that image to investigate their body. The experiments involved marking captive bottlenose dolphins on their bodies with zinc oxide cream (Marten and Psarakos 1995) or non-toxic marker pens (Reiss and Marino 2001). The dolphins would then inspect themselves in a mirror that was placed in their pool. The experiments demonstrated that the dolphins not only paid attention to the information in the mirror, but also they were able to interpret the images as themselves, and not simply another dolphin. Finally, the dolphins used the mirrors as tools to view themselves. These are all indicators of self-awareness.

Using mirror recognition studies, only the great apes had previously demonstrated self-recognition (Gallup 1970, 1982; Lethmate and Dücker 1973; Suarez and Gallup 1981; Anderson 1984). In humans, the ability to recognise one's self in a mirror does not appear until about 24 months of age (Amsterdam 1972). Therefore, bottlenose dolphins have a level of awareness at least as developed as a two-year old child. It should also be stressed that hearing is the primary sense of bottlenose dolphins; therefore, being able to identify visual images as one's self using a secondary sense, is doubly remarkable.

Although self-recognition tests have only been conducted on bottlenose dolphins so far and not on other odontocetes or baleen whales, the experiments demonstrate that at least one species of cetacean is indisputably self-aware and can, therefore, be considered to be at least as intelligent as our nearest relative, the great apes, and human children. Cetaceans, therefore, cannot be dismissed as 'dumb animals', bringing the ethical and welfare issues of whaling into sharp focus.

Conclusions

This short review of cetacean biology raises a number of issues with respect to killing these animals for profit:

- from a cruelty perspective, the diving adaptations of the animals may make it difficult to determine whether they are dead;
- their sheer mass, complex blood systems and adaptations to marine life will also be complicating factors in trying to kill them swiftly and humanely;
- the intelligence, self awareness and family and other social bonds known from some of the better-studied species raise ethical dilemmas for those that wish to kill, or otherwise, exploit these animals;
- consideration of the dimension of 'culture' should exacerbate these concerns because we, as the human species, now need to consider whether we are in danger of destroying other cultures, as well as destroying individuals, populations and species by our actions.

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5 The IWC and whale welfare

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Welfare concerns and the regulation of whaling

In 1931 the League of Nations drew up a Convention for the Regulation of Whaling, which came into force in 1934 with 17 member nations. A conference, held by the International Council for the Exploration of the Sea, followed in London in 1937, culminating in the signing of the International Agreement for the Regulation of Whaling 1937[1]. The conference concluded, among other things, that governments should place themselves in a position to regulate the methods of killing whales to ensure that: "*....the whale when hit may be speedily killed and wastage thus avoided*" and "*abate something of the undoubted cruelty of present methods of whaling*" (International Whaling Conference 1937).

Following the Second World War, governments agreed the International Convention for the Regulation of Whaling (ICRW) in 1946, under which the International Whaling Commission (IWC) was founded. However, issues relating to the cruelty of animals within commercial whaling were not discussed at that meeting and the ICRW did not provide the IWC with any mandate to take action regarding the obvious welfare problems involved in whaling methods. The following year Dr Harry D Lillie spent a season aboard a British whaling factory ship in Antarctica as a physician. In an address to University College London in 1947 he said:

> *"If we can imagine a horse having two or three explosive spears stuck into its stomach and being made to pull a butcher's truck through the streets of London while it pours blood in the gutter, we shall have an idea of the present method of killing . The gunners themselves admit that if whales could scream the industry would stop, for nobody would be able to stand it".*

Dr Lillie represented the World Federation for the Protection of Animals (WFPA) as an observer at the first United Nations Conference on the Law of the Sea meeting in 1958. One of their aims for this meeting was to include an article to reduce cruelty to marine mammals under international law. The IWC itself decided not to send an observer to this meeting, which adopted a resolution requesting: "*…States to prescribe, by all means available to them, those methods for the capture and killing of marine life, especially of whales and seals, which will spare them suffering to the greatest extent possible*".[2] This UN resolution encouraged a debate within the IWC on ways to reduce the suffering of whales during whaling operations. The issue was raised at the 10th meeting of the IWC under the agenda item: 'Humane Killing of Whales: Further Consideration of Action by the Commission to Assist the Application of the Resolution of the 1958 Conference'. At this meeting the commission "*...fully accepted the spirit of the [UN) resolution*" (IWC 1959) and established a working party on 'Humane and Expeditious Methods of Killing Whales' that reported back to the 12th IWC meeting in 1960. The working party concluded that for whales: "*...pain could not be measured and that for*

humanitarian purposes the time taken to inflict death must be regarded as the significant factor". The working party considered and discounted the possibility of developing quicker and surer methods of killing whales involving drugs, carbon-dioxide gas and electricity, but agreed that a combination of explosive harpoon and electricity "*might provide a speedier method of killing.*" (IWC 1961).

Welfare and the ICRW

Although some IWC members still argue that the ICRW does not provide the IWC with a direct mandate to address humane killing, the Convention grants the Commission competence to make binding regulations that are "*based on scientific findings*". The text states: "*The Commission may amend from time to time the provisions of the Schedule by adopting regulations with respect to the conservation and utilisation of whale resources, fixing… (e) time, methods, and intensity of whaling… (f) types and specifications of gear and appliances which may be used*" (ICRW, Article V, 1946). Moreover, Article VI states that the commission may "*make recommendations to any or all contracting governments on any matters which relate to whales or whaling.*"

These articles have subsequently provided IWC members concerned about the welfare of hunted whales with a means to try to prohibit the use of certain killing methods. Despite this, little was achieved before 1980 that directly improved the humaneness of whaling operations because the rules governing the killing of whales were focussed on improving efficiency and reducing wastage rather than improving animal welfare. Although serious questions regarding the cruelty involved in whaling were put to the IWC as early as the 1950s, it took 30 years before the 'cold' or non-explosive harpoon was finally banned for all species by the 1982/83 season[3] (Table 1).

Welfare and the moratorium

In 1972, international concern over the plight of the whales was raised at the UN Conference on the Environment, held in Stockholm. It called for an immediate ten-year moratorium on whaling and the 'strengthening' of the IWC, which was, at that time, dominated by whaling interests. By 1982, many countries had heeded the UN's call a decade earlier and had joined the IWC to support a moratorium on commercial whaling. Many of these cited the cruelty of whaling as a reason for their decision.

Rather than introduce a moratorium, the IWC responded to the UN by adopting the 'New Management Procedure' (NMP) in 1975, to regulate the industry. However, the NMP did not include any new welfare provisions. The previous year, the IWC Scientific Committee considered a paper by Peter Best of South Africa on 'Death Times for Whales killed by Explosive Harpoons' (Best 1974). He argued that it was unlikely to be possible to reduce times to death by any other device than the explosive harpoon because of "*....the practical difficulties associated with consistently scoring a lethal hit on an unrestrained target from a moving platform.*" The Scientific Committee recommended that the commission seek advice from experts to "*examine ways of improving the efficiency of existing methods*" (IWC 1975a).

The following year there had been little progress, but significantly, the Scientific Committee recommended that: "*criteria should be established for judging the humaneness of killing*" and that "*....the rapidity with which the whale is rendered unconscious and killed is the most important factor, both from the humane and commercial point of view*" (IWC 1975b). In 1977, a proposal that the number of harpoons used to kill whales should be reported was not adopted by the Commission (IWC 1977).

In 1978, another attempt to obtain data on the number of harpoons used and struck and lost rates failed, but the Commission agreed a resolution calling for information to be reported on "*...time to death from the time struck, and the reliability of the killing device*" (IWC 1979a). The Commission also accepted the Scientific Committee's recommendation for a research programme into humane killing. However, a sub-committee on 'humane killing techniques' concluded that the explosive harpoon was still the most humane killing method available (IWC 1979b).

In 1979, the working group considered reports on whale killing from expert witnesses who were shocked by what they had observed (IWC 1980). The Commission adopted various recommendations to collect more data on killing times and planned to convene a 'workshop to consider more humane methods'.

In 1980, the IWC held its first 'Workshop on Humane Killing Techniques for Whales'. It considered reports of killing methods including the use of the electric lance and rifle as secondary killing methods in Japanese and Norwegian operations respectively. The group adopted a working definition that "*humane killing of an animal means causing its death without pain, stress or distress perceptible to the animal*" (IWC 1980). However, neither the impact of the chase on the individual (see chapter 9) or the impact of the kill upon other group members, were considered because the participants said they lacked the expertise to assess these factors. The issue of how to determine the time of death or unconsciousness in whales was also raised. However, attention focussed on developing a penthrite explosive grenade that could be used during minke whaling, instead of either the cold harpoon, which resulted in protracted times to death, or the black powder explosive grenade which spoilt more of the meat (chapter 2).

Japan reported to the workshop that whales might die "*...within 4 to 5 minutes after the start of electrocution*" and Norway reported that three or four rifle shots were needed to kill some whales that had already been harpooned (IWC 1981). It was clear from the data presented that whales were suffering extensively in whaling operations and particularly from the use of 'cold' harpoons. This sparked a debate that led to a UK proposal to ban the use of the 'cold' or non-explosive harpoon to kill all whales except minke whales. Australia proposed that the ban be extended to include minke whales by 1982 (although this did not come into effect until the 1982/83 pelagic and 1983 coastal seasons). In a landmark decision the IWC agreed to the ban (although, subsequently several countries filed objections to the ban[4]) and the significance of this decision reverberates to this day. This was the first time that the IWC had acted to improve the humaneness of whaling by outlawing the use of a specific killing device. The IWC had, de facto, accepted competence for humane killing, a fact the whalers refute to this day.

Although the moratorium on commercial whaling was eventually adopted in 1982, the cruelty issues within whaling were still not comprehensively addressed by the IWC. In 1984, the United Nations Environment Programme (UNEP) endorsed the 'Global Plan of Action for the Conservation, Management and Utilization of Marine Mammals', which called for: "*Ensuring that any exploitative or low consumptive use of marine mammal populations is conducted in a humane manner....*". The IWC considered the UNEP plan that year and again "*endorsed its implementation*" (IWC 1985). However, the Commission did not at that time join the Planning and Consultative Committee (PPC) charged with implementing the plan, due to objections raised by some contracting governments.

Welfare and the modern IWC

From 1980 onwards, the issue of humane killing has been regularly discussed at the IWC. So as to avoid unnecessary suffering, in 1984, the Commission backed the Technical Committee's recommendation that the use of electricity, drugs and high-pressure gases were not suitable methods for killing whales. Killing methods used in Aboriginal Subsistence Whaling were discussed and some improvements made, although much concern remains regarding the protracted death times reported from these operations (chapter 6). Since 1992, regular workshops on humane killing have been convened and an IWC resolution against the use of the cruelly ineffective electric lance was adopted in 1994 leading to Japan voluntarily discontinuing its use in 1997. However, the degree of cooperation from whaling nations in providing data, and the 'quality' of the data provided on killing methods has often remained poor (chapter 6).

Since 1993, the IWC has been developing a Revised Management Scheme (RMS), a set of management rules for whaling that must be agreed before any consideration can be given to lifting the ongoing moratorium on commercial whaling. However, the RMS contains no welfare provisions. In 1996, the UK proposed some guidelines for collecting data that could be incorporated into the RMS. A formal protocol for the collection of welfare data was proposed by the UK in 2001 (IWC 2001). However, the proposal met fierce opposition from the whalers and as yet no agreement has been reached on its adoption.

Conclusion

The inherent cruelty which is thought to exist within whaling remains a potent argument against this industry and yet for the first three decades of its existence, the IWC seems to have not fully addressed these welfare issues to prevent cruelty. The failure to address welfare concerns in whaling operations appears to have played a significant role in the IWC's decision to introduce the moratorium on commercial whaling that exists today.

Despite apparent improvements in estimated times to death (TTDs), as reported by some whaling nations, the question of how to determine the point of insensibility and death in whales remains unresolved (chapter 11). Consequently, any estimated death times are not considered to be reliable. Over the years, the IWC has focused its efforts upon reducing TTDs, rather than addressing the issue of the pain and suffering inflicted on the target animal, both during the pursuit and by injuries sustained from the killing method. Additionally, the killing methods used by subsistence hunters for both large and small cetaceans are also cause for concern (chapter 6). Progress is very slow in improving the humaneness of these hunts. Unfortunately, some IWC contracting governments are increasingly reluctant to cooperate with the IWC on issues relating to small cetaceans or humane killing.

The future of animal welfare considerations within the IWC currently depends to a certain extent on reaching an agreement on a data collection protocol on welfare proposed by the United Kingdom, but this has so far been vigorously resisted by the whalers. The protocol, entitled 'Suggested Guidelines for Collecting Data on Humane Killing of Whales' will only become operative if the Revised Management Scheme (RMS) is agreed and adopted, and the existing moratorium on commercial whaling is lifted. However, the debate about the accuracy of present IWC criteria used for determining insensibility and death in cetaceans is yet to be resolved. In these circumstances, if the RMS is agreed and adopted and the commercial whaling moratorium is lifted, the inherent

TABLE 1 A chronology of key welfare decisions at the IWC

1957	Humane killing of whales defined as – The process by which the animal is rendered instantaneously insensible until death supervenes.
1959	First working party on humane killing convened with 'time to death' (TTD) identified as the main indicator of humaneness.
1975	IWC working party on humane killing disbanded in 1962. The Scientific Committee is tasked with addressing issues relating to humane killing. The IWC adopts the 'New Management Procedure' (NMP) for whaling in response to UN call for moratorium. However, the NMP has no welfare provisions.
1978	Commission passes Resolution requiring member states to report routinely on TTDs and on the reliability of killing devices.
1980	First Workshop on Humane Killing convened to "consider methods of improving existing killing techniques or to suggest alternative, more humane, methods". Working definition of humane killing agreed as "death brought about without pain, stress or distress perceptible to the animal". 'Cold' or non-explosive harpoon banned for commercial killing of all whales except minke whales.
1982	Moratorium on commercial whaling agreed, from 1985/6 season, with many countries citing cruelty as a reason for their support. Commission agreed to hold the first Working Group on Humane Killing the following year. 'Cold' harpoon ban extended to include minke whales.
1984	IWC endorsed the Technical Committee recommendation that electrical harpooning, use of drugs and of high-pressure gases are not suitable methods for killing minke whales and recommends discontinuing their use.
1985	Commission adopts Resolution urging, "*the prompt adoption of more efficient methods of killing whales, that reduce cruelty and inhumanity, in areas where aboriginal and subsistence whaling is practised.*"
1991	Terms of Reference for the Humane Killing Workshop expanded to cover 'other whaling activities covered by the Convention'.
1992	Workshop on Whale Killing Methods (WKM) convened and Resolution on humane killing, adopts the 11- point 'Action Plan'[5] from the Workshop. Resolution on pilot whales adopted, requesting more information from Denmark on the killing methods used in the pilot whale hunt in the Faroe Islands.
1993	IWC adopts Resolution calling on parties to continue to progress the 'Action Plan' and calls for another Workshop to be convened prior to the 47th annual meeting. Another Resolution on pilot whaling is adopted[6].
1994	Resolution on the use of the electric lance is passed expressing concern regarding its ineffectiveness and urging member governments to develop more satisfactory methods of killing whales.
1995	Workshop on WKM – Action Plan' reviewed, two welfare Resolutions adopted[7].

1996	UK proposes guidelines for collecting data on the killing of whales as part of the Revised Management Scheme (RMS).
1997	Commission adopts resolution calling on aboriginal subsistence whalers to "*do everything possible to reduce still further any unavoidable suffering caused to whales in such hunts*". Japan announces it will use rifles in place of the electric lance from the next whaling season.
1999	Workshop on WKM convened. The Humane Killing Working Group name is changed to 'Working Group on Whale Killing Methods and Associated Welfare Issues' (WKM&AWI) after objections to the word 'humane' are raised. Resolution adopted requesting data on instantaneous death rate, struck and lost rate, details of killing weapons used and criteria for determining unconsciousness or time to death. Also calling for aboriginal hunters to provide more data. Adoption of the 'Revised Action Plan' on WKM.
2001	Independent workshop held in London[8] concludes that IWC criteria for determining death and insensibility in whales are inadequate. IWC Resolution adopted expresses disappointment that no data on the killing of sperm and Bryde's whales during Japan's special permit whaling is provided. Formal protocol for welfare data collection under RMS is proposed by UK
2003	Workshop on WKM&AWI convened – 'Action plan' again reviewed. Further calls made for data on killing times from Japan's special permit whaling and from Aboriginal subsistence hunts. Minimum calibre rifles for secondary killing recommended. Calls made for further investigation into the criteria used for determining insensibility and death in cetaceans. Japan walks out of discussion on proposed collection of welfare data under the RMS.

cruelty of whaling, which played a significant role in the decision to impose the moratorium, will remain unresolved for the foreseeable future.

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Footnotes

1 Signatories comprising the governments of: the Union of South Africa, the US, the Argentine Republic, the Commonwealth of Australia, Germany, the UK, Northern Ireland, the Irish Free State, New Zealand and Norway.

2 Resolution V, United Nations Conference on the Law of the Sea, 25th April 1958, Report of the Third Committee.

3 Article III, paragraph 6 of the Schedule to the ICRW.

4 The objections of Japan and the Russian Federation remain.

5 The Action Plan called for: details to be provided on equipment and methods used and for cooperation in improving methods, investigation into criteria for determining death, assessments of cause of death in relation to observed time to death (using post-mortem data), provision of data on time to death and struck and lost rates in all whaling operations, including ASW (particularly noting the need for data provision and the reduction of struck and lost rates in the Greenland beluga and narwhal hunts), and for the development of methods for determining stress indictors in hunted whales.

6 Calling for Denmark to provide all 'additional information' on the pilot whale hunt in the Faroe Islands to the next annual meeting and expressing concern about the adequacy of the implementation of existing Faroese legislation.

7 A resolution requesting further data on killing methods and a specific resolution referring to the killing methods employed during the pilot whale drive hunt.

8 Hosted by the RSPCA (RSPCA 2003).

Section Two

Whale killing

6 Commercial and Aboriginal subsistence whaling

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Commercial whaling

Despite the implementation of a worldwide ban on commercial whaling by the International Whaling Commission (IWC) in 1986, four types of ongoing modern whale killing activity are commercial in nature in that the products of the hunt are sold for profit:

- Norway lodged an objection[1] to the IWC's moratorium decision and recommenced commercial whaling in 1992. Norway currently takes between 550 and 640 minke whales a year[2], the products of which are sold domestically and, in recent years, have been exported to Japan, Iceland and the Faroe Islands.
- Japan and, since August 2003, Iceland conduct whaling under a 'special permit' provision in Article VIII of the International Convention for the Regulation of Whaling (ICRW), which allows contracting governments to issue permits to their nationals authorizing the killing of whales for purposes of scientific research. The whaling operation may process and dispose of the edible tissue from the whales killed without restriction by the IWC. Japan undertakes two scientific whaling operations annually: JARPA[3] currently targets approximately 440 minke whales annually in the Antarctic and JARPN[4] targets 150 minke, 50 sei, 50 Bryde's and 10 sperm whales in the eastern North Pacific. The meat and blubber from the hunts are sold commercially to Japan's extensive, but declining, domestic market. Iceland plans to take 38 minke whales in 2003, and up to 250 minke, fin and sei whales annually in subsequent years5, and has expressed its intent to export whale products to Japan. The legitimacy and ethics of this 'scientific research' are the subject of another chapter of this review (chapter 13).
- Japan, Norway[6], and Iceland also permit the consumption of whales that have died as a result of entanglement in nets ('bycatch'). Japan has recently changed its laws to permit the commercial sale of bycaught whales. The killing of bycaught whales has become known at the IWC as 'net whaling'.
- The products of some whales, which are taken under IWC rules permitting Aboriginal Subsistence Whaling, are sold commercially on the domestic market and two countries currently conducting ASW have recently expressed interest in exporting whale products[7]. Aboriginal Subsistence Whaling will be discussed at the end of this chapter.

The welfare implications of each whaling technique will be considered in this chapter. Table 1 shows the number and species of whales killed over the last five years by Japan and Norway, the average and maximum time they took to die (time to death, TTD), the instantaneous death rate (IDR) and the proportion of animals shot but lost (the 'struck and lost' rate, SLR).

Table 1 Commercial, special permit and net whaling 1998-2002[8]

Contracting Government	Season	Type of Whaling	Species	Number killed	IDR (%)	Average TTD (seconds)	Max TTD (minutes)	Number Struck & Lost
NORWAY	1998	Under	minke	625	63	198	68	11[9]
	1999	objection	minke	591	62	241	86	14
	2000	to the	minke	487[10]	78.2	136	59	6
	2001	moratorium	minke	552	79.7	145	90	10
	2002		minke	634	80.7	141	90	1
JAPAN*	1998/99	JARPA	minke	389	31.6	285	NO DATA PROVIDED	
	'99/2000	Special	minke	439	44.4	173		
	2000/01	Permit	minke	440	36.1	205		
	2001/02		minke	440	33.0	203		
	2002/03		minke	440	40.2	157		
JAPAN†	1998	'Net	minke	24	DATA NOT AVAILABLE			
	1999	Whaling'[11]	minke	19				
	2000		minke	28				
	2001		minke	79				
	2002		minke	109				

Note Japan does not supply any comprehensive data on minke, sperm, Bryde's and sei whales killed during the JARPN hunt.

†Figures obtained from National Progress Reports submitted annually by Japan to the IWC.

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Killing methods used during commercial and special permit whaling

With the exception of bycaught whales (discussed later in this chapter), the methods used by Japan, Iceland and Norway for killing whales are very similar. In each case, whalers use a penthrite grenade harpoon, which is fired from a cannon mounted on the prow of a ship, as the primary killing method. The harpoon is intended to penetrate to about a foot (approx 30cm) into the whale and then detonate, creating sufficient energy to kill the whale either by the trauma or laceration, or by the generation of shock waves, causing trauma to the brain. Upon impact, spring-loaded claws are released by the harpoon and embed in the surrounding flesh when the line comes under tension. If the whalers determine that the first harpoon has not killed the whale, either a second penthrite harpoon is deployed or a rifle (of minimum calibre 9.3mm) is used as a 'secondary killing method' in both the Norwegian and Japanese hunts. Until recently, Japan used electricity as a secondary killing method.

Norway manufactures a penthrite grenade harpoon known as 'Whalegrenade-99', which it uses in its domestic hunts and sells to Iceland, Japan and Greenland. Japan also uses a slightly modified version of this grenade with a longer trigger cord that delays the explosion until the harpoon is embedded deeper in the animal (Ishikawa 2002). Japan's Institute of Cetacean Research (which oversees Japan's whaling operations and scientific research, and also markets the meat), is conducting comparative tests between the Norwegian grenade and Japan's own modified version. It is expected, however, that financial rather than humane considerations will determine the government of Japan's ultimate choice of whale killing technology. Despite evidence presented by Japan to the 2003 IWC meeting demonstrating that the instantaneous death rate for minke whales killed using the Norwegian grenade was greater than for those killed using the Japanese grenade, Japan conceded that "*Financial concerns may be the most important factor related to the decision whether or not to introduce them* [the Norwegian grenade] *to Japan*" (Ishikawa and Mogoe 2003, Ishikawa 2003).

Reporting data

The schedule to the ICRW includes a reporting form[12] for the collection of data from all factory ships and catcher ships[13]. The data collected are considered annually by the Commission's standing Working Group on Whaling Killing Methods and Associated Welfare Issues, and in greater detail every 3-5 years by its expert Workshop on Whale Killing Methods and Associated Welfare Issues. The last workshop met in June 2003 just before the 55th Annual Meeting of the IWC. Norway provides data on whale killing as required under the schedule. However, Japan continues to withhold much of the data it collects from its whaling operations[14]. For example in 2003, Japan only presented data (which was itself incomplete) on two of the four species that it hunts in the North Pacific 'JARPN' hunt. It also provided some details, for the first time since the hunt began in 2000, of the harpoon it uses to kill sperm whales, but offered no TTD or IDR data. Nor did it volunteer any substantive reasons for its choice, for sperm whales, of a 75mm harpoon and a penthrite charge 1.7 times greater than is used on minke whales (30g) (Anon 2003c).

Evaluation of methods used during commercial whaling

Despite the similarity of methods used by Norway and Japan for killing whales, there are marked differences in killing efficiency as illustrated by the IDR and the average TTD in each hunt (Table 1). There may be several operational reasons for this difference. Japan often points to the weather (chapter 8) and the accuracy of new gunners as a causative factor for this difference. Japanese whalers may aim for the thorax in order to preserve the whales' ear-plugs for their research. However, the choice may also be influenced by the larger target offered by the thorax.

Many countries have regulations requiring stunning immediately prior to slaughter of livestock animals that are killed for food. The objective is to cause instantaneous insensibility to pain through a loss of consciousness which lasts until death (Gregory and Lowe 1999) (see chapter 12). In order for this to be achieved in whales, energy must be supplied to nervous tissue to bring about a stunned state. This can be achieved either via a percussive energy wave, through blast energy induced neurotrauma, or by electrical energy delivered directly, or close to, the brain.

Whaling techniques compare unfavourably to terrestrial slaughterhouse killing methods in achieving instantaneous insensibility or death. In 2002, 80.7 per cent of whales were instantaneously killed or rendered insensible in Norway's hunts and only 40.2 per cent in Japan's Antarctic hunt (the rates for other, larger, species taken by Japan during the JARPN hunts are unlikely to be 'better').

It can be argued that the figures for IDR and average TTD quoted by Japan and Norway do not hold up well to scientific scrutiny. There is, for example, much debate over the adequacy of criteria that are currently used by the IWC to determine the onset of permanent irreversible insensibility and death in cetaceans, and some scientists believe that the current criteria[15] are inadequate (Butterworth *et al*. 2003). Furthermore, since cetaceans are adapted for diving, and consequently have developed mechanisms for storing oxygen in their tissues (Anon 2003a), they may survive, and potentially experience pain over a period that is longer than the current IWC criteria indicate (see chapter 11).

Size considerations

It is considered that one of the main reasons for the poor IDR in whaling operations is the fact that current killing methods, which have been designed and tested on relatively small minke whales, are not adequately adapted to account for the different morphology and physiology of other species on which they are used. The most profound physical differences occur between the sperm whale (an Odontocete or toothed whale), which can weigh up to 57 tonnes (Silva and Downing 1995) and reach 18.3 metres (Reeves *et al*. 2002), and the baleen whales (*Mysticetes*). For example, the brain of the sperm whale is buried deep in the whale's head, behind a substantial depth of bone and the fatty tissue of the spermaceti organ, thus making a direct strike to the brain in this species very difficult (see chapter 10). The sperm whale also has physiological adaptations that enable it to dive to a maximum depth of 2000 metres and remain submerged for up to 79 minutes (Stewart 2002).

There are also significant differences between the baleen whale species currently killed for commercial purposes. For example, while the sei whale can weigh up to 50 tonnes (Silva and Downing 1995) and can reach a maximum length of 19.5 metres (Reeves *et al*. 2002), the minke whale (*Balaenoptera acutorostrata*) weighs up to only 10 tonnes (Silva and Downing 1995) and reaches a maximum length of only 10.7 metres (Reeves *et al*. 2002).

Several physiological factors will determine the efficacy, on a bigger species, of a device that was designed to kill smaller animals. For example, the thickness of the species' blubber (which comprises between 15 per cent and 50 per cent of the total mass of a great whale depending on the season and the species (Castellini 2000)) may significantly affect the penetration of the projectile (Anon 2003a), which must reach a sufficient depth to be lethal. In addition, operational factors relating directly to the technology used will also affect whaling efficiency. For example, the quantity of explosives used will be a significant factor, as evidenced by the greater charge used by Japan to kill sperm whales. In addition, the strength of the forerunner rope may be significant since, if it is not sufficiently strong to take the strain of a larger species, the number of whales struck and lost, or that have to be secured and killed by other means (Anon 2003a), may increase.

Secondary killing methods

Clearly, the need for a secondary killing method to be used will directly correlate to the efficiency of the primary killing method, including its specific suitability for the species taken. That is, if a grenade explodes at a sub-lethal level, fails to explode at all, or fails to secure the animal, a secondary killing method, or an alternative means of securing the fleeing or sinking animal, will be required. As data on secondary killing methods in commercial whaling operations are only provided for minke whales, this correlation (between frequency of use of secondary killing methods on larger species and the adequacy of the primary method) is most clearly illustrated in Aboriginal Subsistence Whaling (ASW) operations. (See page 45).

The IWC has not established any formal criteria for determining when to apply a secondary killing method to a wounded whale, and the decision, including about which method to use, rests with the hunter. This means that, in situations where a whale is not lethally wounded by the primary killing method, it is possible that the hunter may wait some time to see if the whale dies before deciding to administer a secondary killing method. Cost considerations, and the risk of damaging more, or higher value, edible tissue, are likely to influence this decision, particularly when the secondary killing method is a second explosive harpoon. The most commonly only used secondary killing method is the rifle.

It is of concern that, despite a ban imposed by the IWC on the use of the 'cold' (non-exploding) harpoon[16], Japan permits the use of a cold harpoon as a secondary killing method on minke, Bryde's, sei and sperm whales in its North Pacific whaling operation[17]. The JARPN permit authorises its use "*in order to shorten the time to death of the whale which was struck by an explosive grenade harpoon*".

The adequacy of the rifle as a killing method

It is essential that the goal of a secondary killing method should be to immediately kill, or render insensible to pain, an already wounded and compromised whale. In order to achieve this, any secondary killing method will need at least equal or greater power and accuracy than the primary killing method. When rifles are used as a secondary killing method, the target should be the brain, since rifles targeted elsewhere are unlikely to produce a swift death. The small amount of data available on secondary killing methods, largely derived from ASW operations, indicates that rifles may often be inadequate to kill whales with a single shot (Stachowitsch and Brakes 2003).

In addition to factors related to the morphology of the target whale, the efficiency (and, therefore, the appropriate choice) of a killing method will also be determined by operational factors relating to the gunner, vessel and specification of the weapon used. Some of these factors will be within the control of the gunner, including the power and accuracy of the weapon, the accuracy of the gunner and his ability to identify and aim at specific external landmarks. Others will be outside his control, such as the prevailing weather conditions (see chapter 8). A further consideration when choosing both primary and secondary killing methods (including vessel type) should be species-specific behaviours. These include the manner in which a species behaves in response to being struck, which may have significant practical repercussions. For example, if the behavioural response to the stimulus of a harpoon is to dive (in an attempt to move away from the stimulus), this will have implications for the choice, and administration, of any secondary killing method (Anon 2003a).

'Struck and lost' whales

The failure to land whales that are struck and injured, but not landed, by a whaling operation has grave welfare implications. It is also a conservation problem, if struck but lost whales do not count towards the quota established[18]. The schedule has specific requirements for the reporting of these 'struck and lost' individuals[19] in commercial whaling operations. Information provided to the IWC on struck and lost whales commonly reports that either the harpoon pulled out, the forerunner rope broke, or that the harpoon struck but did not engage properly (Anon 2003b). It is possible that not all whales that are struck are reported, as in some cases it may be difficult to evaluate whether a whale has actually been struck, especially when the primary killing method is a rifle as in some Aboriginal Subsistence hunts.

Since struck and lost whales can incur a wide range of injuries, the prognosis for these animals will vary significantly. Whales that have been struck by an explosive harpoon that pulled out, or whose forerunner rope broke, may suffer some considerable internal damage. Once the whale has 'escaped' and the opportunity to administer a secondary killing method has been lost, pain, suffering and TTD may be considerably protracted. In contrast, it should be noted that the escape from a slaughterhouse of a significant proportion of wounded animals would not be tolerated. In this manner, as many others, expectations of the welfare of whaling operations differ fundamentally from that of slaughtering other animals for food (see chapter 12).

In the short-term, the damage cause by a poorly aimed harpoon or bullet may lead to bleeding, significant nervous tissue damage and/or damage to internal organs. Depending on the extent of injury, these wounds may prove fatal over time. In the longer term, less immediately perilous injuries, such as strikes to the musculature or bullets embedded in bone, may be significantly debilitating, although not immediately fatal. Such injuries may lead to infection, restricted mobility, ankylosis of shattered joints and eventually even to muscle or limb atrophy. This could lead to loss of use of the pectoral fins or tailstock, which would impede swimming ability. A number of different injuries could, therefore, result in an inability to feed, socialise and reproduce, and could potentially cause a slow death through starvation (Anon 2003b). Furthermore, struck and lost whales are almost certainly more susceptible to infection. In addition to physical wounding, exertional myopathy induced by a prolonged flight, may also have a significant impact on the long-term prognosis of struck and lost animals (see chapter 9).

Iceland

During the 55th IWC meeting, in June 2003, Iceland presented its proposal for a scientific whaling programme, targeting 100 fin whales, 100 minke and 50 sei whales annually over two years. The proposal met strong opposition from both the Scientific Committee[20], and the Commission, which adopted a resolution describing scientific whaling as "*an act contrary to the spirit of the moratorium on commercial whaling and to the will of the Commission*"[21] and called on Iceland not to proceed with its plans (see chapter 13 for more details).

In August 2003, Iceland announced its intention to implement the first stage of its scientific whaling programme, involving the take of 38 minke. This hunt commenced on 11th August 2003.

Whale bycatch

The killing for food of whales caught in nets is not a new practice. Japanese whalers have been actively using nets to trap whales since the seventeenth century (Mitchell, Reeves and Evely 1986). In 2001, Japanese legislation[22] was amended to permit the killing of whales accidentally caught in nets and the commercialisation of their products. Before this amendment, fishermen were required to free trapped whales and were prohibited from selling them. It is not clear whether the subsequent four-fold increase[23] in whales caught in nets in Japan in 2001/2002 resulted from better reporting of bycatch incidents, or whether a new commercial incentive led to more whales being killed[24]. However, there are growing concerns from some IWC members that fishing nets are used intentionally to catch whales for commercial purposes in an effort to circumvent the moratorium on commercial whaling[25]. This was further evidenced by the figures presented to the 2003 IWC Scientific Committee by Japan which demonstrated that in 2002, 109 minke and three humpback whales were reported to have been caught in Japanese nets.

The use of the products of bycaught whales for commercial purposes is not unique to Japan. In Korea, where it is also legal to commercialise the meat of whales caught in nets, a bycaught whale can fetch between US$30,000 and US$40,000 at auction (IAKA and KAPS 2002). In Greenland, whaling regulations permit the killing of a sick or injured animal, including species not included in the ASW quota, and the distribution of its meat to public institutions.

In countries where the intention is to dispatch bycaught whales for human consumption, no details are available on the methods used, or who undertakes the kill. It is likely that a wide range of weapons are employed, including knives, rifles and cold or exploding harpoons (Anon 2003a). It is doubtful that veterinarians are consulted on the best welfare option for the whale, which should include its possible release. It is equally doubtful that, if fishermen kill the whales, they will have had any appropriate training. As a result, the range of wounds incurred by these animals may be extensive and their TTDs protracted.

Aboriginal Subsistence Whaling

The IWC permits 'aborigines', whose cultural and nutritional need for whales and whaling it has recognised, to hunt some baleen species 'exclusively for local consumption'[26]. The IWC establishes five-year blocks of annual Aboriginal Subsistence Whaling (ASW) quotas that are based on the advice of its Scientific Committee. These subsistence quotas are currently taken by indigenous people in the US (who take gray and bowhead whales), Greenland (who take minke and fin whales) and Russia (who take gray and bowhead whales), and by Bequians of St Vincent and the Grenadines (who take humpback whales).

The IWC recognises that killing methods used in ASW hunts are less accurate and efficient than those used in commercial whaling operations, and result in longer times to death, lower instantaneous death rates, and higher struck and lost rates. Paragraph 13 of the IWC's schedule, which sets out the quotas for the species that may be hunted in ASW operations, does not include any specific welfare provisions. However, through a series of resolutions, and direct recommendations from the working groups, the IWC has urged aboriginal subsistence whalers to do everything possible to reduce any avoidable suffering caused to whales in ASW hunts[27]. Contracting governments are requested to provide relevant data from their hunts for analysis by the Workshop and Working Group on Whale Killing Methods and Associated Welfare Issues, so that advice on techniques and equipment can be given by experts (which, in practice, often means other ASW hunters).

The IWC has been slower to address welfare concerns relating to ASW than to commercial whaling, and has been particularly hesitant to consider whether (and if so, how) the integrity of subsistence hunts should be maintained through the use of traditional, but inherently less efficient, equipment and vessels. As indigenous hunters have begun to use more non-traditional equipment to chase and shoot whales, ASW hunts have become more efficient, but they have also become more expensive and have lost some of their defining cultural characteristics. Although the IWC's workshops and working groups provide increasingly technical advice, the Commission leaves the decision about which equipment to use to the discretion of the governments concerned and their hunters. It also requests all contracting governments to provide appropriate technical assistance to improve the 'humaneness' of aboriginal subsistence whaling and reduce time to unconsciousness and death[28]. As a result, native US whalers have shared technology, provided training and donated

equipment to Russian subsistence whalers, while Norwegian experts with commercial whaling expertise have provided technical advice to Aboriginal whalers in, Greenland, Russia and the US.

A variety of different killing methods are used in the current ASW hunts for fin, gray, humpback, minke and bowhead whales. Data from each hunt should, in theory, illustrate the relative efficiency of these different methods for each species, as well as enabling a comparison between aboriginal and commercial hunts using the same techniques or targeting the same species. However, the information provided to the IWC by all nations conducting ASW is incomplete and the data that are collected are not necessarily based on consistently applied criteria, making a comparative analysis difficult[29]. For example, Greenland's hunters use the same harpoon on the same species as Norway, but apply different criteria for judging the onset of death or insensibility (table 2).

Table 2 Criteria used to determine death during Aboriginal Subsistence Whaling[30]

ASW Hunt	Criteria used for determining death
Russian, Chukotka	Estimated subjectively by the hunters and inspectors, from the time that the first harpoon struck the whale until complete cessation of movement of the flukes.
Alaskan Inuit	Time to prayer, rather than time to death, is used. This is the time when it is considered safe by the whaling captain to approach the whale, which is usually to between 5 to 10 minutes after the whale is considered to be dead by the hunters.
Greenland	When the whale does not move and the flippers are immoveable
St Vincent – Bequian	Details not provided, however one account states that "*When the whale spout blood and she float dead...*" (Ward 1999).

Although all current ASW operations are still conducted from small boats, most now use motorised vessels to chase the whale. Probably the most effective 'modernisation' of Aboriginal Subsistence Whaling (in terms of reducing TTD) has been the adoption of the penthrite grenade as a primary killing method in some hunts, although it is used in different ways in different hunts. Often, however, a darting gun is used, with either a black powder grenade, or a cold harpoon. The projectile has line and floats attached which are intended to slow the progress of the whale through the water. In this instance, the harpoon is intended to secure the whale, rather than kill it outright. The final kill is then achieved using rifles, further harpoons or, depending on the hunt, sometimes spears. Despite concerns expressed by experts regarding the adequacy of the calibre commonly used (Anon 2003c), the rifle is still a popular hunting method for aboriginal whalers, particularly as a secondary killing method.

Killing methods used during ASW

Russian gray whale and bowhead hunt

Chukotkan hunters use darting guns with black powder grenades, or harpoons. In both cases, floats and line are attached to secure and mark the whale. Spears are also sometimes used during these

hunts. A rifle or darting gun is then used to dispatch the animal. The long times to death reported in the Russian Federation's gray whale hunts indicate a serious lack of efficiency in this method. The average time to death for gray whales taken in 1999, 2000 and 2001 was 53 minutes with an average of 47 bullets used per whale. In 1997, ten floats were required to secure a whale and then a metal tipped lance and 600 to 700 bullets to kill her (HSUS 1997). In a 1999 hunt, it took over three hours and 40 minutes and 180 bullets to kill a single gray whale.

The data provided to the 2003 Workshop on Whale Killing Methods show the proportional use of harpoons, darting guns and three models of rifles (including the semi-automatic 'CKS' which is the civilian version of the SKS) by Russian whalers in 2002. Of 131 gray whales killed that year, the harpoon and rifle were used in every case and the darting gun was used on 71 per cent of the whales (an average of 2.7 darting gun projectiles was used on each whale). The CKS was used on 10 whales, but the number of rounds used on these occasions was not provided. Not one gray whale was killed instantaneously by the harpoon in 2002 and all required the use of a secondary killing method. The maximum estimated time to death was 56 minutes and the mean time to death was 32 minutes. The maximum number of bullets used on a single whale was 100 and the median number, 52.

In response to a question at the 2003 workshop about the small calibre of the rifles and the adequacy of cartridges used in its gray whale hunt, the Russian Federation explained that hunters use whatever weapons are available and gave behavioural, as well as operational, reasons for the large number of bullets and darting gun projectiles used, and for the long times to death. The Russian Federation delegate explained that, because the gray whale is aggressive, hunters tend to 'overuse' bullets to make absolutely sure that the whale is actually dead, and overestimate the time to death to be sure that the whale is not still moving before they approach it.

The efficiency in the Russian hunt for bowhead whales is also of concern to the IWC. During 2002, two bowhead whales were landed and another was struck and lost. One whale was killed using a harpoon and darting gun and the other using a harpoon, darting gun and rifle. The number of bullets used was not, however, reported. The maximum time to death was 53 minutes and the mean, 41 minutes. In 2001, the Russian Federation provided different data, making a comparison impossible. It reported that six harpoons and floats and five darting gun projectiles were used on the one whale killed that year, but did not provide time to death data.

US Alaskan bowhead and Makah gray whale hunt

The Alaskan Inuit hunt for bowhead whales also employs a darting gun with black powder projectile with 35-fathom line and floats attached, which is designed to mark the position of the whale and slow it down. The secondary killing method, which is used once the whale is secured, is either another darting gun or a smooth bore, 7-gauge shoulder gun. Alaskan hunters have recently tested a penthrite grenade in the darting gun and reported to the IWC in 2003 that it appears to be more effective in producing a rapid death than the traditional black powder projectile.

The US claims that hunting efficiency in the Alaskan Eskimo bowhead hunt has improved over the last 20 years, although in 2001, only 36.7 per cent of whales were killed instantaneously and 26 struck whales were lost. The US does not provide time to death data to the IWC, claiming that it is too dangerous for hunters in a small boat to stay close to a whale following a strike. In 2003, the US reported that it has introduced a new reporting form on which hunters are to record 'time to prayer'.

This is the time from the throwing of the first harpoon to the time at which the crew traditionally prays for the whale, having monitored it from a distance for at least 5-10 minutes post strike, before approaching to confirm its death. The US conceded that this is a very inaccurate measure.

The Makah tribe of Washington State took a single gray whale in 1999. A steel harpoon was thrown from a traditional whaling canoe and, once struck, the whale was shot with a .577 calibre hunting rifle fired from a motorised chase boat. The whale was reported to have been killed within eight minutes, with two shots from the rifle. In 2002, a US court concluded that the US's issuance of a gray whale quota to the tribe violated federal law, and prohibited further hunting.

Greenland hunts

Three different hunts are conducted in Greenland. On the west coast, up to 19 fin whales may be hunted annually. Here, a 50 mm mounted harpoon cannon fitted with a penthrite harpoon purchased from Norway is both the primary and secondary killing method. These are mounted on boats measuring between 36 and 72 feet. For the first time in 2003, Greenland reported that a specially constructed penthrite grenade with a longer trigger line is used for fin whales (Anon 2003c).

Up to 175 minke whales may also be hunted annually on the west coast of Greenland, but the same hunting method is not used in each case. For some whales, the primary killing method is the boat-mounted harpoon cannon using a penthrite grenade purchased from Norway. For others, however, a rifle (mainly of calibre 30.06 (7.62 mm)) is used. The secondary killing method for all west coast minke whales is a rifle.

On the east coast of Greenland, the whaling communities do not have vessels with mounted harpoon cannons. Here, all minke whales are shot with rifles fired from small boats known as skiffs in a 'collective hunt' comprising up to five boats. According to Denmark's report to the IWC's workshop on whale killing methods in 1999, the collective hunt "*starts with shooting at the whale, then the hand harpoon was used, and thereafter the rifle to kill the whale*". The main target area is the whale's head.

Greenland has historically reported its whale killing data to the IWC by species (or population) and not by method used. This makes it impossible for the IWC to assess the relative efficiency of the two hunting methods used on minke whales in West Greenland, although the data provided from the east coast minke whale hunt (which only uses rifles) clearly demonstrates that the rifle results in longer TTDs, lower IDRs and higher SLRs. At the 2003 IWC meeting, in response to several requests, Greenland reported TTD data by method for the West Greenland minke hunt. This showed the maximum time to death for minke whales killed in the harpoon hunt in West Greenland was 30 minutes, whereas the maximum for those killed during the collective hunt, where only rifles are used, was 300 minutes (five hours). Furthermore, the average TTD for those killed in the harpoon hunt was seven minutes, whereas the average for those killed in the collective hunt was 33 minutes (Anon 2003d).

For East Greenland minke whales the mean TTD was 21 minutes (maximum 90 minutes), and for fin whales it was nine minutes, with a maximum recorded TTD of 25 minutes. No East Greenland minke whales died instantaneously in 2002 and none of the West Greenland minke whales killed during the 'collective' hunts (also killed only with rifles) died instantaneously. Almost 8 per cent of West Greenland minke whales killed in the harpoon hunt and 7.6 per cent of fin whales were

recorded as dying instantaneously (Anon 2003d). It should also be noted however, that data were only provided for 131 West Greenland minke whales out of 139 hunted, therefore these TTD and IDR data are incomplete.

Struck and lost rates are high in Greenland's ASW hunts. Between 1990 and 2002, West Greenland minke whales were struck and lost in 11 out of 13 years, with an average SLR of 2.4 per cent per year. In contrast, East Greenland minke whales were only struck and lost in three out of 13 years, but the rates were high on each occasion: three out of eight whales in 1992 (37.5 per cent)[31]; three out of 14 in 1997 (21.4 per cent) and three out of 17 in 2001 (17.6%)[32]. Greenland's SLR for fin whales is also particularly poor in some years, but zero in others. In fact, the SLR for the East Greenland minke and fin whale hunts is highest in the same years, which suggests that a common factor, such as bad weather, may be to blame.

Despite longer TTDs and higher SLRs sustained by minke whales in Greenland's rifle hunts, the use of rifles appears to be increasing. In West Greenland, the rifle quota was set at 50 Minke whales for 2003, but in April was increased to 55 Minke whales with possible adjustment to 57 in September[33]. The number of skiffs participating in Greenland's collective hunts has also increased in recent years; from 506 reported for 1998 to 630 reported for 2000 and 2001.

Greenland's use of a 30.06 calibre (7.62mm) rifle on minke whales has been a subject of concern at the IWC, with expert opinion expressed for several years that it may not be sufficiently powerful to kill this species swiftly (see chapter 10). Norway's chief whale welfare expert commented to the IWC's 1999 Workshop on Whale Killing Methods that he had seen whales shot by 7.62mm pointed bullets that did not penetrate the skull, but might only have caused concussion. He stated that he did not recommend the use of 7.62mm bullets and that 9.3mm rifles are used in Norway as the secondary killing method for the same species (Anon 1999). Despite this advice, and the recommendation of Greenland's National Association of Hunters that a .375 calibre rifle is used, Greenland tells the IWC that use of a higher calibre rifle would be too expensive to implement.

St Vincent humpback hunt

St Vincent has not provided any data to the IWC in recent years on methods and vessels used, times to death, instantaneous death rates or struck and lost rates.

According to various reports, humpback whales are secured using a cold harpoon thrown by hand from a boat and are brought alongside the vessel. Then an 8-foot lance is "*repeatedly thrown in attempts to puncture the whale's heart or lungs*" (Ward 1999). Sometimes the whale is finally killed by a 'bomb lance'- an exploding projectile discharged from a shoulder gun. In some instances, however, it appears that the bomb lance is administered at the same time as the initial cold harpoon. A final killing method, which may be applied in some extreme cases, is a projectile from a 40-pound bronze shoulder gun or 'bomb gun'. Females are traditionally hunted, with whalers targeting calves first in order to lure their mother to the boat.

In light of developing understanding of the dying process in cetaceans and their adaptation to low levels of oxygen, it is of particular concern that the objective in this hunt is to pierce the lungs or the heart of the whale, rather than to aim for a lethal shot to the brain.

Table 3 Aboriginal Subsistence Whaling 2000 to 2002[34]

Contracting government	Season	Species	Number killed	IDR (%)	Average TTD (minutes)	Max TTD (minutes)	Number struck & lost
Russian Federation (Chukotka hunt)	2000	Gray[35]	113		57	130	2
		Bowhead	1				0
	2001	Gray[35]	112		43	87	0
		Bowhead	1				0
	2002	Gray[35]	131		32	56	
		Bowhead	2		41	53	1
United States (Alaskan Inuit hunt)	2000	Bowhead	35				12
	2001	Bowhead	49				26
	2002	Bowhead	39				11
Greenland	2000	Minke W	142[36]	10.5	12	60	3
		Minke E	10[37]	0	40	120	
		Fin	6	17	28	60	1
	2001	Minke W	137	10	13.2 sec	120	2
		Minke E	14	0	19.1 sec	50	3
		Fin	7	0	19.9 sec	45	1
	2002	Minke W	131	5.3	16	300	5
		Minke E	10	0	21	90	0
		Fin	13	7.7	9	25	0
St Vincent & the Grenadines	2000						
	2001						
	2002						

Key: Shaded Area – No data supplied
Minke W – minke whales killed in West Greenland
Minke E – minke whales killed in East Greenland

ASW strike limits

The IWC sets a 'strike limit' (i.e. the quota sets a maximum number of whales that may be struck with a harpoon or shot) for the Alaskan bowhead and the West Greenland minke whale hunts. For all the other ASW hunts, however, it sets a limit on the number of whales that may be landed. There appears to be no rationale for the difference, but it has significant implications for the Russian and Greenland hunts, which have high struck and lost rates: it means that ASW hunters can land the maximum number of gray, fin and East Greenland minke whales permitted in the IWC quota, but strike and lose an unlimited number in addition. This has important welfare, as well as conservation, implications for Aboriginal Subsistence Whaling.

Conclusion

A wide range of technology is used during both commercial and Aboriginal Subsistence Whaling operations, with varying degrees of efficiency being apparent. However, scientific evaluation of the data collected is hindered by a lack of consistency in reporting and the inadequacy of the current IWC criteria for judging the onset of death.

Factors relating to the species killed, such as its size, may greatly influence both the efficiency of any killing method and the struck and lost rate. The prevalent use of secondary killing methods illustrates the inadequacies of primary killing methods used and there are concerns that, in some hunts, the use of underpowered cartridges may be resulting in prolonged times to death. Furthermore, the instantaneous death rate in all hunts falls well below the expectations for other animals killed for food.

During ASW hunts the lack of data, including on hunting conditions (such as weather) from these hunts makes it very difficult for the IWC to assess the relative efficiency of each method, and to suggest improvements. Furthermore, the failure by Japan to submit adequate data on its JARPN hunt in the Eastern North Pacific, particularly in relation to the killing of sperm whales, prevents any independent evaluation from other member of the Commission.

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Footnotes

1 Permitted by Article V of the IWC's founding treaty (the International Convention for the Regulation of Whaling, ICRW).

2 The quota set for 2003 was 711.

3 Japan's Antarctic Whaling Research Programme.

4 Japan's North Pacific Whaling Research Programme.

5 According to a research proposal submitted to the IWC in June 2003.

6 Norway noted during the infraction sub-committee that, according to Norwegian national regulations, bycatches have to be landed and are consumed in order not to waste valuable resources. Report of the Infractions Sub-Committee IWC/55/Rep4.

7 In December 2002, Greenland Radio reported Greenlandic interest in exporting whale meat to Norway in exchange for blubber. At the 2003 IWC meeting, Russia made a request to commercialise blood and other non-edible products from gray whales.

8 Data sourced from papers submitted to IWC Working Group or Workshop on Whale Killing Methods and Associated Welfare Issues.

9 Norway reports that these animals are all lost after they are dead.

10 Data recorded for only 481 whales.

11 Annual number of whales reported as bycaught in trap nets. Data from Japan's Annual Progress Reports, submitted to the IWC.

12 Article VI, paragraph 28, Appendix A.

13 In addition, the Commission is developing a data collection form as part of its negotiations of the Revised Management Scheme, which will manage commercial whaling in the future if the Moratorium is ever lifted.

14 At time of writing, Iceland has not completed its first season and it is not known if it will report any data collected to the IWC.

15 Relaxation of the lower jaw or no flipper movement or sinking without active movement (Anon 1980).

16 Effective for all whales, except minke, killed for commercial purposes from the beginning of the 1980/81 pelagic and 1981 coastal seasons. Effective for minke whales from the 1982/83 pelagic and 1983 coastal seasons. (Paragraph 6, ICRW)

17 Permit No. 14-SUIKAN-1299, dated April 4 2003.

18 The IWC is inconsistent in addressing this issue for Aboriginal hunts; for example only setting a limit on the number of whales 'taken' in Greenland's fin whale and East Greenland minke whale hunts, but capping the number of whales 'struck' in its west Greenland minke hunt.

19 Article VI, Information Required, paragraphs 25 and 27.

20 Thirty-nine of the Scientific Committee's national delegates from many different nations had concluded that, not only was Iceland's research proposal poorly contrived and unlikely to yield relevant results, but that it was 'deficient in almost every respect'.

21 IWC Resolution 2003-3.

22 First passed in 1990 and amended in 2001.

23 According to data provided to the IWC by Japan, before 2001 the average number of whales bycaught in Japanese trap nets was 20, however, this leapt to 79 in 2001, following the implementation of the new legislation.

24 The Hokkaido Shimbun (a Japanese newspaper) reported that, of 123 whales caught in nets between July 2001 and July 2002, 119 were killed. This represents an increase in the first year since the law was changed to permit fishermen to kill and sell the whales caught in their nets.

25 For example, the UK stated (and others concurred) to the IWC meeting in 2002 that "*animals killed under Japan's new legislation which, under certain circumstances, authorises the deliberate killing of whales bycaught in fishing operations, should be reported as infractions*" (Chair's Report of the 54th Annual Meeting. P 45).

26 Paragraph 13 of the schedule to the ICRW.

27 For example, in 1979, the Technical Working Group on Humane Killing recommended that governments act to reduce waste and inhumane methods of killing. In 1985, the Commission adopted a resolution on humane killing in Aboriginal Subsistence Whaling that "*urges the prompt adoption of more efficient methods of killing whales, that reduce cruelty and inhumanity, in areas where aboriginal and subsistence whaling is practised*" (Chair's report of 37th Annual Meeting, appendix 3). These sentiments were reiterated in Resolution 1997-1, which urged aboriginal subsistence whalers to "*do everything possible to reduce still further any unavoidable suffering caused to whales in such hunt*s".

28 IWC Resolutions 1997-1 and 1999-1.

29 In Resolution 1999-1, the IWC notes "*the lack of information regarding time to death on aboriginal subsistence hunts prohibits an assessment of any improvement in these hunts*".

30 According to information submitted to IWC working groups and workshops.

31 Table 1. International Whaling Commission Report 1992-3.

32 Based on information provided by IWC Secretariat, April 2003.

33 http://www.nanoq.gl/nyhed.asp?page=nyhed&objno=53164

34 Data sourced from papers submitted to IWC working group/workshop on Whale Killing Methods and Associated Welfare Issues.

35 Note that for the 2000 Russian hunt, secondary killing methods were used on all 113 gray whales and for the bowhead whale killed. Thus although the instantaneous death rate for this hunt was not reported officially reported, it would have been zero per cent.

36 Information recorded for only 114. Greenland reported 12 out of 114 West Greenland minke whales were killed within two minutes.

37 Information recorded for only seven.

7 The small cetacean dimension

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Every year it is estimated that hundreds of thousands of small whales, dolphins and porpoises (small cetaceans) are killed around the globe as a result of human activities, including hunting and incidental capture in fishing nets. Many small communities in developing countries target small cetaceans as a source of food and these hunts often occur outside the regulation of their national governments. Aboriginal communities in the High Arctic for example hunt narwhals, beluga whales and other small cetaceans for subsistence purposes, and their products are sometimes traded, while hunts for commercial purposes are conducted in several developed countries including Japan.

Whilst recognising that certain human communities may be nutritionally dependent on hunting, including hunting cetaceans, and that for others there can be economic gains from such activities, this is a complex issue. A full discussion of the pros and cons of such activities is outside the scope of this chapter but it is, nevertheless, important that they are considered within an animal welfare context to prevent unnecessary cruelty or suffering and that is the focus here.

This chapter considers the history of small cetacean management by the IWC, taking the hunts in Japan and the Faroe Islands as case studies of killing methods used. It does not consider management or conservation measures for small cetaceans undertaken by other agreements, such as the Bern Convention (for details see chapter 14).

The ICRW and small cetaceans

Small cetaceans have long been a cause of dispute within the International Whaling Commission (IWC), set up under the auspices of the International Convention for the Regulation of Whaling (ICRW). Although different opinions have been expressed, on balance there would appear to be no juridical obstacle to the IWC taking action with respect to both large and small cetacean species. Legal opinions have carefully scrutinised the text of the Convention, and the work of the Commission, and have concluded that the IWC is competent to discuss, recommend action and manage all cetacean species (Cameron 1990, Cameron 1991).

A list of species in the form of 'The Annex of Nomenclature' was appended to the Final Act of the International Whaling Commission Conference 1946, which concluded the ICRW. It was not intended to form part of the ICRW or to be an exhaustive list of the species to which the ICRW applied. It was merely a list of translations of the common names used for the species regulated because they were the most commercially valuable and, therefore, the most threatened by over-exploitation at that time (Cameron 1990). However, those countries opposed to small cetacean regulation by the IWC, have repeatedly argued that the IWC should only address issues related to species on this list.

For example, Greenland and the Faroe Islands, represented by Denmark, and Japan strongly oppose any action by the IWC on small cetaceans. They have not permitted the IWC's Scientific Committee or its Working Groups and Workshops on Whale Killing Methods and Associated Welfare Issues to examine their hunting practices, and have ignored IWC guidance (personal observation). These countries do not appear to have carried out conclusive research into the sustainability of hunts. Japan is thought to be putting huge pressure on small cetacean populations (see section on The Japanese Dall's porpoise and Baird's beaked whale hunts later in this chapter) and there are growing concerns about the status of beluga and narwhals which are hunted in Greenland but for which no quotas are set.

Most small cetacean species live in coastal waters and several Latin American countries have resisted IWC actions on small cetaceans, claiming conflicts with their sovereignty over their 200-mile exclusive economic zones (EEZs). Recently, however, most of these countries have recognised the importance of the IWC's work on small cetaceans, and have contributed to it constructively.

Within the IWC, the decision as to which species is considered to be a small cetacean is not set by any specific criteria. Some inconsistencies have resulted. For example, the toothed Baird's beaked whale has generally been considered to be a small cetacean despite reaching a size of 12.8 metres (42ft). Conversely the toothed North Atlantic bottlenose whale and the baleen minke whale, both about 10 metres (33ft), are considered to be 'great whales' and it is accepted by all countries that they are protected by the moratorium on commercial whaling. It is recognised that this type of anomaly can result in difficulties in determining what appropriate regulations do apply and there is clearly a need for a more uniform approach to be taken. This would enable regulations to be more readily applied.

History of small cetacean action by the IWC

The IWC set up a sub-committee on Small Cetaceans of its Scientific Committee in 1974, and has created a valuable database of information on small cetaceans. It has reviewed the status of species after species and made constructive recommendations to assist with conservation strategies. Until 1986, however, the Commission itself took no specific action to conserve or manage small cetaceans. In 1986, the Technical Committee of the IWC, in an effort to reduce the cruelty of the pilot whale hunt, called on the Faroese government to minimize the use of the gaff or whaling hook, restrict the use of the hook from boats, and reduce the number of official 'whaling' bays used in the hunts. The Faroese government enacted these recommendations only in part (IWC 1988).

Concerned about the high numbers of Dall's porpoises being killed in Japanese waters and responding to concerns of Japanese scientists about the sustainability of the hunt, in 1990 the IWC adopted its first ever resolution on small cetaceans with only one vote against – that of Denmark representing the Faroes. The resolution called on the government of Japan to reduce the takes of Dall's porpoises to at least the levels taken before 1986, approximately 10,000 per year (IWC 1990). Japan abstained on the vote.

The Commission has thus formally demonstrated its competence to make management recommendations on small cetaceans and, since 1990, has passed numerous other small cetacean resolutions. Repeatedly, the IWC's working groups and workshops on whale killing methods and associated welfare issues have examined the Faroese pilot whale hunt and expressed concern about the

methods used to kill these whales. Despite the Commission making numerous requests for submission of information on the killing methods used, the government of the Faroe Islands has been reluctant to submit data for international examination and peer review (IWC 1999). Similarly, Japan has consistently refused requests for information on the methods used in its hunts of whales, dolphins and porpoises and has also physically absented itself from some IWC discussions of its hunts (IWC 2000). At the 2003 IWC meeting, Greenland stated that it would not comply with a request to bring data from its small cetacean hunts to the next meeting.

The politics of small cetaceans and the IWC

Japan's small cetacean hunting has been found to be linked to its large cetacean hunting and the commercial sale of these whale meat products. It would appear to have used its small cetacean hunts to try to influence the Commission to grant a coastal commercial whaling quota despite the moratorium. When criticised because the scale of the Dall's porpoise hunt had reached nearly 40,000 animals, Japan stated that unless the Commission granted it a coastal minke whale quota, it would be compelled to kill even more small cetaceans (IWC 1989).

Japan has used the issue of small cetacean competence to enable it to continue hunting Baird's beaked whales despite the moratorium on commercial whaling, and despite the size of this species. By persevering with the argument that the IWC has no competence to set catch quotas for this large whale, Japan forced the issue off the IWC's agenda in 1993. Japan has used this hunt to help maintain its capability to hunt large whales in it coastal waters in the hope that the moratorium will be overturned in the future.

Traditionally, Dall's porpoise products were used for local consumption in Japan. In the mid-1980s, as catch numbers rose, Japan's big whaling companies started trading in porpoise meat, allegedly to compensate for the reduction in availability of products from the larger whales resulting from the moratorium. Most importantly, their intention was to maintain the demand for whale products in the hope of resumed commercial whaling (EIA 1999). Much of the small cetacean products have been openly sold as 'little whale' or 'whale', or been mislabelled as 'minke whale' (EIA 2002).

The Faroes government has used the 'traditional' description of the pilot whale hunt to provide political support for this hunt, and has involved itself in the campaign to overturn the moratorium. For example, in a challenge to the IWC and the Convention on the International Trade in Endangered Species (CITES) in 2003, the Faroe Islands imported minke whale meat from Norway despite the CITES ban on international trade in whale products and the IWC's moratorium (Associated Press, 25 March 2003). The Faroese government was also at the centre of the establishment of the North Atlantic Marine Mammal Commission (NAMMCO), an organisation that challenges the right of the IWC to manage whales and whaling globally, and which aims to control the management of cetaceans in the North Atlantic (Grindabod 1993).

Small cetaceans and their killing methods – two case studies

Small cetacean hunts around the world are largely unregulated. Even in Japan and the Faroe Islands, countries with high standards of living, there is little legal regulation of hunting of small cetaceans.

Faroese pilot whale hunt

Pilot whales have been killed in the Faroe Islands for over 400 years and it can be appreciated that in

the past they made an important contribution to the Islanders' survival in the harsh conditions of these isolated islands. Hundreds of dolphins and porpoises are also often killed. Today, however, the Faroese people enjoy a standard of living at least as high as that of any other country in Scandinavia. The consumption of pilot whales is, therefore, thought to be no longer necessary for survival, but the hunt continues. This is despite the Faroese Health Department's recommendations to substantially limit consumption of pilot whale meat and blubber because of the high levels of toxins in the tissue, which has been directly associated with developmental problems in some children on the Islands. The advisory notice issued in 1998 warns females expecting to have children in the future not to eat pilot whale meat at all (Anon 1998).

Until 1979, the Faroe Islanders killed about 800 pilot whales each year. In the early 1980s the average number of whales killed increased to over 2,000 per year with 2,909 being killed in 1981 (Zoological Department, Museum of Natural History, Faroe Islands 2000). At the same time, the Faroese economy was booming as a result of the implementation of the Faroe Island's 200 mile Economic Exclusion Zone (EEZ), although the need for pilot whale meat and blubber is thought to be increasingly unnecessary to the Islanders' survival. No research was carried out into the sustainability of this dramatic increase in hunting. As a result of international pressure and concerns about high levels of pollutants found in the meat and blubber, the numbers killed each year dropped in the 1990s to below 1,000 whales.

Killing methods

The pilot whale hunt is governed by the Faroese Pilot Whaling Regulations, dating back to 1832 and which has been periodically updated (Gibson-Lonsdale 1990). The regulations were not developed to address the welfare aspects of the hunt, but to bring about reorganisation so that this resource could be more fully utilised. As a result of international pressure, some changes to the regulations were introduced in the mid-1980's in an attempt to make the hunt less cruel, including the banning of the use of the spear (Olsen 1999).

When a herd of pilot whales is sighted offshore, permission is sought from the local sheriff to bring the whales into one of the 23 authorised whaling bays. A group of boats gathers in a semi-circle behind the whales and drives them towards the shore. The drive quickens as the whales approach the shore, in an effort to beach as many as possible. Those whales that are not beached will either flounder in the shallows or swim in the deeper water, prevented from escaping by the boats in the bay, and perhaps also by the bond that they have with the rest of their school. The aim is to kill the entire herd, although sometimes a few individuals will not be killed.

The whales are struck with a sharp-ended steel traditional whaling hook weighing around 2kg. The hook is driven into the whales flesh in order to secure them. The whales in the shallows, or in deeper water are hauled several metres onto the shore by ropes attached to the hooks. Some whales are hauled by a recently developed round-ended hook which is inserted into the blowhole (Olsen 1999).

A sharp knife with a blade 16-19cm long is used to cut through the skin, blubber and flesh to sever the spinal column and the blood supply to the brain in order induce loss of sensibility, and to bring about death as a result of blood loss (Olsen 1999). A new knife is also being tested, which has a long slim blade designed to sever the blood supply to the brain and the spinal cord with one incision. (Foreign Department, Faroe Islands 2003). However, the new knife requires greater precision to be

effective, and whalers are likely to need to be specifically trained to use this knife effectively. Once the slaughter is complete, the whales are moved to a quay for counting, measuring, butchering and distribution among the hunters and the local community (Gibson-Lonsdale 1990).

Evaluation of killing method

The Faroese government records the numbers of pilot whales killed and some information on the length of drives and the total duration of kills. It does not, however, analyse each hunt, or record times to death for each individual animal.

As a result of criticism of the cruelty of the hunt and in particular the use of the traditional steel hook, the Faroese government appears to have recognised that the hook must be phased out (Department of Fisheries, Faroe Islands 1991). A new blunt-ended hook was developed which is placed in the air sac in the whale's blowhole to secure and haul it (Olsen 1999). Although the new hook produces no visible bleeding, there has been no published post mortem research on the effects of the hook in the blowhole, but it is likely that there is tissue tearing and the possibility of bleeding into the lungs resulting from the hauling by the hook. This hook may also hinder breathing, causing an obstruction to the airway and forcing the blowhole to stay open. By extrapolating human experience and findings for airway obstruction in other mammals, it seems probable that the hook would produce a 'gagging' response, and may induce a 'panic' response. Meanwhile, the traditional whaling hook has not been phased out (Olsen 1999).

Several other factors contribute to the potential for cruelty of the Faroese pilot whale hunt.

1. Pilot whales may be driven several miles to the nominated bay. There has been no assessment of stress myopathy or any other impact of the drive on the whales. The distance and duration of the drive combined with the noise of the boats and drivers may cause confusion and stress to the members of the herd and may have long-term implications for any survivors.

2. Pilot whales live in close communities with strong bonds between the individual members of the herd, most of whom are blood relatives (Amos 1993). It can take tens of minutes or even hours to complete the slaughter of the herd. During this time individuals are swimming in seawater filled with the blood of their relatives or closely bonded companions. They are also subjected to the chaos of the killing and almost certainly to the distressed communications from their family members and companions.

3. Several factors may result in repeated strikes and wounding before the steel hook is secured in the body of the whale:
- The striker may be standing on the shore, on rocks, in the shallows or wading in waist deep water.
- The whale may be struggling on the shore, floundering in the shallows or swimming in the deeper water increasing the difficulty of making a successful strike.
- The boats and whales may cause turbulence, destabilising the striker.
- The skin of the whale is very smooth and wet and may cause the hook to slip.
- During the hauling, the hook may loose purchase and be struck into the body again.

4. The hauling of the whales by the hook attached to the rope is likely to cause pronounced trauma to the tissues of the blowhole, contributing to the suffering of the animals. No evaluation,

however, has been made on the extent of tissue tearing and trauma, or its impact on the whales.

5. The 'traditional' sharp hook is secured into any part of the body. Whales have been documented with hooks struck into the eye (EIA, 1987).

6. Each unsuccessful strike extends the time from first wounding of the animal, to final loss of sensibility, and eventual death. Although the Faroese authorities claim that it takes only a few seconds to cut through the skin, blubber and flesh to sever the blood supply to the brain (Olsen 1999), several factors may increase the cutting time, delaying time to loss of sensibility and death:
- The whale may be struggling as a result of fear or the pain from the hook wound/s.
- The slaughterer may be standing on rocks or in shallow water.
- The slaughterer may not be experienced at cutting whales.

7. The impact on those individuals who escape back to sea, having been trapped in the bay while the killing of their companions or family members takes place has not been explored. It is unknown if these animals survive and join another herd.

These aspects of the killing methods are thought to result in severe welfare problems for the animals concerned. Regulation should be introduced that would ensure that where whale hunting does occur, it is carried out in a manner that does not result in unnecessary individual suffering and prolonged times to death.

The Japanese Dall's porpoise and Baird's beaked whale hunts

About 20,000 whales, dolphins and porpoises are killed in Japan's coastal waters each year. There is little regulation of the methods used to kill them or the equipment used and no official training is apparently given to hunters (EIA 1999). As a consequence of intensive hunting, several cetacean populations are at risk of extinction in Japan's coastal waters and the animals may be subjected to severe cruelty. The Japanese government records the numbers of cetaceans reported taken, although concern has been expressed that the numbers of Dall's porpoises may be under-reported. There is no data collected on the duration of hunts, individual times to death, numbers struck and lost, or the numbers of females taken that are accompanied by calves.

The Japanese government has published virtually no information describing the methods used to kill cetaceans in its coastal waters. Investigations and research by non-governmental organisations (NGOs) and the media, however, has provided some information on the killing methods.

The Dall's porpoise hunt

Dall's porpoises have been hunted in Japanese coastal waters for centuries, with the hand harpoon being first used in the early 20th century. With the advent of faster boats in the 1970s, the catch averaged 8,000 per year, causing IWC scientists to warn that it was too high (EIA, 1999). Catch numbers continued to rise and, in 1988, as Japan reduced its commercial whaling operations as a result of the commercial whaling moratorium, the Dall's porpoise hunt was increased with the introduction of new specialised boats, and the hunting season extending throughout almost the entire year. In 1987, 25,600 animals were reported killed. In 1988, this figure increased to 40,367 porpoises – about 30 per cent of the estimated population in Japanese waters. The catch figures for 1987 and 1988 are both thought to be underestimates. A year later in 1989, the catch was estimated

to be around 30,000 animals, and Japanese scientists warned that the hunting levels were unsustainable (EIA 1999).

As a result of pressure from the IWC and the international community, the annual hunt has now been reduced to about 17,000 animals. There is, however, continued concern about the sustainability of this hunt and inadequacies in the reporting of the numbers killed.

Killing methods

Using specialised boats equipped with a bow platform, hunters travel offshore, anticipating that the Dall's porpoises will 'bow ride' the boats[1]. The hunter leans from the platform and throws harpoons attached to long detachable shafts at the bow-riding porpoises. The harpoons are also attached to buoys by lines to secure the harpooned porpoises while the hunt continues for other porpoises. When the boat returns to collect the harpooned porpoises, they are dragged to the side of the boat and brought aboard the vessel. Some hunters apply a charge of electricity to the animals through the harpoon as it strikes them, or once they are aboard, if they have not been killed by the impact of the harpoon. Porpoises which have not been killed by either the harpoon or the electricity will have their necks cut with a knife, probably from the underside of the head, so that they bleed to death.

With numbers of Dall's porpoises severely depleted in the Sea of Japan, hunters are targeting porpoises accompanied by calves. As the calves tire more quickly and the females will not abandon them, they are, therefore, easier to catch. Although the hunters do not take them, abandoned calves will inevitably die (Perry 1999).

Baird's beaked whale hunt

Baird's beaked whales reach a length of 12.8 metres (42 ft). The Japanese government sets itself a quota for 62 of these rare whales to be taken in its coastal waters each year. The Scientific Committee and Working Group on Whale Killing Methods of the IWC have not formally considered the hunt but since the moratorium was passed in 1982, 1032 Baird's beaked whales have been killed in Japan's coastal waters (EIA 1999).

These whales have been hunted for several decades with heavy exploitation by Soviet and Japanese hunters until 1970. In 1952 alone, 332 whales were taken. In the 1970s the catch averaged 44 whales per year and on the imposition of the moratorium in 1986, Japan set itself a quota of 40 Baird's beaked whales per year. In 1989, the quota was increased to 62 whales, with the claim that this was an emergency increase to be reduced if a coastal quota of 50 minke whales was granted to Japan. This was refused and Japan reduced the Baird's beaked whale quota to 54 animals. In 1999 the quota was arbitrarily increased to 62 whales.

Killing methods

Baird's beaked whales are hunted off the Pacific coast of Japan and in the Sea of Japan off the coast of Hakodate, Hokkaido, using 48-ton 'small type' whaling boats. In the Sea of Japan, the boats travel to the feeding grounds (EIA 2003) where the whales are harpooned with a 50mm harpoon (Braund 1989). There are indications that non-exploding or cold harpoons may be being used to kill some of the whales (EIA 2003). The cold harpoon was banned in 1980 by the IWC on welfare grounds (ICRW schedule). There is no information available on the implement used if the impact of the first harpoon does not kill the whales immediately. Reports from people associated with the Sea of Japan

hunt indicate that the whales are secured with the harpoon and left to bleed to death if the harpoon impact does not kill them immediately (EIA 2003). Female and male whales are targeted regardless of whether the females may be pregnant or accompanied by a calf.

Evaluation of the killing methods for Dall's porpoises and Baird's beaked whales

Several factors contribute to the high potential for cruelty in these two unregulated Japanese hunts as well as extended killing times from the first wounding of the animals to final loss of sensibility and death. The implements and their use in the hunts are not regulated by the Japanese government and no official training is given to hunters. Research is needed to establish the most effective way of killing cetaceans in Japan's coastal waters, so as to prevent unnecessary suffering

Harpoons hit the whales and porpoises in almost random locations on the body because the animals, the boat and, therefore, the hunter, are usually moving in the swell (see chapter 8). At the same time the efficacy of the harpoons used has never been evaluated and animals frequently take a long time to die.

The use of electricity in the Dall's porpoise hunt is haphazard and unregulated. Some porpoises can therefore be 'burnt' by the electrical charge and not stunned, due to the weakness of the charge or the ineffective placement of the electrode (EIA 1999).

The effectiveness of the methods used to slaughter the whales and porpoises if they are not killed by the impact of the harpoon has never been evaluated to ensure the animals lose sensibility and die as quickly as possible.

Conclusion

Small cetacean hunts carried out worldwide present a number of significant welfare and conservation concerns. It has been difficult for the global community, through the IWC, to examine these hunts due to failure of many countries to recognise the authority of the IWC in the area of small cetaceans. Nonetheless, available information strongly suggests that the capture and slaughter techniques used are not acceptable to most observers, and to the international community, on welfare grounds. In addition, small cetacean hunting provides an alternative source of cetacean meat and blubber for the consumer, and this helps to maintain the market in whale products despite the commercial whaling moratorium.

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Footnote

1 'Bow riding' is when cetaceans using the pressure wave at the bow to help them move along.

8 Weather, sea condition and ship motions affecting accuracy in whaling

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Introduction

The dimensions of exploding penthrite harpoons are such (Kestin 1995), that a harpoon shot into or through the body of a whale results in a wound at least 20 centimetres wide. This size triples when the harpoon barbs become extended and anchor the harpoon inside the body. Massive injury is caused when the penthrite grenade, fitted to the harpoon, detonates 60-70 centemetres inside the body (Knudsen and Øen 2003). A whale that is shot with such equipment will, therefore, be significantly injured and will suffer, if it remains conscious. The whale is then hauled towards the vessel, using the forerunner rope, which is attached to the harpoon. Thus, in addition to the injury, the restrained whale will be disabled and unable to control, predict or flee from the life threatening circumstances it faces. Loss of ability to predict and control are key psychological factors in evoking severe and pathological levels of stress in vertebrates (Weiss 1972; Wiepkema and Koolhaas, 1993).

The efficiency of whale killing methods is evaluated by the IWC, primarily by measuring the time to death (TTD) according to the current IWC criteria (chapter 11). Gunners are advised to aim for the upper thorax of the minke whale. This is because it is assumed that a hit here renders the animal rapidly unconscious or immediately dead (Anon 1999, Knudsen and Øen 2003). According to Norwegian whalers, the latter is defined as dead within ten seconds after being hit by a harpoon (Øen 2003). Nevertheless, a significant proportion of harpoons are shot at other parts of the body (Knudsen and Øen 2003). The question of whether or not the animal is indeed brain dead or irreversibly and deeply unconscious is outside the scope of this chapter. While this uncertainty remains unresolved (chapter 11), Norway reports that 20 per cent of the minke whales that it takes are not killed instantaneously (Øen 2003). During the 2002 hunt this equated to 127 whales (of 634 whales caught). The figures are systematically higher in the Japanese hunt for Antarctic minke whales. During the 2002/2003 season, 60 per cent of the 440 minke whales killed, were not killed instantaneously (Ishikawa 2003). This equated to 264 whales. These poor instantaneous death rates occur despite technical adjustments to the harpoon and penthrite grenade (chapter 6) and the development of a training programme for the gunners over the past 20 years. The current high proportion of animals which are not killed instantaneously, and the systematic differences between Norwegian and Japanese whaling, even following 20 years of weapon research and training, indicate that the accuracy of the gunner may be significantly influenced by other major factors.

Commercial and special permit whaling activities typically use a harpoon canon, mounted relatively high above the bow. The height from the cannon above sea level is at the least 6.5 metres in Japanese vessels (estimated on the basis of photos and unchallenged in Anon 2003) and four to six metres in Norwegian whaling (Øen 1992). The more vigorous and frequent the movement of a ship, the more

difficult it will be to hold and aim the harpoon. Accuracy will also directly depend on visibility. Precipitation and fog reduce visibility, while a rough sea hampers the ability of the gunner to see through the water and follow the course of the animal below the surface (Anon 2000). Thus in conditions of poor visibility the gunner may not be able to properly recognise and predict the position of the animal and its surfacing pattern, for an accurate shot.

Weather and sea condition are major impediments to killing a whale instantaneously. This has repeatedly been stated by Japanese delegates to the IWC (Anon 1999,Anon 2001) and accepted in IWC resolution 2001-2. It is, therefore, pertinent that details relating to the circumstances of these hunts are systematically not included in the discussions about the way in which whales are killed. Furthermore, there is no analysis or any discussion regarding the relationship between the external variables, such as weather conditions, and the number of animals that are not killed instantaneously. This paper provides details about the weather and sea conditions under which Japanese whaling takes place. A first and preliminary insight is also provided of the motion on board a whale catching vessel.

The research area in an Antarctic whaling ground

The area considered in this chapter is limited to an Antarctic region called area V of the Southern Ocean Sanctuary. This area includes the sea north of the Ross Sea. Its latitude is between 80° S and 60° S, while the longitude limits are between 130° E and 170° W. This includes areas where Japanese whaling took place, at least between 1946 and 1984 (Mierzejewska *et al.* 1997). Mierzejewska *et al.* (1997) show for these years that Japanese whaling vessels have been present in the area between 60°S and 70°S in the period from November to March. According to several Japanese sources, minke whale capture operations also took place in area V and in and close to the Ross Sea area between 1988 and 2001 (Anon 1991; Kojima 1993; Nishiwaki *et al.* 1995; Nishiwaki *et al.* 1997 and Anon 2001). These sources also indicate that whale catching can take place south of 60° S in March.

Air temperature, probability of precipitation and fog, wind speed, wave height and wave period have been analysed for this sea area to provide averages for each month of the year, based on multi-year databases. Most data are from the Comprehensive Ocean-Atmosphere Data Set (COADS), which primarily uses ship observations. Temperature data are recorded at Scott Island, a small, central island at 67.37° S and 179.97° W, by the weather station of the US National Science Foundation Office of Polar Programmes. In addition, descriptive statistics about wave features have been kindly provided by Oceanweather Inc. Details of the data sets and the analysis can be found in Van Liere (2003).

The temperature at Scott Island

The low temperatures at Scott Island are severe and vary between an average of 0.1° C in January (Antarctic summer) and -15.0° C in August (Antarctic winter). Ocean water with a salinity of 35gr per litre of water would freeze on deck at -1.9 ° C. That means that during most of the year, frost may hamper equipment, icy decks may become slippery and work on deck may be made difficult by the need to wear thick, insulating clothing. Stability and the speed of response of the gunner may, therefore, be affected by these factors. It is not clear how current Japanese operations deal with such problems. March (with an average of -2.3 °C) and November (average -5.3 °C) are likely to produce the most temperature-related difficulties during whaling operations in this area.

Precipitation and fog in the researched area

The chance of precipitation increases between January and April from 21 to 31 per cent, while the

chance of fog decreases from 15 to 5 per cent. In the following months to November there is no clear trend. In December, the probability of precipitation is 24 per cent. These results indicate that March has the highest chance of precipitation of all the whaling months. The probability of fog is highly variable in the winter, but from September onwards, the probability of fog increases from 3 per cent to around 15 per cent in December and January. Thus, in the period when the probability of precipitation is low, the probability of fog is relatively high. So if the issue of reduced visibility is considered, fog-related problems add to those caused by precipitation in these months. How the whalers respond to fog or precipitation is unclear, and it would be of great value if more information was made available by the whalers to help understand how these weather states affect the efficiency of whale killing.

Wind speed and wave height

The average wind speed, regardless of its direction, increases from 7.4 ms-1 (a moderate breeze) in January to 9.3 ms-1 (fresh breeze) in March. However, the wind speed is highly variable from April until October, with the highest variation in the months with the highest averages. These are September and October (10.5 ms-1; fresh breeze). Thereafter the wind speed reduces to 7.7 ms-1 in December. Given the variation, probabilities of wind speeds higher than 11.2 ms-1 (strong breeze and higher) in March or November, or 14.3 ms-1 (moderate gale and higher) in October are significant (10, 13 and 20 per cent respectively).

The average height of the waves (calculated from the upper third of all wave heights, known as 'significant wave height', see also www.oceanweather.com) and the time between reoccurrences of the most violent and energetic waves (known as 'Tpeak') is estimated at one location: 67.5° S and 180° W. This has been done using the GROW model of Oceanweather Inc. and is based on the years 1970 until 2001. The average significant wave height tends to increase from 2.2 to 3.4 metres between January and March and tends to remain relatively high until June with an average wave height of 3.2 metres. The height is not known for the following months, but averages 1.9 metres in December. The missing values are for months in and after the winter, when the ice covers the sea. The model excludes data in these cases. The Tpeak seems to follow the same trend as the wave height, starting with around 10.5 seconds in December and January and increasing thereafter to about 11.5 seconds in the period April to June.

The wind increases from January until March, but becomes more variable thereafter. This together with the growing percentage of ice in the area, blocking wave formation after March, may explain why the highest waves are found in March before the significant formation of sea ice. It can, therefore, be postulated that March may be one of the most severe months (in terms of adverse weather conditions) in which to perform whaling operations in the research area.

Ship motions in March and December at an Antarctic whaling ground

Ship motions have been calculated using the SHIPMO computer programme of the Maritime Research Institute in the Netherlands (Anon 2002). The ship used for these calculations was similar to the Japanese whale catching vessel Toshi Maru No.25. A sailing speed of 6 knots, head seas coming in at 30 degrees and local sea depth of 1,000 metres were used in the model. The model was run for estimated sea conditions during March and December, as described above. The motions considered were, the sway (from left to right), heave (up and down) and surge (forward and backward), as would be experienced at the level of the harpoon on top of the bow. Table 1 provides the results for these different motions in December and March.

Table 1. Significant peak-to-peak sways, heaves and surges			
		December	**March**
Sway	mean	0.61	1.20
	st. dev.	0.17	0.37
	N	658 (11)	386 (6)
Heave	mean	1.82	3.37
	st. dev.	0.57	1.23
	N	224 (4)	116 (2)
Surge	mean	0.26	0.62
	st. dev.	0.10	0.22
	N	531 (9)	226 (4)

Table 1. Significant peak-to-peak sways, heaves and surges (in metres) on the basis of the SHIPMO model and at 6.5 metres above the waterline at the bow of a ship comparable to a Japanese whale catcher sailing at six knots in December and March with 30 degrees head waves as characterised in the forelast paragraph. N is the number of samples in the upper third of the frequency distribution taken during one hour. The number in one minute is in brackets.

The results of conditions in March demonstrate that six sways averaging 1.2 metres, two heaves averaging 3.4 metres and four surges of 0.6 metres, could be expected each minute. When the model was run using sea conditions expected during December, sways and surges were reduced by half, while the average heave was 1.8 metres. However, the numbers of sways, heaves or surges per minute, was twice that which would be expected under the March simulation. Figure 1 illustrates the effect on accuracy when only one heave is considered. In this figure the height of the harpoon above sea level is ′h′ and the horizontal distance between the harpoon and a whale is ′d′. Thus, a theoretical line between the aimed harpoon and the whale would make a triangle with height h and base d. Suppose h is 6.5 metres and d is 40 metres as in a whaling operation. Then an increase x of h (which at the least equals half a peak-to-peak heave) would give a substantial change (y) in projection of the harpoon. In the example y would be 5.5 metres when the heave is 1.8 metres as might be

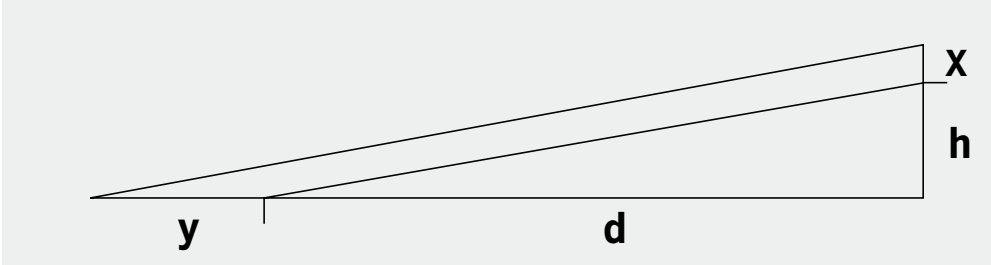

Figure 1. A relatively small increase (x) in the height (h) of the harpoon as a wave lifts the bow of the ship, results in a large change in projection (y) of a harpoon aimed just before the wave at a whale at a distance (d) from the whaling ship, which would have to be compensated during the wave motion in order to try to maintain the aim (for further explanation see the text).

experienced in December, or y could even be 10.5 metres when the heave is 3.4 metres as can be experienced in March. In addition, if we include the effects of surge, this will give a deviation to y of ± 0.13 metres in December and ± 0.31 metres in March. Moreover, there is also the component of movement caused by sway, which will give a left or right deviation of y of 0.31 metres in December and 0.60 metres in March. In conclusion, the relatively large motions experienced in March and their relatively high frequency of motion in December will impact greatly on the accuracy of the gunners while hunting in this ocean region during either December or March.

Conclusions

The weather condition, sea state and ship motions which are discussed in this study, give rise to serious concern about the ability to accurately harpoon a whale and to reliably kill a whale instantaneously. Major differences exist between the shooting of terrestrial mammals and the killing of whales, as during whaling operations both the gunner and the animal are in motion in almost all cases. Furthermore, the gunner has no means to reduce these movements. It is, therefore, appropriate to relate weather and sea conditions, and harpoon and ship motions, to the proportion of whales that are not being killed instantaneously. If the weather or sea conditions, or the motions of a ship do not allow a properly aimed shot, then there is significant risk of poorly placed harpoon hits resulting in extended TTD's and animal suffering. This argument provides a strong case that harpooning should be halted under difficult sea conditions, to promote best practice, and to help protect the welfare of the hunted animal.

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9 The potential stress effects of whaling and the welfare implications for hunted cetaceans

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Whaling may impose physical and psychological stress even before any harpoon is fired. This may apply as much to whales that are struck and eventually killed as to those that evade capture. The IWC has, so far, restricted discussions on whale hunting to primary and secondary killing methods. However, from first sighting to the time when a whale is killed, the elements of pursuit, such as approach, duration, speed and distance covered may affect morbidity (defined as the incidence of disease or the occurrence of pathophysiological or degenerative changes) and mortality even among animals that successfully evade harpooning.

Whaling operations and the potential for exertional stress and fear

Whether whales experience stress as a result of being hunted depends on the level of exercise imposed on the animals. Øen and Walløe (1995) argued that because the top speed of most Norwegian whaling boats does not exceed 7-8 knots, this only permits a "*slow stealthy approach when they try to position the boat next to the predicted surfacing of the whale*" and so does not constitute a chase. Yet, according to the 1994 minke whaling summary report, "*one* [veterinary] *inspector reported that a vessel had chased a whale for at least 6-7 hours. He proposed that a maximum permitted duration should be introduced for such chases.*" (Government of Norway 1995). Minke whales normally swim at speeds of four to five knots but can maintain 20 knots for short spurts. Therefore, it would appear that Norwegian whaling boats can force minke whales to exceed their comfortable swimming speed and the potential for chase depends on pursuit duration and speed as well as distance covered.

Japanese catcher vessels are faster than Norwegian boats and can both match and maintain a minke whale's maximum speed. Thus, Japanese whale hunts have a greater potential to cause forced exertion. Eyewitnesses report that pursuit times of 30 minutes are not unusual in Japanese hunts, although 45 and even 90-minute chases also occur. In order to place a shot, the catcher boat must obtain a proximity range of 40-60 metres, and several hours may pass before this range is achieved (Tanaka 1987). It is routinely reported in Japanese hunts that a targeted whale's respiratory rate is deliberately raised to shorten surfacing intervals, as this increases opportunities for harpooning.

In aboriginal hunts, such as the hunting of gray whales in the North Pacific by the native Chukotka, it can take two to three hours to place the first of several harpoons (Zemsky *et al.* 1999). Zemsky *et al.* describe the duration of Chukotka hunts - "*after a long chase of a whale, whalers have to stop whaling due to the impossibility to approach the animal at a near distance* (sic)" (Zemsky *et al.* 1999). This suggests a race in which whalers try to get close enough to set the harpoon. The application of floats hamper a whale's escape by slowing it down and impeding dives. Zemsky *et al.* (1999) list the

"*absence of ships and boats necessary for long-distance chases of grown-up whales capable of energetic and long resistance*" as one of the factors impeding the 1998 hunt. However, "*chasing a whale to exhaustion*" is considered unacceptable in the Makah gray whale hunt (Ingling 1999).

Fear is regarded as stressful in both animals and man and can compound the physical effects of stress-related exertion (Broom 1985; Rushen 1986a, b; 1990). Biologically, fear can be understood in terms of sensory inputs related to previous experiences, or the unknown (e.g., Brambell 1965; Jones 1987; Hemsworth and Coleman 1998). The neuro-pharmacological system involved in fear and anxiety is the benzodiazepine receptor system, which occurs in all vertebrates except the *agnatha* (lamprey and hagfish).

The manoeuvrability of the whaling boat and its movement in the direction of the whale or toward its anticipated surfacing area (see Øen and Walløe, 1997) are factors likely to influence whether the animal considers itself threatened. Threat perception can raise stress hormone levels and cause physiological changes. The significance of the whale's perception of pursuit by whaling vessels was raised by Van Liere (see IWC/47/18). Van Liere emphasised the persistent and uncontrolled nature of pod disturbance associated with whale hunts and suggested that whales subjected to pursuit are likely to suffer stress. Øen (1995) on the other hand stated that in Norwegian minke whale hunts, whales are killed without the animals realising they are being hunted. Aboriginal whaling is invariably associated with a chase, utilises less effective weapons and ammunition and requires several harpoons with floats to tire and slow the whale (Øen, 1999, IWC/51/12, SC/51/AS29). Kills are therefore usually slow with the boundary between pursuits and kills increasingly blurred.

Whales are pursued at least some of the time during commercial, scientific and aboriginal whale hunts. Current knowledge on cetacean hearing (Richardson *et al*. 1995) suggests that whales are aware of whaling vessels where they are about to surface. Predation is unlikely to have been a major selective force in the evolution of large cetaceans – nor are whales themselves predators that overwhelm their prey through prolonged pursuit. They may, therefore, not be physiologically adapted to 'anti-predator' behaviour involving prolonged and forced physical exercise. Although Norway reportedly carried out a pilot study examining stress hormones in minke whales (Øen and Walløe 1999), detailed hormone measurements have not been made available. Although elevated plasma cortisol levels (an indicator of stress) were not found, it is not known whether baseline measurements from undisturbed minke whales were used for comparison and if so how they may have been obtained. No significant differences in plasma cortisol levels between whales killed 'instantaneously' and those that survived between 1-13 minutes were found. The study concludes that plasma cortisol may not be a reliable stress indicator in minke whales. However, cortisol secretion in minke whales killed 'instantaneously' may already have peaked, and measurement of aldosterone level might have been of value.

A study on the serum chemistry of minke whales by Ishikawa (1996) revealed results consistent with findings from animals with severe tissue damage. The study also found significant effects of sampling schedules and protocols (e.g., including the orientation of the dead whale during transport, sampling time and site and type of injury) on several blood parameters, thus confirming incompatibilities between rigorous scientific protocol and the limited procedural options associated with lethal whale research.

The concept of stress

Animals rely on behavioural and physiological mechanisms, which enable them to maintain homeostasis in response to external and internal stimuli. These regulatory mechanisms have optimum and maximum tolerance ranges, which depend largely on a species' evolutionary history, but can be moderated by individual genetic make-up, as well as short and long-term history. Environmental stimuli, which fall outside an animal's adaptive range with regard to duration, intensity or frequency, or because of the nature of the stimulus itself, are associated with pathology and reduced survival. These 'overtax' behavioural and physiological control systems and are referred to as 'stress' (Broom and Johnston 1993).

Stressful conditions, such as confrontation with a predator or rival, disturb homeostasis and result in profound physiological and behavioural changes, which involve complex interrelated hormonal, metabolic, neural and neuroendocrine responses (e.g., Toates 1995). The main transmitter substances and hormones involved include glucocorticoids (cortisol, corticosterone), the mineralocorticoid aldosterone, catecholamines (adrenaline and noradrenaline), insulin, thyroid and growth hormone. During stress the body mobilises carbohydrates and fatty acids to provide energy. At the same time blood pressure, cardiac and respiratory rate increase. This provides the efficient transport of vital nutrients to the skeletal and cardiac muscles. Less immediately important processes such as digestion, immune defence, reproduction and growth are inhibited to further maximise available energy. These changes are independent of physical activity.

Psychological stimuli, including fear, elicit strong adrenal responses and an assessment of how stimuli are perceived is therefore critical. Mason (1971) emphasised the psychological dimensions of all animal treatments (see also Toates 1995 and von Holst 1998) and considers it virtually impossible to avoid the psychological element of physical stressors.

Physiological indicators of stress and their interpretation

Stressful situations cause behavioural and physiological changes that can be gauged through a range of biological indicators. Measurements of cardiac and respiratory rate, body temperature, as well as a number of physiological, haematological and biochemical profiles can provide important information about whether or not an animal is stressed. Interpreting biological parameters used to assess the impact of potentially stressful conditions is not always straightforward, and several indicators should be employed to avoid misleading results. The importance of accurate baselines against which experimental measurements can be compared is critical. Even without visible signs of stress, biochemical and physiological profiles may be affected, and haematological assessment should, therefore, consider sex, nutritional state, circadian rhythms, seasonal variation, and physiological state. Sampling itself can have effects and lead to persistently overestimated baseline levels. The same is true for animals that are already stressed when samples are taken. Sampling method, sample preparation and storage may affect samples.

Stress associated with pursuit

Acute stress on capture may bring about short and long-term morbidity and mortality in both domestic and wild species (Mitchel *et al.* 1988). Hyperthermia, profuse sweating, hyperventilation, hypotension and degrees of skeletal and cardiac muscle damage are common post-chase and post-capture conditions.

Both chase and pursuit cause stress in terrestrial mammals; this includes stress-related mortality, a factor which may apply to cetaceans. Pursuit-related stress may manifest as a syndrome called: 'exertional myopathy' (EM), 'capture myopathy', 'stress myopathy', or 'exertional rhabdomyolysis'. Myopathies are diseases of the muscle fibres. EM, however, is distinguished from other types of myopathy, such as nutritional and toxic myopathies by its cause, as it affects both skeletal and cardiac muscles in response to exertion, fear and stress.

Commonly associated with strenuous or prolonged pursuit, capture, restraint or overexertion, EM develops irrespective of capture. Mental stressors, such as fear and anxiety, too, have been recognised as predisposing factors, as have high ambient temperature and impeded thermoregulation. These elements may act singly or together. The acute stress on capture may bring about short and long-term morbidity and mortality. Williams and Thorne (1996) stated "*even species that have evolved for efficient running, either for predator avoidance or for predation, may develop EM following intense or prolonged muscular activity associated with extreme stress during air or ground pursuit*". These authors consider pursuit time a major factor in the development of EM.

As energy and oxygen reserves are depleted during strenuous exercise, muscles switch to anaerobic glycolysis. This leads to either local or systemic build-up of lactic acid, local heat production, muscle degeneration and death of areas of muscle tissue (necrosis) (Fowler and Boever 1993). Increased cardiac and respiratory rates, elevated body temperature, ataxia, paresis or paralysis and acute muscle disruption are some of the symptoms associated with EM (Harthoon and Young 1974, Bartsch *et al.* 1977, Chalmers and Barrett 1977, Basson and Hofmeyr 1978; Fowler and Boever 1993). Identifying or interpreting these factors requires knowledge about the animal's normal undisturbed behaviour. Harthoorn (1973) describes four syndromes associated with the disease, namely hyperacute, acute, subacute and chronic EM, although according to Williams and Thorne (1996) these "*represent a continuum of physiologic and pathologic changes that occur over time after the initial exertion insult*". Clinical signs, including death, may occur within minutes or hours, or in the case of muscle necrosis and nephrosis (destruction of functional kidney tissue), more gradually over days, weeks or even months. Affected animals may initially appear normal (Spraker 1993), and even those which recover from acute problems, may die after weeks or months as a result of scar formation in the heart muscle (myocardium) (Jubb *et al.* 1993).

Stress in cetaceans

Despite a wealth of evidence from terrestrial species and birds, information on the physical and behavioural effects of stress in cetaceans, and particularly Mysticeti, is limited. However, stress-related changes in adrenal and thyroid hormone levels have been documented in cetaceans (reviews in Dierauf 1990; St. Aubin and Dierauf, 2001and Curry 1999).

Chase-capture and restraint of six captive bottlenose dolphins (*Tursiops truncatus*) led to 100 per cent higher plasma cortisol levels than under calm-capture conditions. However, plasma cortisol measurements increased "*even under the calmest conditions of capture*". Unlike most mammals, stressed cetaceans may manifest moderate cortisol elevations, although the physiological consequences of cortisol secretion in the body are maintained. Aldosterone levels on the other hand can increase substantially in cetaceans and may be a better indicator. Aldosterone moderates effective water and sodium resorption and elevated levels result in excessive sodium retention (e.g., Townsend 1999).

Thyroid function in cetaceans can also be affected by stressful conditions, but interpretation should take account of sex and age (St. Aubin *et al*. 1996). For examples see; a) beluga whales (*Delphinapterus leucas*): St. Aubin and Geraci 1988, 1992; b) captive white-sided dolphins (*Lagenorhynchus obliquidens*): Ridgeway and Patton 1971; c) bottlenose dolphins (*Tursiops truncatus*): Orlov *et al.* 1988; see also St. Aubin *et al*. 1996.

As in most vertebrates, stress can alter immunocompetence in cetaceans (see Romano *et al*. 1992, 1993, 1994; St. Aubin *et al*. 1989, 1990; Medway *et al.* 1970; Townsend 1999; reviewed in Curry 1999). Suppression of natural killer cell activity is reported in beluga whales (De Guise *et al*. 1997), and capture stress can suppress leukocytes and blood iron levels (Geraci and Medway 1973, St. Aubin and Geraci 1989). Thomson & Geraci (1986) report high mortality associated with capture and confinement stress in various small cetaceans, including *Phocoena phocoena* (Dudock van Heel, 1962), *Phocoenoides dalli* (Ridgeway, 1966) and *Delphinus delphis* (Walker, 1975).

Muscle damage and exertional myopathy in cetaceans

Muscle damage was found in dolphins after capture experiments and is likely, therefore, to arise in other cetaceans. Muscle activity during pursuit and capture can affect blood enzymes – creatinine kinase (CK), aspartate aminotransferase (AST), lactate dehydrogenase (LDH), and blood urea nitrogen (BUN) and potassium levels in cetaceans. Colgrove (1978) diagnosed EM following the transportation of a bottlenose dolphin, with first signs appearing 22 hours post-transport. Young *et al*. (1997) found 11 blood and serum parameters linked to stress in net-caught wild and healthy captive bottlenose dolphins, which matched those for terrestrial animals suffering from EM. The authors conclude that dolphins are susceptible to EM. Thurnbull and Cowan (1998) speculate that the deaths of small cetaceans following capture for marine collections may be linked to EM.

Dolphins may be particularly prone to stress-related cardiomyopathy or contraction band necrosis (CBN). CBN is characterized by lesions associated with hypercontracted myocardial cells, which in turn have been linked to elevated catecholamine concentrations (Reichenach and Benditt, quoted in Thurnbull and Cowan 1998). They can occur following traumatic circumstances ranging from psychological stress and drowning to exertional myopathy and are considered to contribute to their fatal outcome. Identical lesions occurred in a sample of stranded cetaceans of nine species. The authors attributed these lesions to physiological and psychological stress linked to stranding, disease and injury. Elevated CK levels in some dolphins killed during purse-seining are considered indicative of "*muscular exertion or muscle damage*" which may result in unobserved post-release mortality (Stuntz and Shay 1979 quoted in Curry 1999). More recent evidence for potential stress-related injury or unobserved mortality emerged for dolphins involved in purse seine fishing operations (NOAA 2002).

Conclusions

The degree of exercise imposed on whales during whaling may fall outside the species' adaptive range. "*Even species that have evolved for efficient running, either for predator avoidance or for predation, may develop exertional myopathy following intense or prolonged muscular activity associated with extreme stress during air or ground pursuit.*" (Williams and Thorne 1996). Whalers depend on gaining a minimum distance between themselves and whales for successful harpooning. From what is known about the behavioural response of cetaceans to ships, this range is likely to fall below what would naturally be maintained by wild cetaceans in many cases. Pursuit as part of whaling may, therefore, be stressful

and manifest in a series of lethal and sub-lethal pathologies. Some whales, which successfully evade being harpooned, or are missed, may still suffer fatal syndromes, such as exertional myopathy (EM). Thus, pursuit may increase anthropogenic mortality levels, and this has implications for the welfare of all hunted whales, including those that are pursued but escape the harpoon. Such effects may be exacerbated where gravid females or females accompanied by dependent offspring are targeted.

Physiological assessments of stress, as part of currently practised lethal whale research, seem plagued by technical (manner and schedule of sampling, handling and storage etc, see Ishikawa, 1996; Øen and Walløe 1999) and biological problems, which can significantly distort results. A physiological stress assessment carried out during current lethal research is therefore fraught with difficulties. This includes problems with partitioning the physiological and biochemical effects of pursuit and killing, and the fact that the trauma of harpooning will mask any effects of pursuit. With regard to EM the fact that clinical signs may not manifest for hours, days, weeks or even months poses additional problems.

Rather than focus on harpooning alone, the IWC might consider whale hunting to start from when a whale is first sighted to when it is killed. Factors such as pursuit duration and speed, distance covered as well as direction of approach and weather condition should be taken into account and recorded. Such information, particularly if combined with behavioural data from target and non-target animals, and easily monitored biological parameters, such as respiratory rate, would provide a practical basis for assessing the potential stress-related risks of whaling.

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10 Euthanasia of cetaceans

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A number of different methods are used worldwide for the euthanasia of cetaceans. This reflects the many practical difficulties associated with euthanasing these large marine mammals. This chapter endeavours to highlight how, and why, these difficulties occur during the euthanasia of cetaceans on the beach and during whaling activities.

Euthanasia is defined as: "*Humane destruction; the killing of an animal without causing fear or suffering*" (Hine 1988). 'Humane' is further defined as 'inflicting as little pain as possible' (Hanks 1988), and there is, therefore, an expectation that euthanasia should be conducted using best practice; to ensure that it is as swift and as 'humane' as possible. There are international precedents for the humane slaughter of many species, irrespective of whether they are being killed for food or in 'acts of mercy' (chapter 14). The motivation for euthanasia of stranded cetaceans is to alleviate suffering, which contrasts with the motivation for killing cetaceans for food. It is proposed that the principles of efficient euthanasia, which have been developed for stranded cetaceans, should also be applied to cetaceans killed for other purposes.

In many countries, cetacean strandings have a high media profile, and there is often public expectation that live animals will either be refloated, or humanely euthanased where refloating is not possible. However, among veterinary professionals, there is neither global agreement on the most effective methods to use, nor are there global standards for euthanasia of stranded cetaceans. This is due to both the practical difficulties of administering euthanasia to large marine mammals on the beach and also to the difficulties inherent in determining the point of death (see chapter 11) and consequently accurately assessing the efficiency of any given method of euthanasia.

Euthanasia of stranded cetaceans

There are a variety of practical difficulties associated with the euthanasia of stranded cetaceans. These include the constraints of tide and weather conditions, access to both the shoreline and the animal, and even the gradient of the shore. Furthermore, depending on location, there are often issues of crowd control that must be addressed, ensuring that public safety remains a priority. In some instances, certain euthanasia methods, such as the use of firearms, may be prohibited due to the circumstances of the stranding, in which case the animal may be left to die naturally – i.e. without further human intervention, but usually with protection from malicious acts.

There are various guidelines for the euthanasia of stranded cetaceans in different regions of the world. Although the recommendations may vary to some degree, they are consistent in their attempt to render compromised cetaceans dead as swiftly as possible. In the UK, for example, the principle

method recommended by the RSPCA (1997) for euthanasing cetaceans is the use of drugs (etorphine, or for smaller cetaceans up to 50 or 60kg, pentobarbitone, are recommended). Where drugs are not available, shooting is recommended for toothed species up to three or four metres in length. Specific guidelines are provided on where to aim the shot so that it is most likely to hit the brain. The most effective firing range is considered to be no more than one metre away from the head. The recommended calibre is no less than 7.62mm (.30), used only with solid bullets of at least 140 grains. These recommendations also state that on no account should a shotgun or a .22 rifle be used. Furthermore, the RSPCA does not recommend the shooting of baleen whales as a humane euthanasia method, due to the anatomy of the head and the location of the brain. In cases where no drugs are available for the euthanasia of baleen whales, the RSPCA suggests that the most humane option may be to leave these animals to die naturally.

The requirement to use a sufficiently high-powered weapon and to achieve a direct line of fire to the brain, are similarly echoed in the Standard Operating Procedure of the Department of Conservation (DoC) in New Zealand (Suisted 1999). DoC recommends that high-powered rifles with standard sporting rounds be used for small whales or dolphins up to two metres in length. Cetaceans of between two and eight metres should be shot using .303, .30-06 (7.62x62mm), or .308 (7.62x51mm) rifles with 180 grain soft or solid round nosed projectiles. Baleen whales eight metres and above may only be shot using .303 rifles with MK.6 projectiles, 30-06 (7.62x62mm) or .458 (11.6mm) and solid nosed projectiles. Again, specific details are given on the target areas for the brain. It is recommended that if there is any uncertainty about hitting the target, then consideration should be given to carefully placing three shots in a line through the target area. In addition, it is also recommended that where humane euthanasia is not an option, the animal should be left to die naturally[1].

Special case of sperm whale strandings in New Zealand

Sperm whales strand with reasonable frequency around the coast of New Zealand. On average, since 1988, there has been at least one live stranding per year, which may involve from one to five animals. Two large mass strandings of sperm whales occurred during the 1970s. The first, at Whangara near Gisborne in March 1970, and the second at Muriwai, on Auckland's west coast in October 1974. These strandings involved 59 and 54 animals respectively (Baker 1983). Some single stranded sperm whales die soon after beaching. At the 1970 mass stranding in Gisborne, however, many whales remained alive for up to 72 hours. The size of sperm whales precludes the refloatation of these animals, except in exceptional circumstances. Consequently, the necessity for a euthanasia device arose from a concern for the welfare of live stranded sperm whales that can potentially suffer for several days on the beach before eventually dying.

Euthanasia of this species is fraught with difficulties. The single most effective and practical euthanasia method is believed to be a specially designed firearm (Marsh and Bamber 1999) developed by staff at the Department of Conservation, with the technical assistance of a firearms specialist. There are many safety issues associated with the use of firearms, including the safety of the operator and the presence of members of the public in the vicinity (Donoghue *et al.* 2003).

To develop a firearm capable of penetrating at least 1.2 metres of blubber, muscle and bone with sufficient remaining energy to cause immediate insensibility and death, research was conducted using sperm whale carcases as a testing platform, in order to determine the best firearm/bullet combination

for the task. The correct target area was established using external features as landmarks, so that bullets could be delivered directly to the brain.

Initially the high-energy 12.7x99mm (.50) cartridge was evaluated as it produced 17291 joules (12757ftlb) of energy. A variety of different bullet variants were trialed, but tests showed that in many cases the bullets lost momentum once they had struck bone, and often deviated from their path and began to 'key hole' (turn on their side). To determine penetration and tendency to deviate from the flight path, assorted bullets were evaluated in soft clay. All the assorted 12.7x99 bullets tested began to 'keyhole' after travelling 150mm to 300mm in the test clay. Maximum penetration in the clay was 800-850mm. From this it was concluded that the 12.7x99mm (.50) was not capable of euthanasing an animal of this size or with the specific anatomy peculiar to the sperm whale.

One of the problems often associated with these high-energy cartridges is the fact that the bullets are often in a state of yaw (turning about their vertical axis). Since they can easily be deflected from their flight path, they are not, therefore, well suited to penetrating tissue in order to reach a brain buried 1.2 metres deep. Thus, consideration was given to the largest calibre that could, conceivably, be carried and operated by an individual – the 14.5x114mm. Testing in clay produced a 90 per cent better penetration than the 12.7x99mm round, but at point blank range there was still excessive yaw and deflection. To overcome this a special bullet was designed. When fired, the full length of this new projectile was just in contact with the inside of the barrel, ensuring maximum stability at the muzzle. The projectile had a flat tip and a very poor ballistic coefficient. The latter ensured that the projectile would not travel any appreciable distance if it exited the whale. The flat tip assisted the projectile's stability as it travelled to the brain and also produced a large shock wave so as to impart maximum energy as it travelled through the brain. A monolithic solid was used for ease of manufacture and so as not to distort during penetration.

The result of this research was the 14.5 SWED (sperm whale euthanasia device) which produces a velocity of 1006mt/sec (3300fps) and 31134 joules (22978ft-lb) of energy at the muzzle. Testing in clay showed penetration of close to two metres with no deflection. The SWED was designed to be used by the operator standing alongside it, so that their arms are free to absorb the recoil.

Killing methods used during whaling operations

In sharp contrast to the accuracy implicit in the effective euthanasia of stranded cetaceans which, as discussed, can include carefully placing three shots across the target area at close range, the methods used during whaling operations are highly unsatisfactory in their potential for accuracy. This is due to several factors, not least of which is the range at which the animals are shot.

Other variables that affect the accuracy of methods used during whaling relate to the weapon used, the conditions of the hunt and the specific characteristics of the species killed. All weapons used during whaling should be able to penetrate blubber, muscle and bone in order to reach the target area, (preferably the brain) with sufficient energy to cause irreversible insensibility or death. The brain is the preferred target since observations of laboratory and food animals during slaughter demonstrate that instantaneous unconsciousness is only achieved when the brain itself is traumatically injured in the thalamic region (Anon 1999). The efficiency of weapons used, is therefore, also dependent on the area targeted and the angle at which the shot is fired (relating to both the proximity and orientation of the vessel to the whale). The accuracy of the gunner and their

knowledge of external landmarks for identifying target areas for the species taken, are also extremely important factors. Prevailing weather conditions, including sea state and visibility may, in addition, be significant (chapter 8). Sea state influences both the stability of the platform from which the killing method is applied and the relative movements of the target animal. Adverse weather conditions are frequently cited by the government of Japan as being a cause for the poor instantaneous death rate in their Antarctic hunt for minke whales[2].

Even during the euthanasia of cetaceans stranded on the beach, where euthanasia occurs at close proximity, weather conditions can affect the safe and efficient use of firearms. On the beach, high seas and driving winds can cause stranded cetaceans to be moving constantly, making the effective placement of the bullet in the brain difficult. In New Zealand for example, it is not considered safe to euthanase a stranded sperm whale with the SWED until the animal is no longer surrounded by water. This is to avoid any movements of the whale, caused by immersion in water, which might deflect the course of the bullet and to ensure that the SWED operator has a firm footing before discharging the firearm.

In addition there are a number of characteristics that vary between cetacean species and between individual animals that will influence the accuracy of any killing method. There are considerable anatomical variations among cetacean species to which the same or similar killing methods are applied during whaling operations (Anon 2003). These differences may affect the course of projectiles through the body, as they travel through different depths of blubber and muscle and encounter bone and vital organs at specific locations. Such factors may also apply to individuals of the same species, who vary in size according to, age and sex and vary in blubber thickness according to season[3]. During whaling operations, where the potential for accuracy is often poor, these specific characteristics may greatly increase the margin for error, and therefore, influence the time to death and associated suffering.

During the 2003 IWC Workshop on Whale Killing Methods and Associated Welfare Issues, the United Kingdom presented a paper evaluating the methods that are currently used to kill whales during whaling operations and how these methods are specifically adapted for the species taken (Anon 2003). It concluded that, in general, the killing methods used during whaling operations are not well adapted for the specific anatomical requirements of the different species taken. Concern was expressed that this may be a major contributory factor in protracted times to death and may, in particular, be a cause for concern where larger species, such as fin and sperm whales, are killed using methods developed for the much smaller minke species. It was concluded that during whaling operations there is a tendency for killing methods to be transferred from one species to another, without due consideration for the specific killing requirements between species.

During the 2003 Workshop, the Austrian delegation noted the dependence on secondary killing methods, such as the rifle, during whaling operations (Stachowitsch and Brakes 2003). This reflects the inefficiency of some of the primary killing methods used. The efficiency of secondary killing methods is also dependant on many variables, and it is important that all secondary killing methods seek to render an already wounded animal dead as swiftly as possible. Therefore, all secondary killing methods should be sufficiently powerful, and adequate calibre and bullet design should be selected in order to achieve this. Norway, for example, recommends that a minimum calibre of 9.3mm (.365) (generating at least 5500 joules energy) with round nose full-jacketed bullets should be used for

whales the size of minke whales (Øen and Knudsen 2003)[4]. In addition, good marksmanship is also imperative for efficiency, as is accurate anatomical knowledge of the species targeted.

Despite recommendations of a minimum calibre choice of 9.3mm (.365), lower powered and less effective cartridges continue to be used as both primary and secondary killing methods during some whaling operations (see chapter 6). The Russian Federation for example, continues to use 7.62mm calibre firearms for killing gray and bowhead whales. Greenland also continues to use 7.62mm calibre weapons during some minke hunts. The use of underpowered and low calibre cartridges, in combination with low calibre weapons corresponds directly with the number of bullets that are required per animal and the resultant times to death. During the 1999 Chukotkan hunt, for example, 180 bullets were required to kill one whale, the average time to death was one hour and the maximum time to death recorded was three hours 40 minutes (Kuraev 2000).

Conclusion

The meticulous nature of the methods developed for the euthanasia of stranded cetaceans and the conditions under which these methods are applied, contrast significantly with the often inferior circumstances and substandard methods used during whaling operations. Whalers attempting to achieve a fatal shot, either with a harpoon or a rifle, often must do so at considerable range, and need to overcome a number of significant factors which hinder the accurate placement of the harpoon or bullet to the target site. The significance of these variables and the inadequacies of the methods used are reflected in the poor instantaneous death rate and the average times to death during all whaling operations.

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Footnotes

1 Note that DoC does not recommend the use of drugs for euthanasing stranded cetaceans, due to concerns relating to the disposal of contaminated carcasses.

2 Japan reported that during the 2000/2001 JARPA hunt in the Antarctic the "*relatively bad sea conditions and larger body size of whales*" taken in areas V and VI were responsible for the longer times to death than in areas III and IV (Ishikawa 2001).

3 This was evidenced by data from Japan, presented in 2003, which demonstrated that a swifter kill was achieved for minke whales less than 7.5 metres in length (Ishikawa and Mogoe 2003).

4 Stachowitsch and Brakes note that despite the 9.3mm recommendation by Norway, more that one bullet is often required.

11 Review of criteria for determining death and insensibility in cetacea

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The technology used for killing whales has altered little since the invention of the grenade tipped harpoon in 1840, the only significant change being the introduction of penthrite explosive (*pentaerythritol tetranitrite*) rather than black powder in the grenade – chapters 2 and 6 detail the development of the killing 'technique'. For an assessment of the welfare implications of any commercial slaughtering process, accurate knowledge of the 'time to death' (TTD) is a valuable measure because it allows a reference point for the period during which the animal could potentially suffer. In the commercial slaughter of various farmed species (e.g. cattle, sheep, pigs, poultry), techniques have been developed to reduce the time between the application of the stunning method, the point of insensibility, and the time of death induced by bleeding out (chapter 12). For whales hunted at sea and killed by harpoon, such fine 'control' of the killing environment is not likely to be possible. However, for an informed discussion on the potential for suffering, it is important to determine the point at which the dying whale becomes insensible to pain, and the point at which it dies. If the time between harpoon impact and insensibility is prolonged there is the potential for significant suffering.

Recognising the need for data in this area, an International Whaling Commission (IWC) Workshop on Humane Killing Techniques was held in Cambridge, UK in 1980, and defined three criteria which could be used by observers onboard whaling vessels to establish the time of death in hunted whales:

- Relaxation of the lower jaw; or
- No flipper movement; or
- Sinking without active movement (IWC 1980).

Subsequently, various interpretations of these criteria have been made in IWC documents:

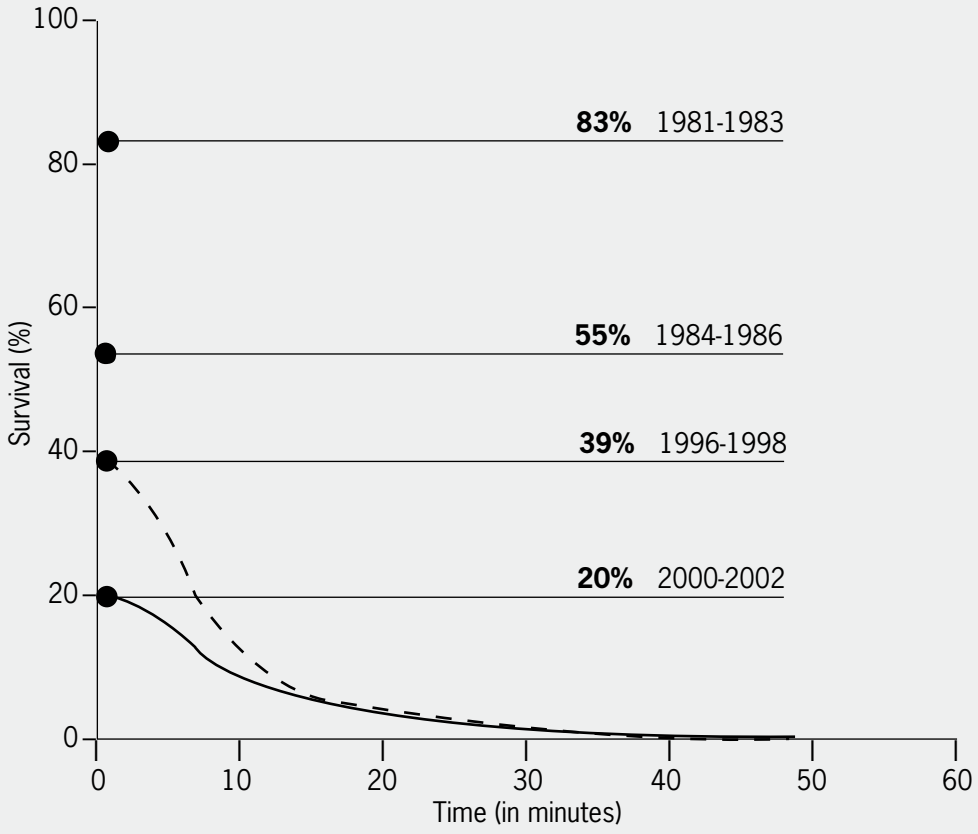
Muscles relaxed; mouth opened wide; or Lower jaw drifted in the waves (IWC 1994).

Relaxation of the mandible; cessation of flipper movement; or Sinking without any active swimming (IWC 1999).

The IWC criteria for the death of the whale are 'exclusive' – any single criteria can be met for the animal to be deemed dead, and for a time from harpoon impact to time of death (TTD) to be recorded. The whaling nations are requested to submit data on killing methods and killing efficiency to the IWC annually. Analysis of recently collected data which uses the three point criteria described above indicate that the TTD for the approximately 1,300 minke whales killed annually by the

Norwegians[1] and Japanese[2] is, on average, between two and three minutes, but with some animals taking over 40 minutes to die (IWC 2003). The number of whales apparently killed immediately[3] is variable, with Norwegian hunts achieving an approximate four in five immediate kill rate (Øen, 2003) (Figure 1). Japan's Antarctic Whaling Research Programme (JARPA) achieved a less than two in five immediate kill rate in the 1998/99 (31.6 per cent), 2000/2001 (36.1 per cent) and 2001/2002 (33 per cent) seasons, and a slightly more than two in five immediate kill rate in the 1999/2000 (44.4 per cent) and 2002/2003 (40.2 per cent) seasons (Ishikawa 2003b, Kestin 2001) (see chapter 6 for a review of these data). Recent data from the Greenland Home Rule minke hunt provide a mean TTD of 16 minutes (and a longest time of 300 minutes) for minke whales hunted in West Greenland in 2002 (IWC 2003).

Figure 1. Survival of minke whales in the Norwegian whaling operations



Points on the y axis show survival if greater than 10 seconds after being hit by the harpoon for all whales caught in the four time periods 1981-83 (cold, non grenade harpoons) 1984-86 (first grenade harpoons) 1996-98 (improved grenade harpoon and improved training) 2000-2002 (new grenade harpoon).

The decay lines show:

Upper dotted- Survival / time for animals in the period 1996-98

Lower solid- Survival / time for animals in the period 2000-2002

(Source: Øen 2003)

It is apparent from Figure 1, that, while there have been improvements in the percentage of animals killed within ten seconds from 17 per cent in 1983, to 80 per cent in 2002, there remain one in five (20 per cent) of whales which do not die rapidly (in less than ten seconds), and whose survival can be as long as 40 minutes. From the tail of the lower survival curve in Figure 1, it is apparent that, despite alterations to the design of the harpoon, and increased training and monitoring of whalers, the decay line for whales taking more than ten minutes to die has effectively remained unaltered between 1996 and the most recent recorded data in 2002. One can interpret this as meaning that, for approximately 10 per cent of all whales killed (the intersection of ten minutes on the time x axis, with approximately 10 per cent on the survival line, y axis) by the Norwegians, death takes at least ten minutes. This figure has not significantly improved since 1996.

The interpretation of the three criteria used to determine time of death is likely to be critical. Differences in the perception of 'flipper movement' (passive or active), or 'sinking without swimming' can create differences in TTD data. Whales are capable of sinking without swimming during normal activity (Ridgeway *et al.* 1984, Dierauf & Gulland 2001), and so sinking alone is not likely to be a fully reliable indicator of non-viability.

In practice, the use of the existing IWC criteria in the field by observers of the Japanese and Norwegian whaling operation has highlighted inconsistencies in their interpretation. For example, in a recent description of his experiences as a veterinary observer in the Norwegian hunt, Bruce (2003) states that the IWC criteria were used in an 'inclusive' fashion (relaxation of the jaw AND no Flipper movement AND no active movement). In contrast to this Norwegian example, recent data provided by Japan from the IWC Humane Killing Workshop in 2003 (Ishikawa 2003a) indicate that Japan does not make the criteria 'inclusive' in general (but sometimes combine criteria such as motionless AND slackened jaw, or motionless AND slackened pectoral fins) Table 1. For the largest part Japan uses 'motionless', a criterion which is not one of the IWC criteria, for determining TTD in most animals (Table 1, 514 out of 566 – 90 per cent).

The IWC holds periodic scientific workshops to examine whale killing methods and associated welfare issues. It has been repeatedly noted at these workshops[4] that existing criteria are in need of improvement and that more reliable indicators of the point of sensibility and death should be produced. An International Scientific Workshop on Sentience and Potential Suffering in Hunted Whales was hosted by the RSPCA in London in 2001 (RSPCA, 2003). The purpose was to review current criteria for assessing insensibility in cetaceans and consider the welfare implications of these criteria for whales. A group of scientists and veterinarians with expertise in welfare, physiology and anatomy reviewed current data on times to death in whale hunts, and the current IWC criteria for determining the point of death in cetaceans. The group concluded that these criteria were not adequate to determine precisely the point of death, and it was agreed that it should be possible to greatly improve current indicators of sensibility and death in whales.

If the scientific community is concerned that the existing IWC measures do not give confidence that the animal is dead, are there better measures? A preliminary study (Butterworth 2003a, 2003b) stemming from this workshop identified that the following measures would be likely to provide reliable information on the sensibility of cetacea – "*breathing rate when the animal is stimulated around the blowhole, electrocardiogram and heart rate, presence (or absence) of rhythmic swimming activity, and the temperature of the surface of the eye*".

Table 1. The criteria applied by gunners to judge the death of whales

Criteria	Number
Motionless	514
Slackened jaw	6
Slackened pectoral fins	8
No reaction to stimulation	1
Tensionless harpoon line	9
Motionless AND slackened jaw	24
Motionless AND slackened pectoral fins	3
Motionless and tensionless harpoon line	1

Table 1. The criteria that gunners applied to judge the death of whales during the 2000/2001 and 2001/2002 Japanese Whale Research Program in Antarctica (JARPA). (All cases of immediate death are not included. Ishikawa 2003a).

In a further study carried out on captive orcas, pilot whales, beluga and three species of dolphin (Butterworth 2003c), measures adapted from those used to establish the point of death in human patients (Pallis 1983, Schlotzhauer *et al* 2002, Wijdicks 2002) and from those used to assess the efficiency of stunning procedures at slaughter (Kestin *et al*, 2002), or depth of anaesthesia in surgical patients were applied. The following were found to be reliable and reproducible measures of physiological state in cetacea: jaw tone, palpebral response, menace response, corneal reflex, vestibule-ocular reflex, Ocular / Skin temperature differential, pupillary reflex, capillary refill time, heart rate (with stethoscope). As emphasized in these two studies it can be unreliable to base judgements about an animal's sensibility on only one indicator. For this reason, it was proposed in this study, that as many indicators as possible should be examined to allow judgments to be 'broad based', and decisions made on the basis of presence (or absence) of a single measure should be avoided. Could these methods be adapted to suit field conditions? This question will remain open until more robust measures can be tested at sea, however, if reliable measures for time to death cannot be used in the field, then it would appear that we cannot fully assess the true welfare implications of killing whales by harpoon.

The 'poor 'control' of the commercial killing of the world's largest mammals must be placed in the context of practical global efforts which are now being made by governments and others to introduce practical solutions to the commercial slaughter of other species and, in so doing, to reduce the potential for poor welfare at slaughter. Those conducting the killing should be required to demonstrate that reliable methodologies are being used to calculate TTD. Only by doing so can the global community be confident that cetacea are not subjected to unreasonable or unnecessary suffering during their slaughter. Without robust terminology, biologically valid measures, and reliably

interpreted criteria, comparisons of TTD data between years, seasons, countries and methods become 'in-credible'.

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Footnotes

1 Norwegian quota is set at 711 for 2003.

2 Japanese quota combined Japanese Antarctic Whaling Research Program (JARPA) and North Pacific Whaling Research Program (JARPN).

3 Immediately – The definition of 'immediate' is taken by whaling countries to mean 'in less than 10 seconds' (times shorter than this being proposed as impossible to determine during the period immediately after the harpoon impact due to movement and splashing). In many documents, the phrase 'instantaneous kill' is used, but this terminology provides an inaccuracy at the heart of the language used when describing whaling, since not only is 'instantaneous death' not possible biologically (any large organism will take at least milliseconds for neural activity to cease), but also impossible temporally as 'instantaneous' time is unmeasurable.

4 Previous calls to refine the criteria for time to death determination – 1992 (IWC/44/18) in a report of the Workshop on Whale Killing Methods (Item 9), 1995 (IWC/47/18) in Appendix 4 of the report of the Workshop on Whale Killing Methods – action plan, 1995 (IWC/47/18) in Appendix 5, suggestions for research needs on whale killing, 1999 (IWC/51/WK15) a proposal for the study of the dying process aimed at improvement of the evaluation of killing methods, 1999 (IWC/51/WK12) – report on the Workshop on Whale Killing Methods.

Section Three

Whaling in the twenty-first century

12 A comparison between slaughterhouse standards and methods used during whaling

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When animals are slaughtered for food it is considered important in many societies that, for ethical reasons, the process used does not cause unnecessary suffering (Wotton, 2001). A killing method that is truly painless and causes minimal distress to the animal can be classified as humane slaughter. The following chapter examines the regulation of slaughter and methodologies used in the slaughter of livestock and compares these with methods used during the slaughter of whales. An assessment is made of the welfare impact of the different methodologies employed.

The guiding principle for the humane slaughter of livestock is the achievement of an immediate state of unconsciousness in the animal, followed by rapid progression to death, and this 'best practice' principle is enforced by legislation in many countries. In a study by Gregory and Lowe (1999), it was found that in the majority of countries reviewed, there was a requirement for the humane treatment of animals prior to, and during slaughter, with emphasis on induction of insensibility with a stunning procedure in order to avoid suffering during the slaughter process.

Modern whaling activities fall outside current livestock legislation. Nonetheless, a legal argument can be made that there is an emerging customary international legal requirement for the humane slaughter and treatment of commercially slaughtered animals for human consumption. The meat from whaling operations, whether it is commercial, aboriginal subsistence or 'special permit', is ultimately intended for human consumption. Even when cetaceans are killed during 'research' activities, the meat is made available for human consumption. It is, therefore, legitimate to consider the welfare implications of whale killing methods alongside slaughter practices for other 'food animals'.

National and international regulation of welfare at slaughter

The international community is showing a growing care and concern for the general welfare of animals. An enforced humane killing standard for animals whose meat is sold commercially is becoming commonplace. Many states around the world have some type of humane slaughter laws or practices. International organizations, European Union regulation and multi-lateral trade agreements are codifying and improving upon these practices. More specifically, there is an emerging

international state practice or customary norm whereby animals that are slaughtered commercially for meat must not suffer at the time of death, must be rendered immediately insensible, and are required to be stunned or anaesthetized before killing (Gregory and Lowe 1999). Some of these laws have been in place for many years. Moreover, these laws are relatively consistent. In Gregory and Lowe's 1999 study, 27 countries surveyed required instantaneous insensibility before death. In most cases, this required a 'stunning' process which when applied to an animal, caused immediate loss of consciousness that lasted until death[1]. Furthermore, most states specified the equipment to be used for stunning and further required that slaughter personnel were specially trained. Gregory's research also demonstrated that regulations concerning slaughter were sometimes more stringent when the meat was exported than when it was consumed locally, indicating that, even when local standards are laxer than the international norm, a clear international norm is recognized.

The World Organization for Animal Health or OIE (Office International Des Epizooties) is an inter-governmental organization set up under an international agreement on 25 January 1924, originally signed in Paris by 28 countries. By May 2001, the OIE had a total of 158 members. The OIE has recently adopted a resolution on animal welfare[2]. It has set up the Working Group on Animal Welfare to develop international standards for humane slaughter, transportation, and housing and management for animals used in agriculture and aquaculture.

The European Union has also passed Community-wide legislation on the protection of animals, which includes mechanisms for safeguarding their welfare at the time of slaughter (EU 1993).

These international and national legal developments in humane care for animals indicate that there is an emerging international customary norm regarding the slaughter of animals sold commercially as meat; and that, this practice may be sufficient to have become customary law. However, the International Whaling Commission (IWC) does not yet have specified rules governing the commercial slaughter of whales.

An assessment of the welfare potential of livestock slaughter and whale killing methods

Scientists have defined the term 'suffering' in animals to mean a "*wide range of unpleasant emotional states*" (Dawkins 1980) including fear, frustration and pain. 'Pain' has been defined as an aversive sensation and feeling associated with actual or potential tissue damage (Broom 2001, Iggo 1984). Physiological, behavioural and learning responses show that feelings of pain exist in many species (Broom 2001). An assessment of the welfare potential of a husbandry system or practice is increasingly used to evaluate different methods of keeping and handling food animals (e.g. Tansey & D'Silva 1999, CIWF Trust 2002, WSPA 2003). Major concerns for animal welfare arise from husbandry practices with low welfare potential i.e. those that fail to meet the behavioural and physical needs of the animal and thereby have the potential to cause pain or suffering.

The welfare potential of any husbandry or slaughter practice is based upon the level to which it fulfils basic determinants of animal welfare. A determinant is a factor that is built into the system to influence its welfare impact. Examples of key determinants – building blocks of a good system – for the slaughter of farm animals include the use of appropriate equipment and an effective process to achieve an immediate pre-slaughter stun. Determinants should not be confused with welfare indicators. Indicators measure outcomes from the performance of a system. Examples of indicators

include levels of premature mortality or lameness. Indicators can measure the overall performance of a system. However, the performance will be influenced by both the determinants built into the system, and the level of human management skill applied to it. In other words, determinants define the welfare potential of the system, and the human operators influence the level to which that potential is achieved.

The classic example of a farming system with the potential for poor welfare is the battery cage for egg laying hens. The cramped and barren environment of the cage does not allow for all the birds' physical and behavioural needs. The birds suffer as a result (Appleby, 1991). The restrictive nature of the battery cage is an inherent part of the system. The battery cage is therefore a system with low welfare potential. No matter how much stockmanship and care is applied to the birds in the system, their welfare is likely to remain poor.

A free-range layer system, however – with its space and enriched environment – has a high welfare potential. If stockmanship levels are poor or neglectful, then the birds may suffer. Similarly, a badly designed unit could also negatively affect the birds' welfare. However, as the problems are not an inherent part of the system, they can be adjusted or improved. Design or husbandry problems in these free-range-type systems can more effectively be addressed, allowing the full welfare potential of the system to be achieved.

The same determinant-based methodology for assessing the welfare potential of a husbandry system can be applied to slaughter practices. The Farm Animal Welfare Council, the UK government advisory body on welfare, identified the basic principles that must be observed when specifically addressing the welfare of animals at slaughter (FAWC, 2003). These principles, the determinants of high welfare methodology, are:

- pre-slaughter handling facilities which minimise stress;
- use of competent well trained, caring personnel;
- appropriate equipment which is fit for the purpose;
- an effective process which induces immediate unconsciousness and insensibility, or an induction to a period of unconsciousness without distress; and
- guarantee of non-recovery from that process until death ensues.

These principles can be used to compare the welfare potential of humane livestock slaughter practices with current whale killing practices.

Pre-slaughter handling facilities which minimise stress

Once livestock animals arrive at the slaughterhouse, best practice is to unload them immediately into a holding area or 'lairage'. Here, the animals can be fed, watered, rested and subject to veterinary inspection before slaughter. Any animal found to have experienced pain or suffering during transport or following arrival at the slaughterhouse must be slaughtered immediately (MAFF, 1995). In the European Union, for example, it is a fundamental legal requirement that animals must not be subjected to any avoidable excitement, pain or suffering (EU, 1993).

In whaling operations, unrestrained whales are pursued by boat. Hunting methods vary. For example, Norwegian whalers attempt to position their boats where the whale is estimated to surface, although animals can be chased for up to six hours (chapter 9). Pursuit before killing is likely to subject the

whale to 'excitement, pain or suffering' to the point where, in some cases, this may induce exertional myopathy, a potentially fatal syndrome (Maas, 2003).

The entire ethos of slaughtering cetaceans during whaling operations differs fundamentally from the responsible attitude now taken by many states towards the slaughtering of food animals. In the UK, for example, legislation requires that animals awaiting slaughter should be inspected and "*any animal found to have experienced pain or suffering during transport or following arrival at the slaughterhouse or knacker's yard, or which is too young to take solid feed, must be slaughtered immediately*" (MAFF, 1995). In contrast, during whaling operations, animals are chosen for slaughter on the basis of proximity to the vessel, ease of access, or on economic grounds (usually relating to size). No consideration is given to choosing an individual for slaughter on the basis of welfare, indeed the practical difficulties of whaling often inhibit this, although at least in some cases a whale that has been injured and then broken free from the harpoon or line may be pursued and killed. It may be argued that the killing of suckling humpback calves in order to entice a lactating female closer to a whaling vessel, a historical practice in the St Vincent hunt, demonstrated a disregard for the welfare of both the female and the calf taken.

In relation to the general treatment of animals during slaughter, UK legislation further prescribes that "*no person shall strike or apply pressure to any particularly sensitive part of the body of an animal, nor twist or break the tail, or grasp the eye(s) of any animal*" (MAFF 1995). Such safeguards against injury to more sensitive parts of the body do not exist for whaling operations, and although whalers may aim for the head or thorax (depending on the type of whaling conducted) harpoons and bullets can enter any region of the body, causing a variety of different wounds. Moreover, in the Faroese drive hunts a blunt ended gaff is placed in the blowhole in order to secure the cetacean. The blowhole is a region with a rich nerve supply and is likely to be very sensitive to pressure and to trauma.

Use of competent well-trained, caring personnel

The achievement of high standards of animal welfare requires an awareness of the physical and psychological needs of the animals involved. It also requires responsible and responsive management; informed, skilled and conscientious stockmanship; considerate handling and transport; and humane slaughter (FAWC, 2003).

A key component of achieving these aims is that slaughter personnel are competent and properly trained. EU law requires that such employees possess the necessary skill, ability and professional knowledge to do their job humanely and efficiently (EU, 1993). UK Slaughtermen, for example, must hold a registered licence that can be revoked on failure to comply with its conditions, or failure to observe other laws concerning animal welfare (MAFF, 1995). Additionally, in every UK slaughterhouse, a competent person is given authority to take action to safeguard welfare.

During whaling operations, some degree of training for gunners is required. However, the training process itself is inherently flawed since training takes place using dead targets. This training process does not mimic the many variables that affect the accurate shooting of a live whale at sea (Stachowitsch & Brakes, 2003). This potential for error was illustrated in a report by Ishikawa (2002) regarding the 2001/2002 JARPA season – "*TTD and instantaneous death rate of whales taken by the new gunners were, on average, worse than that for whales taken by experienced gunners*". Simulating the many variables that effect the accurate placement of a 'clean' shot is highly complex. Furthermore,

the emphasis during some whaling operations (particularly Aboriginal Subsistence Whaling (ASW)) is often on securing the animal rather than on killing it with speed. This means that in ASW insensibility or a lethal shot can usually only be achieved after the animal is secured, and hence, often after a protracted period of time.

Appropriate equipment which is fit for the purpose

The humane slaughter of livestock animals is traditionally a two-stage process. First the animal is stunned to bring about unconsciousness, and this is immediately followed by severing of the major blood vessels in the neck (carotid arteries and jugular veins) to bleed out the animal (exsanguination) and induce death by circulatory collapse. Stunning and killing can be achieved in a one-stage process by using a 'stun-kill' technique that induces both immediate loss of consciousness and cardiac arrest. This technique is only achievable with the use of complex and well regulated electrical stun-kill equipment in slaughterhouses.

The normal slaughter of livestock animals takes place within a controlled and often purposely-designed environment. At the time of slaughter, animals are moved from the holding pen to the stunning point. Cattle are usually moved singly to a stunning box where the animal is restrained to enable an accurate stun. For sheep and pigs, a relatively small-group stunning pen is often used. Animals are not physically restrained within its confines and move around until they are in a position to be stunned.

Stunning can be achieved by:

- Mechanical means – the transfer of energy delivered by a cartridge or compressed air powered captive bolt or percussive head, via the skull, to the brain and spinal cord.
- Electrical means – the application of electrical energy to the brain via electrified stunning tongs (mammals) or a water bath (birds).
- Gas stun/kill methods – the use of Carbon dioxide, Argon or Nitrogen mixtures to induce insensibility and death in birds and pigs.

Modern commercial whaling activities involve the capture and killing of whales with a grenade tipped harpoon fired from a cannon. The harpoon is targeted to strike the animal in the thorax, however, in practice it may strike a range of locations on the animal's body, including, on occasion, the tail. If this primary method has been unsuccessful in killing the whale, then either a second harpoon may be fired, or a rifle used as the secondary killing method. Finally, once the whale is assessed by the whalers to be dead (chapter 11) it is winched aboard the whaling vessel. There is no method for non-invasively securing cetaceans before a killing method is applied during whaling operations. In addition, even when a cetacean has been secured using a harpoon (either a cold harpoon or an exploding harpoon that has failed to render the animal instantaneously dead), this does not guarantee the efficiency of the slaughter, since the cetacean is not 'restrained' in the sense that the whale may still be moving and the medium in which it rests (the sea) may also be moving. The gunner will also be aiming at this moving object from a moving platform compounding the margin for error in any given shot (van Liere 2003). Sea conditions and visibility (chapter 8) and marksmanship, can therefore have a significant impact on the efficiency of any killing method used during whaling.

An effective process which induces immediate unconsciousness and insensibility or an induction to a period of unconsciousness without distress

In livestock slaughter, there is clearly the potential for the stunning procedure to cause pain if performed improperly. It is essential that unconsciousness is induced quickly, so that the animal is unaware of the process. It takes more than 100 milliseconds for the brain to register the perception and experience of pain. To be effective, and thereby painless, unconsciousness must be induced within this period for the stunning method to be classified as humane. The only exception would be if the induction period of unconsciousness could be shown to be non-aversive (Wotton, 2001). Modern stunning practices in slaughterhouses using properly designed mechanical and electrical equipment and executed by trained professionals can achieve this level of effectiveness.

For the killing of a whale to be classified as humane, immediate unconsciousness or immediate death must be induced and no pain and suffering should be caused during the pursuit and securing of the animal. However, Norway reported for the 2002 hunt, an instantaneous death rate of 80.7 per cent (i.e. 19.3 per cent of the whales taken were not killed instantaneously) and an average time to death of two minutes 21 seconds. For the Japanese Antarctic hunt, recent data compares unfavourably with these Norwegian reports. During the 2002/2003 season, Japan reported that some 59.8 per cent of the whales killed did not die instantaneously, and average time to death during this season was two minutes 37 seconds. Maximum times to death during whaling operations can be excessive, as demonstrated by the report of a minke whale that took 300 minutes to die (five hours) during the aboriginal subsistence hunt in West Greenland[3] (chapter 6).

In comparison, legislation in the UK, for example, states that it is an offence to subject animals to avoidable excitement, pain or suffering before and during slaughter. Furthermore, with the exception of specific circumstances such as religious slaughter, animals are required to be stunned before slaughter (Druce and Lymbery 2002). Stunning is defined in this legislation as "*any process which causes immediate loss of consciousness which lasts until death*". The IWC has no comparative requirements, either for ensuring 'avoidable excitement, pain or suffering' or for pre-slaughter stunning. The only protection which cetaceans have been afforded during slaughter under the International Convention for the Regulation of Whaling (ICRW) was the ban on the use of the cold harpoon for commercial whaling implemented in the early 1980s. Japan (and the Russian Federation) still hold a formal objection to the ban[4] and are thus exempt from its effect. Japan still permits use of the cold harpoon in its scientific whaling operation under certain circumstances (see chapter 6). Russia's objection is redundant since it only undertakes aboriginal subsistence whaling to which the ban does not apply.

The ban on the use of the electric lance during whaling operations is only voluntary[5]. Furthermore, the electric lance was never intended as a pre-slaughter stunning device. It was administered after the whale had already been injured and secured using a grenade harpoon and was administered as a secondary killing method. Concerns regarding the inefficiency of this method in supplying sufficient current to the brain to induce death (due to many factors, including the dissipation of the current through the surrounding sea water, the inappropriate placement of the electrodes and the insulating nature of blubber) lead to the voluntary ban on the use of this device[6]. However, Japan continues to use electricity during the hunting of small cetaceans such as the Dall's porpoise (chapter 7).

For livestock, EU and other state legislation demands accuracy in the slaughter process in order to

affect an immediate and thereby lawful stun. Killing methods used during whaling aim to bring about death by one of the following processes: direct disruption of the brain nervous tissue or heart muscle by projectiles, hypovolaemic shock from blood loss through injury, ischaemia (inadequate blood supply to an organ or tissue) or neurotrama caused by the blast-generated pressure waves from exploding penthrite (Knudsen and Øen 2003). However, efficiency of the slaughter method depends entirely on the shot placement and how well the weapon used is adapted for the species taken (Anon 2003b). In comparison to the degree of precision required in many states for the slaughter of food animals, the methods used during whaling are substandard. For example, during whaling operations blood loss occurs as the result of various combined injuries, rather than the accurate severing of major blood vessels.

Some methods for religious slaughter of animals are legal in a number of countries including the UK, for example, which as a special exception omits the requirement to stun animals prior to exsanguination. Nonetheless, there are still legal safeguards to ensure that this type of slaughter is carried out without prolonged suffering. This includes methods for restraining the animal before slaughter, ensuring that a captive bolt instrument is available for use in cases where an animal may be subject to avoidable pain and suffering or may be agitated or injured. In cases where stunning does not precede religious slaughter, the knife must be inspected before each incision to check that it is sufficiently sharp and it must be ensured that both the carotid arteries and jugular veins are severed. Such provisions for the welfare of these slaughtered animals again exceed those of current whaling practices.

Guarantee of non-recovery from stunning until death ensues

Pre-slaughter stunning has been legally defined as "*any process which, when applied to an animal, causes immediate loss of consciousness which lasts until death*" (EU, 1993). In a two-stage slaughter process, the death of the animal is brought about by severing the major blood vessels to cause blood loss or by irreversible destruction of the function of the brain or spinal cord. To bring about humane slaughter through bleeding, it is essential that once an animal is stunned, it is bled as quickly as possible to prevent recovery before or during the bleeding process (Wotton, 2001). Alternatively, the stun/kill method may be used, when the electrical current is applied both to the head and to the chest to cause both insensibility and cardiac arrest (Druce and Lymbery 2002). There are currently no practices exercised during whaling operations that would categorically ensure that the animals are stunned and therefore insensible to the pain from the commencement of the slaughter process.

Scientific and practical studies have identified methodologies for recognising an effective stun in livestock animals. Following an effective captive bolt stun, for example, the animal should immediately collapse, become rigid, and its eyes should have a fixed, glazed appearance. There should be no positive corneal (eye) reflex and no rhythmic breathing. For electric stunning methods, an effective stun is indicated by the presence of epileptic fitting, no rhythmic breathing, rotation of the eyes, and uncontrolled involuntary motor activity (kicking) (Wotton, 2001). These methods can be used to ensure that animals are stunned effectively and remain unconscious until dead.

During the 1980 Workshop on Humane Killing Techniques for Whales, the IWC adopted the following criteria for determining death during whaling operations: relaxation of the lower jaw or no flipper movement or sinking without active movement (Anon 1980). Various interpretations of these criteria have subsequently been made (Butterworth *et al.* 2003). The assessment of death using these

criteria is likely to be problematic, due to the practical aspects of whaling operations and furthermore, it is feared these criteria may be inadequate, and may be responsible for underestimating time to death during whaling operations (chapter 11). For example, using these criteria it may be possible to judge a live whale, that is suffering from paralysis due to injury, as dead. Furthermore, Kestin (1995) argues that in practice, there will be a time lag between striking the whale and making an assessment. 'Instantaneous death' during commercial whaling operations, is likely to equate to a whale that, according to the IWC criteria, shows no signs of life some 10 seconds after the harpoon has been fired.

Welfare potential of whaling operations

A killing method that is truly painless and causes minimum distress to the animal can be classified as humane slaughter and therefore a process with the potential for high welfare. The basic principles that must be addressed to protect the welfare of livestock animals at slaughter provide a useful framework with which to compare the welfare potential of current whale killing methods. From the analysis above, it is clear that there are a number of factors inherent in current whale killing methods which limit the potential for high welfare. These include the initial pursuit, and the difficulties involved in hitting a distant, largely submerged, moving target from a moving platform at sea. The killing methods themselves are often not well adapted for the species taken, or the variability of size between individuals of the same species according to age, sex and season. The significance of these variables and the inadequacies of the methods used are reflected in the poor instantaneous death rates, the average times to death and the need for secondary killing methods during all types of whaling operation.

Discussion

The often poor instantaneous death rate and mean and maximum times to death (see chapter 6) reflect the lack of welfare management and enforcement in the whaling industry. The only provisions relating to welfare that currently exist in the schedule to the ICRW 1946 are provided in Table 1. Note also that the schedule refers only to the killing of whales for aboriginal subsistence need in relation to mean sustainable yield of the stock (article III, paragraph 13a) and no provisions are made, within the schedule, to specifically address the welfare issues associated with this particular category of whaling. Even the IWC definition of 'humane killing' is ambiguous[7]. This definition, although suggested as an ideal, does not require any compliance, nor is it followed with any regularity.

The extent and quality of legislation currently enacted in many states for the protection of animals at the time of slaughter, contrasts with the almost complete lack of regulation on the methods used during whaling operations. Historically attempts have been made within the IWC to address this issue and a number of resolutions and recommendations have been adopted by the IWC (chapter 5).

Despite these resolutions and recommendations, the quantity and quality of data presented at the Working Groups and Workshops on Whale Killing Methods and Associated Welfare Issues remains poor. St Vincent and the Grenadines, for example, failed to submit any data on humpback kills at the 2003 workshop and Japan has consistently failed to submit any data on the slaughter of sperm whales in the North Pacific.

The meagre requirements in the schedule for data collection represent the only guidelines to which

Table 1 Animal welfare and the Schedule to the International Convention for the Regulation of Whaling

Article	Para	Text
III (Capture)	6	The killing for commercial purposes of whales, except minke whales using the cold grenade harpoon shall be forbidden from the beginning of the 1980/81 pelagic and 1981 coastal seasons. The killing for commercial purposes of minke whales using the cold grenade harpoon shall be forbidden from the beginning of the 1982/83 pelagic and the 1983 coastal seasons[8].
III	14 & 17	It is forbidden to take or kill suckling calves or female whales accompanied by calves. [Paragraph 14 refers to baleen whales and paragraph 17 refers to sperm whales].
VI Information Required	25a	All contracting governments shall report to the Commission for all whale catchers operating in conjunction with factory ships and land stations the following information: 1) methods used to kill each whale, other than a harpoon, and in particular compressed air 2) number of whales struck and lost
	25b	A record similar to that described in sub-paragraph (a) of this paragraph shall be maintained by vessels engaged in "small-type whaling" operations and by native peoples taking species listed in paragraph 1, and all the information mentioned in the said sub-paragraph shall be entered therein as soon as available, and forwarded by Contracting Governments to the Commission.
VI	27	Notification shall be given in accordance with the provisions of Article VII of the Convention with regard to all factory ships and catcher ships of the following statistical information: a) concerning the number of whales of each species taken, the number thereof lost, and the number treated at each factory ship or land stations, and ...
VI	28b	The information required under paragraph (a)(2)(iii) should also be recorded together with the following information, in the log book format shown in Appendix A[9], and forwarded to the Commission...

whalers, taking cetaceans under the auspices of the International Whaling Commission, must adhere. Furthermore, there is no enforcement of this data collection process. Therefore, any reporting undertaken in adherence to Article VI of the schedule is at the discretion of the whalers, or national inspectors onboard. There is also no independent verification mechanism for ensuring the quality and accuracy of these data.

Information regarding the adherence to the ban on using the cold harpoon (Article III, paragraph 6) and abstinence from the use of the electric lance must, in addition, be taken in good faith, since this is also not supplied by independently verified sources.

There are no regulatory requirements for 'avoiding excitement, pain or suffering' in the ICRW, as there are no maximum pursuit times, no limit on the number of weapons or bullets that can be deployed on one animal, no upper limit on the acceptable time to death, no specific requirement for the rate of instantaneous kills and indeed, in many hunts, there is no upper limit on the number of animals that can be struck and lost (Anon 2003a). The only binding requirements on contracting governments consist of those listed in Table 1.

Conclusion

When assessing the welfare potential of whale killing methods using accepted principles of humane slaughter, it is clear that current whaling operations have a low welfare potential, and are therefore likely to cause severe pain and suffering in the hunted animal.

Emerging international law governing the commercial slaughter of livestock animals has evolved over the past quarter century or more and gained much momentum in the last five years. This emerging customary law may eventually become as binding upon countries as the ICRW itself. Current national and regional legislation imposes standards to avoid pain and suffering during slaughter. The development of standards for the slaughter of livestock has shown that improvements in welfare are most likely where strict enforcement exists. Such standards and mechanisms for enforcement are currently not available for modern whaling practices. However, even if such mechanisms were put in place, due to the nature of whaling operations and the potential for poor welfare, it is considered unlikely that the slaughter of whales for commercial or aboriginal subsistence purposes would be able to comply with the standards now expected for the slaughter of livestock species.

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Footnotes

1 An exception is made for religious purposes, although even then a specified procedure is required (Gregory and Lowe 1999).

2 Resolution NO. XIV, Animal Welfare Mandate of the OIE May 2002.

3 IWC/55/WK12 – Times to death in the Greenlandic minke and fin whale hunt in 2002.

4 Norway withdrew its objection in 1985.

5 In 1995, a resolution was adopted, calling on contracting governments to suspend the use of the electric lance until a decision could be reached at the 1996 meeting on the use of this device as a secondary killing method. During the 1997 meeting Japan stated that while it maintained the view that the electric lance was still an effective secondary killing method, it intended to use rifles as the principal secondary killing method from the next season and only to use the electric lance in exceptional circumstances.

6 Note that during the 1999 workshop, Japan commented that the electric lance, although not used, is still made ready during all whaling operations. It is not known if this is still the case.

7 At the 1980 Humane Killing Workshop, as a working definition, it was accepted that humane killing of an animal means "*causing its death without pain, stress, or distress perceptible to the animal"* This is the ideal; any humane killing technique aims to render the animal as insensitive to pain as is technically possible, which in practice cannot be instantaneous in the scientific sense.

8 The governments of Brazil, Iceland, Japan, Norway and the Union of the Soviet Socialist Republics lodged objections to the second sentence of paragraph 6 within the prescribed period. For all other contracting governments this sentence came into force on 8 March 1982. Norway withdrew its objection on 9 July 1985 and Brazil on 8 January 1992. Iceland withdrew from the convention with effect from 30 June 1992. The objections of Japan and the Russian Federation not having been withdrawn, this sentence is not binding upon these governments.

9 Appendix A is the only part of this paragraph that refers to the collection of animal welfare data. Appendix A requires details of the first and the 'killer' harpoon used, information regarding the experience of the captain and the gunner, details of the vessel, the time spent chasing whales, number in the group and the weather conditions.

13 Ethics and whaling under special permit

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Background

Of the three countries currently killing whales despite the International Whaling Commission's (IWC) moratorium on commercial whaling, two are carrying out what is termed 'special permit' or 'scientific' whaling under the direction of national research institutes. Scientific proposals detailing the aims of the whaling programmes are submitted to the IWC's Scientific Committee for review, after which each contracting government issues its own institute a permit to carry out the whaling and research, irrespective of comments received in the IWC review process.

Under this aegis, Japan's whaling fleets currently kill 650 whales of various species each year, while Iceland has initiated a project aiming to kill 250 whales annually.

Whilst described as scientific research by the whaling nations themselves, these lethal takes do not conform to many of the criteria commonly expected from a scientific research plan. One omission is that, in many research and academic institutions an ethical review would usually be required before a permit was granted to carry out animal research.

Development of ethics in science

Historically, the pursuit of scientific discovery focussed on the collection and interpretation of information, without any consideration of methodologies by which the information was collected. Hence, it would not have been regarded as inappropriate to kill a lion to quantify the arrangement of teeth in its jaw.

However, it has now become common practice to consider a number of additional factors about the validity of the information being collected. The question of how the information is collected is now considered in tandem with whether the collection of the information in a particular way is itself justified. In other words, does the end justify the means? This question forms part of the ethical debate, in which any potential harm (to humans or animals) caused by a particular scientific proposal must be weighed against its potential benefit.

As ethics has a moral component based on the values of the culture in which it resides, ethical views may differ between societies. However, in general, an element of accountability is incorporated into modern scientific disciplines, particularly the biological and medical sciences. The result is that the pursuit of scientific knowledge is subject to close scrutiny both for its scientific validity and for its moral and ethical acceptability.

Ethical reviews are now a standard requirement during the assessment of scientific proposals in many countries. Guidelines and legislation regulating the use of animals in scientific experimentation have been adopted in many countries including New Zealand, Australia, Japan, Canada, US, European countries conforming to the EU Directive 86/609 on the protection of animals used for experimental purposes, and others (see examples in Gillespie 2000, Bradshaw 2002). The laws in these various countries have in common a stipulation that procedures carried out on animals must be carried out with the minimum of pain and suffering and that during treatment, animal welfare must be optimised. In the US, a review process equivalent in many ways to the ethical review, is carried out by an Animal Care and Use committee.

The ethical review process usually covers any procedure likely to cause pain, distress or lasting harm to animals and, in a number of countries, such reviews cover even the smallest procedures, for example tagging a wild animal.

By incorporating an ethical review into their assessment of the validity of scientific proposals, many countries have acknowledged the legitimacy of animal welfare in science.

The objective of an ethical review process

An ethical review (or an animal care and use review – the term ethical review will be used to cover both) aims to critically assess the justification for animal use in situations likely to cause pain, suffering, distress or lasting harm to the animal. This process includes review of procedures likely to alter the normal behaviour of a wild animal (e.g. altering its foraging or ranging behaviour) as well as invasive procedures likely to cause tissue damage or the individual's death. The ethical review ensures that the scientific proposal is subject to close scrutiny, both in terms of its scientific validity, and its moral acceptability. Ultimately, the research must be justified in terms of a benefit to man, to other animals, or to the environment.

The basis of an ethical review is an acknowledgement that unregulated exploitation of animals in the name of scientific endeavour is not acceptable and ethical reviews now usually aim to assess the scientific proposal using the concept of the 3 Rs: Replacement, Reduction and Refinement (see Table 1). The concept of the 3Rs is widely accepted and promoted in the field of animal experimentation, as best practice (ANZCCART 2003). Research proposals must demonstrate that all efforts have been made to find alternatives to the use of animals; that numbers required are placed at a minimum; and that techniques to be applied are those least likely to cause pain or suffering or lasting harm.

Such reviews are carried out by a committee with a mix of scientific or technical expertise (to assess the validity of the scientific proposal), scientific, veterinary and animal welfare expertise, as well as lay public representation, to promote a balanced assessment of the worth of the science when weighed against the costs to the animals concerned. The ethical review must ensure that all adverse effects on the animals are recognised, and that the experimenters are sufficiently competent to ensure that the research is effective and achieves valuable results while optimising animal welfare and minimising suffering.

Use of ethical review in science (institutions, governments and scientific literature)

The UK Animals (Scientific Procedures) Act (1986) came into force in early 1987, and, ten years later,

Table 1. Consideration of the 3Rs in the ethical review process

Replacement

Alternatives to the use of animals must be sought, and efforts to find alternatives documented. If no alternatives are found, and non-animal based experiments are deemed inappropriate, then explanation must be provided for the need for animal use and the reasons that alternative approaches are inappropriate.

Reduction

Research must use the minimum number of animals necessary to gain meaningful results. Expert consultation and advice must be sought to ensure appropriate statistical power and biological relevance from all sampling and experimental procedures. On-going research should be subject to regular review to assess the potential for a downward revision of number of the animals originally proposed.

Refinement

Animal suffering may be reduced by considering the precise techniques to be applied, whether there are alternative, less invasive techniques, and whether use of alternative pecies may permit use of alternative procedures. Researchers should justify the need for specific experimental procedures and strive to reduce pain to an absolute minimum and to relieve suffering wherever possible.

the government carried out a review of its effects on the use of animals in scientific establishments. The review identified a number of problems that led to compromised animal welfare, including: a lack of awareness within institutions of the potential to improve animal welfare; a conflict between optimising animal welfare and optimising use of resources; and the existence of entrenched attitudes, incompetence or insensitivity to animals (see Jennings *et al.*1997 for summary).

Subsequent to this review, the UK Home Office (Home Office 2000) identified ethical review as one of the key requirements for improving animal welfare in scientific research establishments, combined with developing initiatives to promote the widest possible application of the Three Rs. The establishment of an ethical review process by research institutions has now been made mandatory in the UK. Similarly, in Australia, Animal Ethics Committees (Bradshaw 2000) associated with individual research institutions carry out ethical reviews and issue permits to scientists within the institution.

Ethical review is not only carried out at the level of a government or institution. Many scientific journals now acknowledge the importance of ethical considerations and scientific papers submitted for publication frequently require that researchers confirm that ethical approval was granted for the study. Some journals go further and have their own ethical review committees, publishing guidelines to which submitted research must conform (e.g. Anon 2003).

Relevance of ethical review to whaling conducted under the auspices of science

Whaling for scientific purposes is permitted under Article VIII of the International Convention for the Regulation of Whaling (see chapter 6). Any proposal for lethal scientific research on whales ('scientific whaling') must be submitted to the Scientific Committee of the IWC for review. This Committee consists of scientists from contracting governments to the IWC, and invited scientists from other nations, with the necessary expertise to assess the validity of research projects.

A requirement of the review is that "*an evaluation of the likelihood that the methodology will lead to achievement of the scientific objectives*" is carried out (as per requirements laid out in the Report of the International Whaling Commission 36, 133). Any contracting government can submit such a proposal.

Scientific reviews of proposals are carried out by the Scientific Committee, and involve lengthy review and comment upon the initial proposals, interim results of long-term projects, and analyses of the validity of results from finished projects. However, at no point is an ethical review of the proposal conducted, although the IWC has acknowledged the validity of an ethical review process. In 1998 a resolution was passed requesting that the Secretariat of the IWC conduct a comprehensive review of ethical considerations applied in other international scientific organisations (IWC 1999a). The Secretariat's review led to the general conclusion that existing international ethical guidelines stress that research should aim to cause "*the minimum of stress and distress, suffering and pain, and at the same time considering if the research results can be achieved using fewer animals or by other (non-lethal) means*" (IWC 1999b).

Were an ethical review to be carried out on Japan's and Iceland's whaling proposals, a number of issues of relevance would emerge (see Table 2). Concerns have regularly been raised by some members of the Scientific Committee as to the likelihood of the lethal research proposals actually achieving their aims. Some scientists in the Scientific Committee have criticised Japan's research programmes, stimulating repeated debate on the scientific validity of the studies (IWC 1999c, IWC 2000, IWC 2001, IWC 2003b).

In 2003, Iceland presented its first proposal for scientific permit whaling in 14 years and various views were expressed, including the statement that "*this proposal is inadequate especially in its description of sample sizes*" and "*concerns were raised regarding the adequacy of the sampling scheme to meet the intended objectives*" (IWC 2003c, p.48-49). In fact, Icelandic scientists acknowledged that the sample sizes in their proposal for lethal research may not be adequate to resolve all of the objectives of the project (IWC 2003c, Annex Q, p.11).

When doubt is so clearly cast upon the validity of a scientific proposal and its ability to achieve its aims, then the lethal take of any animals is likely to be judged as unethical. Additionally, if the specified number of animals to be used will not achieve a conclusive result, then the research proposal must be seen as flawed. An ethical approval permit would not be issued for this work in other areas of animal research.

A number of non-lethal methods are regularly used to address questions similar or identical to those proposed in the permit whaling programmes. Non-lethal biopsy sampling is widely used to collect small plugs of tissue from live cetaceans. A technique for 'scrubbing' a cetacean's skin is also used to collect

skin samples, without the need for any more invasive procedure. These techniques enable rapid and comprehensive collection of samples without killing the animals and call into question the justification for killing whales to assess population genetics.

Techniques now exist to collect faeces from a whale as it swims, using a net to scoop up the sample near the water surface and to carry out DNA amplification to analyse the species composition within the samples and hence in the diet (Jarman *et al* 2003). This technique is very valuable as it enables repeated sampling of the same individual and construction of dietary profiles over time. Such techniques bear no welfare cost to the animals being studied.

The method of euthanasia is a critical consideration during ethical review. In the case of scientific permit whaling, the killing method is the same as that applied to the commercial slaughter of whales: explosive harpooning on the open seas. A review of current killing efficiencies (see chapter 6) reveals that the scientific permit whaling conducted by Japan is actually less efficient than commercial whaling. Because the method of euthanasia (harpooning) in special permit whaling immediately kills less than half of whales after first being struck (see chapter 6) it is likely that this method would be considered ethically unacceptable by the ethical review process in other areas of animal research.

Table 2. Comparison of the 3Rs with current practice of Whaling under Scientific Permit

Replacement	
Killing whales to determine stock structure	Non-lethal biopsy sampling is widely used to collect tissue for genetic analysis. Such sampling techniques are more effective than killing the animals.
Killing whales to determine diet	Techniques now exist to sample whale faeces and construct diet from the DNA profiles provided.
Killing whales to determine pollutant levels	Pollutants research can be carried out using biopsy sampling, using samples from stranded cetaceans and by analysing incidental catches.
Reduction	The scientific validity of the number of whales killed has been repeatedly questioned in the Scientific Committee of the IWC.
Refinement	Current killing methods are deemed to be inadequate by virtue of the time taken for the whales to die (chapter 5.1).

Discussion

Are ethical and moral 'values' relevant to the assessment of the science carried out under the auspices of the International Whaling Commission? I argue that they are: a progressive viewpoint on animal care requirements in science, already adopted by many members of the convention, could appropriately be applied to the scientific work of that convention. Some of the components of an ethical review are already routinely covered within discussions in the Scientific Committee. Additionally, the Commission itself has stated that: *"non-lethal techniques available today will usually provide better data at less cost to both animals and budget*" (IWC 2003a).

Therefore, I propose that it is both appropriate, and important, to establish an ethical review process under the auspices of the IWC, and to review the large-scale lethal whaling programmes currently being conducted in the name of science. Scientists already operating under such legislative controls in their own countries should see no conflict in incorporating such requirements into the review of scientific permits for whaling.

Without an ethical review, even if valid science is conducted during scientific permit whaling, there is a danger that it will not be acceptable for publication in international journals. This would prevent the dissemination of the gathered information and effectively render any valid science that may be conducted useless due to its inaccessibility

Ultimately, the scientific merit of a proposal is a fundamental consideration for any ethical review process. It has been suggested that a badly designed research programme, whether peer reviewed or not, is inherently unethical (Jennings *et al.* 1998). Given that whaling programmes have received sustained criticism of their scientific validity from peers, and contain no consideration of animal welfare at all, it seems appropriate that they must be deemed ethically unacceptable.

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14 Legal precedents for whale protection

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> *"Recent history indicates that man's impact upon marine mammals has ranged from what might be termed malign neglect to virtual genocide. These animals including whales, porpoises, seals, sea otters, polar bears, manatees and others, have not only rarely benefited from our interest; they have been shot, blown up, clubbed to death, run down by boats, poisoned and exposed to a multitude of other indignities, all in the interest of profit or recreation, with little or no consideration of the potential impact of these activities on the animal populations involved"* (US Congress 1971).

Introduction

This powerful testimony presaged both the birth of the 'save the whale' movement and a call by the United Nations Conference on the Human Environment for the International Whaling Commission (IWC) to consider adopting a ten-year moratorium on all commercial whaling[1]. Although the IWC took fifteen more years to agree a moratorium on the commercial slaughter of whales, the number of national, regional and international agreements concerning whales has increased significantly since the early 1970s, and continues to grow.

The laws that were first enacted in the 1970s and 1980s tended to focus primarily on cetacean conservation, not welfare, and were mainly directed at trying to regulate the exploitation of whales. However, in the last 30 years, civil society has shown a growing concern for the protection of animals in general, and for cetaceans in particular. As a result of this movement, which has gained even greater momentum in the last 15 years, the science of animal welfare has developed into a major discipline, and national, regional and international animal protection legislation has been enacted.

Space does not permit a review of the evolution of animal protection legislation in general, although such reviews exist (Ritvo 1987, The Animal Welfare Institute 1990, Wise 2003). This chapter briefly considers some national, regional and international developments relating to cetaceans that are consistent and concurrent with this trend, and summarises the various regional and international agreements that specifically address the treatment of cetaceans. It argues that emerging customary law may modify these agreements over time to incorporate even greater protection measures for cetaceans in the future.

Whales and the law

Cetaceans (and whales in particular) have a special legal status, almost unique in the animal kingdom, that reflects the highly migratory status and unique life histories of the 80-plus species[2] and their history of over-exploitation.

Consistent with the trend in civil society towards treating cetaceans and other 'high order' mammals as a 'flagship' species for the environment, and the growing tendency of the public to identify with individual animals[3] as well as their species as a whole, whales and dolphins are increasingly afforded even greater treatment under the law. Many coastal states, in addition to, or included within, their general animal welfare or conservation laws, have strong specific provisions relating to marine mammal protection.[4] For example, New Zealand[5], Australia[6] and the US[7] (all former whaling nations) have adopted whale or marine mammal protection acts that address the welfare as well as the conservation of cetaceans and prohibit killing, harming or harassing them.

Many countries prohibit the killing, taking or injuring of cetaceans regardless of their conservation status.[8] Some countries, such as the US, extend this prohibition to their nationals operating within international waters, while Australia extends it to other sovereign jurisdictions.

A number of countries have taken the additional step of protecting cetaceans in their territorial waters by establishing areas of sanctuary from human activities[9]. Although many of these sanctuary zones (including those designated by the IWC[10]) are not 'Marine Protected Areas', as defined by The World Conservation Union (IUCN)[11], and so lack management plans or enforcement provisions, they reflect the international groundswell of support for the special status, and need for protection, of cetaceans. The IWC has already designated two whale sanctuaries in the Southern Ocean and the Indian Ocean. Argentina and Brazil, and Australia and New Zealand have proposed new sanctuaries in the South Atlantic and South Pacific respectively.

The concept of 'global commons' is clearly defined (Palmer 1998)[12]. Highly migratory species of whales are treated as the property of no nation, but the responsibility of all – i.e. a 'global commons'. As a result, several international and regional agreements address their conservation and management. Some of these agreements, including the International Convention for the Regulation of Whaling (ICRW), the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area (ACCOBAMS), incorporate important provisions relating to the welfare and humane treatment of cetaceans[13].

INTERNATIONAL AGREEMENTS

United Nations Convention on the Law of the Sea (UNCLOS)[14]

UNCLOS provides the foundation on which all marine management is built. It came into force in November 1994 and currently has 143 member parties. It declares the 'preservation and protection' of the marine environment and 'conservation' of marine living resources as fundamental obligations. All States must take measures to control pollution from all sources and are obliged to manage the living resources within sustainable limits in both national jurisdictions and on the high seas (IUCN 1996). This is a dramatic departure from the conventional practice of unregulated exploitation of common resources of the past (Prideaux 2003).

Of specific importance to cetacean conservation is Article 65 of UNCLOS, which limits the exploitation of marine mammals and safeguards the "*right of coastal states or the competence of an international organisation to prohibit, limit or regulate the exploitation of marine mammals more strictly than provided for under the rules applicable to fisheries in the Exclusive Economic Zone*"(Vicuna 1999). Article 120 makes a clear distinction between marine mammals and other living marine resources and extends the provisions of Article 65 to the high seas.[15] Both articles clearly distinguish the management of marine mammals, and more specifically cetaceans, as absolutely distinct from fisheries, and exempts them from Article 64 which calls for "*optimum utilisation*" (Birnie 1985). Marine mammals in coastal Exclusive Economic Zones (EEZs) remain the responsibility of coastal states under Article 65, according to the conservation and utilisation obligations of Articles 61 and 62, except where conservation measures are less than those stipulated in Article 65. Marine mammals are also considered to be highly migratory species and are, therefore, governed by the cooperation aspects of Article 64 (Brown 1994). Some commentators have argued that Article 65 reflects a trend in the protection of cetaceans beyond economic value, to include considerations of a moral and ethical nature (Maffei 1992).

As can be seen in the presentations of Articles 61-65, "*freedom of exploitation is no longer the prevailing principle in international law in this context*"[16] Both Articles 61 and 62 provide a stricter standard of conservation for marine mammals than is applied to other species, and Articles 65 and 120 set a higher standard again for marine mammals and, in particular, cetaceans (Prideaux 2003).

The International Whaling Commission (IWC)[17]

The International Whaling Commission (IWC), established by the 1946 International Convention for the Regulation of Whaling (ICRW), (see chapters 2 and 5) is the recognised international organization with primacy over the management and conservation of whales and currently has 51 members. The ICRW was established after World War II in an effort to both regulate the whaling industry and to conserve whale populations for future generations.

Article V of the ICRW enables the IWC to adopt protective regulations "*such as are necessary to carry out the objectives and purposes of this Convention and to provide for the conservation, development, and optimum utilization of the whale resources*". These include the setting of quotas; prohibitions on killing certain species; the designation of protected seasons and areas; limitations on the sizes of whale that may be killed and the methods and equipment that may be used.

Since the IWC implemented a commercial whaling moratorium in 1986, it has placed greater emphasis on the conservation of whales rather than on regulating their exploitation. For example, it has designated established 'sanctuaries' in the Southern and Indian Oceans. Today, a majority of the IWC members are more concerned with protecting and conserving whales (and small cetaceans) than promoting and defending an industry that previously decimated whale stocks and proved impossible to regulate.

Although not all members recognise the IWC's legal competence to address welfare issues in its regulation of whaling, the Commission has a long, and well-established, practice of advancing 'humane killing'[18] (see chapter 5). Any controversy about the IWC's welfare mandate was effectively resolved in 1980/1 when it banned the use of non-exploding harpoons, except in aboriginal hunts, on welfare grounds. Every year since then, welfare issues have been discussed by the Commission, its

scientific and technical committees, and its specialist Working Group and Workshop on Whale Killing Methods and Associated Welfare Issues.

Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)[19]
Complementary to the IWC, which regulates whaling, CITES regulates trade in cetaceans. CITES came into force in 1975 and currently has 163 Parties. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival. CITES has three appendices in which species are listed according to their level of endangerment and the threat of trade to them. CITES lists all 'great whale'[20] species and some freshwater and marine cetaceans in Appendix I, which affords the highest level of protection by prohibiting their international trade for commercial purposes. All other cetaceans are listed in Appendix II and may be traded internationally if the trade would not cause detriment to the survival of the species. Although much of CITES (including its resolutions) speaks in terms of conservation and sustainable trade, the preamble to the treaty recognises "*that wild fauna and flora in their many beautiful and varied forms are an irreplaceable part of the natural systems of the earth which must be protected for this and the generations to come*". Language in both the text of the Convention and several resolutions directly pertains to the welfare and humane treatment of live animals covered by the agreement.[21] In particular, animals must be transported humanely and CITES has adopted standards set by the International Air Transport Authority (IATA) for the transport by air of cetaceans. As a result, shipment by air of a live cetacean that does not comply with IATA's Live Animal Regulations violates the treaty and renders the export illegal.

CITES has adopted several resolutions that relate to whales which were consolidated in 2000 in Resolution 11.4 on Conservation of Cetaceans, Trade in Cetacean Specimens and the Relationship with the International Whaling Commission. This recognises the primacy of the IWC and seeks cooperation between the two organisations. The IWC has reciprocated with a series of Resolutions welcoming the continuing cooperation between CITES and the IWC on issues related to trade in whale products, and urging all governments to continue to support IWC and CITES obligations with respect to this issue[22].

The Convention on Migratory Species (CMS)[23]
The Convention on Migratory Species (CMS) (also known as the Bonn Convention) aims to conserve terrestrial, marine and avian migratory species throughout their range on a global scale. The treaty entered into force in 1983 and currently has 84 Parties. CMS lists species in appendices according to their biological status and need for protection, and directs special attention to endangered species, and to populations or species whose habitat is threatened.

Importantly, migration is defined by CMS as: "*the entire population or any geographically separate part of the population of any species or lower taxon of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries*"[24]. By 1985, CMS had agreed that migration included international waters (outside of national sovereignty) and that conservation and management plans should extend into international waters (CMS 1985).

For Appendix I species, CMS urges states into whose waters cetaceans range to remove obstacles to migration, prohibit takes, restore habitats, and control factors that threaten the species' survival[25]. Uniquely, its Appendix II lists migratory species that require, or would benefit significantly from,

international co-operative agreements[26]. By the 7th Conference of the Parties, 11 species or populations of cetaceans were listed in Appendix I and 39 in Appendix II.

CMS has been building its competency in the area of cetacean conservation since 1985 when it listed five great whales, and proposed the Indus River dolphin for listing in Appendix I, while recognising the need to include a number of other small cetacean species in the Appendices (CMS 1987). During the seventh Conference of the Parties (2002), three species of great whale were included in Appendix I and three more on Appendix II and a resolution was adopted indicating that the three in Appendix II should be revisited at the next Conference of the Parties (CMS 2002a). There was further discussion of complimentary competency with other agreements, noting that "*while IWC was striving to address limited hunting, and CITES addressed the trade in the species, it was the business of CMS to address the threats of habitat degradation and by-catch*" (CMS 2002b).

Regional agreements

Like CITES, some regional conservation agreements, like the Bern Convention, the SPAW Protocol, and CMS agreements, protect cetacean species through appendices which offer varying levels of protection from human activities and, in several cases, also protect species habitat.

The Bern Convention[27]

The Convention on the Conservation of European Wildlife and Natural Habitats came into force in 1982 and currently has 45 Parties. The Convention has a threefold objective: "*to conserve wild flora and fauna and their natural habitats; to promote co-operation between states and to give particular emphasis to endangered and vulnerable species, including endangered and vulnerable migratory species*".

Thirty cetacean species are listed in Appendix II, which requires Parties to take appropriate and necessary legislative and administrative measures to ensure their special protection, including the prohibition of all deliberate capture, keeping and killing, damage to, or destruction of, breeding or resting sites and disturbance. All other species are listed in Appendix III, which requires Parties to regulate exploitation in order to keep the populations out of danger.

The Specially Protected Areas and Wildlife Protocol (SPAW) to the Cartegena Convention

SPAW is a Protocol of the Convention for the Protection and Development of the Marine Environment of the wider Caribbean Region (the Cartagena Convention), which is a legally binding environmental treaty for the wider Caribbean that entered into force in April 2000 and currently has 11 parties. The objectives of the SPAW Protocol are to significantly increase the number of, and improve the management of, national protected areas and species in the region, and to develop specific regional as well as national management plans developed for endangered, threatened or vulnerable species. All cetaceans are included in Annex II of SPAW which requires each Party to ensure their "*total protection and recovery*" by prohibiting their taking, possession or killing, and by minimising disturbance[28].

Agreements under the Convention on Migratory Species, CMS[29]

Two agreements relating to cetaceans have been concluded under CMS: the Agreement on Conservation of Small Cetaceans of the Baltic and North Seas (ASCOBANS) and the Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area (ACCOBAMS).

ASCOBANS came into force in 1994. Forming part of this is a conservation and management plan which requires Parties to undertake habitat conservation and management, including by developing modifications to fishing gear and fishing practices in order to reduce cetacean by-catch and preventing other significant disturbance, especially of an acoustic nature.

ACCOBAMS came into force in 2001. ACCOBAMS goes even further than ASCOBANS, as it requires signatories to 'protect' dolphins, porpoises and other whales, and to establish specially protected areas for feeding, breeding and calving. It calls on its members to enforce legislation to prevent the deliberate taking of cetaceans in fisheries by vessels under their flag or within their jurisdiction, and to minimise incidental catches.

INTRODUCTION TO CUSTOMARY INTERNATIONAL LAW

The international legal obligations of states may be created in two ways: 1) through treaty, and 2) by customary international law. Both treaty and customary law are expressions of a state's consent to the creation of binding rules. Customary law is the result of a general consensus to create binding rules on all states (Villiger 1985). By contrast, a treaty is a meeting of wills of individual states that creates rights and obligations between them. Both forms of international law are recognised as equal in stature and effect (Kontou 1994). As a result, states may regulate their relations by employing either method; in other words, states can create international law by either treaty or custom, or by replacing an existing treaty rule by new customary law or vice versa.

It is generally accepted that treaties may codify customary law. On the other hand, rules originating in treaties may become so widely accepted by the international community that their provisions become customary law and may bind states, which are not now, nor ever intend to become members to the convention (for example, certain provisions of the Law of the Sea and the Vienna Convention on the Law of Treaties). Thus treaties and customary law are continuously defining and redefining each other. Customary international rules may be less obvious than convention rules; nonetheless, a large number and a wide variety of international legal requirements are generated by international custom rather than by treaty.

The fundamental idea behind the notion of custom as a source of international law is that states, in and by practice, may implicitly consent to the creation and application of international legal rules. Article 38 of the Statute of the International Court of Justice (ICJ) provisions states in part:

> "*The Court, whose function is to decide in accordance with international law such disputes as are submitted to it, shall apply: (a) international conventions, whether general or particular, establishing rules expressly recognized by the contesting States; (b) international custom, as evidence of a general practice accepted as law...*"

Evidence of customary international law

The sources of evidence demonstrating the application of custom are quite numerous and include: state legislation, diplomatic correspondence, policy statements, press releases, the opinions of official legal advisers, official manuals on legal questions, executive decisions and practices, comments by governments of drafts produced by the International Law Commission, internal and national judicial decisions, bi-lateral agreements, treaties, or UN resolutions. The value of these sources varies

and the type of source used depends on the situation. The International Law Commission itemised a non-exhaustive list of the classic forms of evidence of customary international law. This list includes: treaties, decisions of national and international courts, national legislation, diplomatic correspondence opinion of national legal scholars, and practice of international organizations.

The interplay between treaty law and international customary law

Treaty and international customary law exist side by side. Most legal scholars posit that treaty and international customary law are of legally equivalent weight, rather than hierarchical, in the sense that one source supersedes the other (Kontou 1994). Since treaty and customary law are of equal status legally, it is irrelevant whether a practice or a norm is clad in customary rule or in a treaty rule, since in either case, the rule of law is binding (Villiger 1985).

A treaty and an international custom can be complementary. Despite the widespread use of treaties, a treaty obligation is often more limited than a customary obligation. For instance, a treaty is binding only on those countries that are signatories (unless the treaty requirements have become customary law). Treaties are difficult to modify and often require consensus to change treaty language. Consensus in this case may be hampered by political considerations, or by substantive discord or disagreement by one or a small minority of countries[30]. Because of the cumbersome nature of treaty law, international law more often may be modified by custom than by treaty negotiation; in this sense, treaties are inevitably, inextricably, linked to the evolution of customary international law (Janis 1999).

The basic principle of treaty law, *pacta sunt servanda* (treaties are legally binding) is itself a rule drawn from the customary practice of states. Thus, the concept that a treaty is binding is itself legitimate only due to a customary international norm obligating state action. Moreover, treaties must often be interpreted in light of the rules of customary international law. Like statutes in a common law context, treaties often presume and rely upon pre-existing or subsequently established set of legal rules.

As a contemporary form of international law, international custom can modify or abrogate a treaty. Likewise, states can modify a customary rule by concluding a treaty. Moreover, a treaty that modified customary law can then be modified once more by customary international law and so on.[31]

A treaty, however wide its membership, cannot prevent the formation of new law. State practice may continue evolving outside the treaty in response to changing conditions or perceptions of interest, and new custom emerges as a result (Kontou 1994). This new custom may then either modify, reinterpret or even terminate an existing treaty. When a new customary rule has developed on the same subject matter as a pre-existing treaty rule, the latter will either be reinterpreted or modified. A treaty will be clarified or exemplified in light of the new international custom if the rules are analogous. However, a treaty will be modified if the emerging rules are not identical. Generally, modification of a treaty occurs when growing state consensus or practice reveals that the treaty rules are out of date or inappropriate. Changing structure or shifting values or principles of the international community can also inspire arguments for modification (Villiger 1985). In such circumstances, a new customary law overrides the original law, and the new law will be binding not only on the parties, but possibly non-parties as well.

The Treaty of the Panama Canal, enacted in 1903, is one such example of customary law modifying an existing treaty. Panama argued that the treaty was incompatible with new principles of customary international law and should be amended. Panama argued:

> *"The 1903 treaty was concluded at a time when colonies and the occupation of small countries by powerful ones was a common practice in the world, that is to say, by a treaty that doesn't conform to the principles, precepts and rules of law, justice and international morality which are universally accepted today...and should therefore be revised."*[32]

During the UN meetings there was general agreement that the revision of the 1903 Treaty was necessary in order to "*write off and cancel one of those historical mortgages and to do so by bringing to bear the entire body of ideas, principles and norms that the international community has evolved over the last decades.*"[33]

The implications of customary international law for whales

State practice and other soft law[34] has shown that notions of pure conservation without regard for the welfare of whales and other wildlife is becoming outmoded. Thus, the two most recent international wildlife agreements focus on protection to the same degree as conservation: The Inter-American Convention For The Protection and Conservation of Sea Turtles (IAC) and Agreement on the International Dolphin Conservation Program (AIDCP) both recognise the welfare of the species in question: The IAC focuses on the reduction, to the greatest extent practicable, of the incidental capture, retention, harm or mortality of sea turtles in the course of fishing activities. Likewise, the AIDCP requires certain protective measures in an effort to keep dolphins from being injured or killed during tuna fishing operations in the eastern Pacific Ocean.

The legal outlook for animal welfare appears to be on increasingly strong ground. Management of cetacean species has evolved from unrestrained consumption, to regulation for industry's sake, through an emerging conservation ethic, to the current protection that the great whales enjoy under the international moratorium on commercial whaling. Commentators argue that the next stage will be the entitlement of all cetaceans to a basic right to life, which could be realised when the moratorium imposed by the IWC in 1986 becomes permanent[35], is enforced and is extended to include small cetaceans.

While there is still debate around issues of species rights vs. individual rights and also moral vs. legal rights,[36] the energy directed towards the protection of animals in general, and cetaceans in particular, over the last 30 years has forced the beginnings of a legislative evolution both nationally, regionally and internationally. Far from being radical and extremist, this 'protection' sentiment is now reflected in numerous national policies and is regularly seen in statements by Parties to international meetings, as well as resolutions adopted by conservation agreements. For example, the IWC has adopted at least fifteen resolutions whose purpose is to improve the welfare of whales, and the most recent meeting of the World Parks Congress agreed that marine species require 'protection' and that their habitat needs 'conservation' through domestic and high seas protected area systems[37].

Conclusion

It is the contention of the authors of this chapter that the emerging international customary law of animal protection is well illustrated in the case of cetaceans. Future international agreements directly

or indirectly impacting animals are likely, therefore, to include measures protecting their welfare. Additionally, it is possible that existing conservation treaties that address cetaceans, such as the IWC and CITES, will be modified over time by this emerging customary law and amended to adopt greater protection measures.

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Footnotes

1 This call was endorsed by the United Nations General Assembly later that year.

2 As a result, their need for protection extends beyond national waters and requires cooperation between states, including on the high seas.

3 For example Keiko, the orca who, in response to public pressure, was released from a life in captivity in 2001.

4 Wildlife Interest Group, *Journal of Internal Wildlife Law & Policy.*

5 New Zealand adopted *The Marine Mammals Protection Act in 1978* which prohibits any killing, harming, injuring or harassment of cetaceans.

6 Legislation in Australia attributed a base level of rights to cetaceans in its *Whale Protection Act 1980*, followed by the *Environment Protection and Biodiversity Conservation Act 1999*. In Australia, permits to interact with cetaceans and other listed species are given only when there is assurance that the specified action will contribute significantly towards the conservation of the species, the interference is incidental to the action, and will not adversely impact on the animals. Under Australian legislation it is a punishable offence to recklessly kill, injure or to take a cetacean.

7 *The Marine Mammal Protection Act* was adopted by the US in 1972 to ameliorate the consequences of human impact on marine mammals. Its goal is to "*protect and promote the growth of marine mammal populations commensurate with sound policies of resource management and to maintain the health and stability of the marine ecosystem.*"[7]. Subject to certain exceptions, the MMPA prohibits the importation of marine mammals, and their products, into the US, and forbids the taking of marine mammals in US waters and by US citizens on the high seas. 'Take' is defined as any act "*to harass, hunt, capture, or kill, or attempt to harass, hunt, capture or kill any marine mammal*".

8 See, *Australia, Environment Protection And Biodiversity Conservation Act 1999* – SECT 229A-232. See Also *US, Marine Mammal Protection Act* and Brazil's *Act No.7.643 Prohibiting the Catching of Cetaceans (1987).*

9 For instance, whale sanctuaries have been established in Mexico, the United States, and Ireland, while the governments of Fiji, the Cook Islands, Australia, New Zealand, French Polynesia, New Caledonia, Niue, Papua New Guinea, Tonga, Samoa and Vanuatu have established a network of nationally declared, legislated and implemented whale sanctuaries in their EEZs for the effective conservation of whales in the South Pacific Ocean.

10 Article V of the ICRW permits the IWC, by a three-fourth's majority, to designated 'closed areas' in which whaling is not permitted. The IWC has declared 'sanctuaries' in the Southern Ocean and Indian Ocean. The 'Indian Ocean Sanctuary' was adopted by the IWC at its 31st meeting in 1979, initially for a period of ten years. It was renewed in 1989 for another ten years and indefinitely in 1992. It covers waters of the Northern Hemisphere from the coast of Africa – including the Red and Arabian seas and the Gulf of Oman – to 100°E; and the waters of the Southern Hemisphere from 20°E to 130°E.
'The Southern Ocean Sanctuary' was adopted by the IWC at its 46th Annual Meeting in 1994. This sanctuary will be reviewed at succeeding ten-year intervals. The IWC has recently considered proposals to establish two new sanctuaries in the South Atlantic and South Pacific.

11 The definition of a protected area adopted by IUCN is "*An area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means*". IUCN has further developed a system of categorisation for protected areas. See: IUCN, Guidelines for Protected Area Management Categories (CNPPA with the assistance of WCMC, IUCN, Gland, Switzerland and Cambridge, 1994). Summary at http://www.wcmc.org.uk/protected_areas/categories/eng/index.html

12 In old English law, the commons or common was a tract of ground shared by residents of a village, but belonging to no one. It was property held in common for the good of all its citizens. Likewise, whales belong to no one country, the idea of absolute sovereignty over migratory species is an idea whose time has passed. It is the obligation of all countries and its citizens to share in the protection and conservation of whales through international agreements and cooperation.

13 In addition to agreements specifically addressing whales there are numerous laws that indirectly benefit these

animals, such as the UN Declarations banning drift nets and conventions dealing with marine pollution.

14 http://www.un.org/Depts/los/index.htm

15 UNCLOS, Article 65, 120.

16 ibid

17 See www.iwcoffice.org

18 'Humane Killing' was first raised as an issue by the IWC in 1957 at its 9th annual meeting.

19 see www.cites.org

20 All 'baleen' species and the sperm whale. Appendix I also includes some endangered species of marine and freshwater dolphins, porpoises and small whales.

21 The welfare of Appendix I and II species that are traded internationally is covered under Articles II and lV respectively. Likewise, the text considers the welfare of species that are 'bred in captivity' for commercial purposes (Res. Conference 12:10) and considers the humane treatment of animals in rescue centres (Article Vlll.5).

22 IWC Resolutions 1994-7; 1995-6; 1996-3; 1997-2 and 1998-8,1999-6.

23 See www.wcmc.org.uk/cms/

24 CMS 1979, art I (1)(a).

25 CMS 1979, art III (4)(5).

26 CMS 1979, art IV and V.

27 http://www.nature.coe.int/english/cadres/bern.htm

28 Article 11.2

29 See www.wcmc.org.uk/cms/

30 For example, the ICRW.

31 The International Law Commission in 1964 unanimously adopted Draft Article 38, which directly addresses the issue of modification by customary law. The article uses the wording; inter alia, "*modification of a treaty by a subsequent practice or by customary law.*". The operation of a treaty may also be modified:
(a) by a subsequent treaty between the parties relating to the same subject matter...
(b) by subsequent practice of the parties in the application of the treaty establishing their agreement to an alteration...
(c) by the subsequent emergence of a new rule of customary law relating to matters dealt with in the treaty and binding upon all parties..."

32 17 UN GAOR (1962), Plenary Meeting.

33 17 UN GAOR (1962) Plenary Meeting, 235.

34 Soft Law has usually been defined as agreements on principles that are non-binding. Often these agreements are laid down in declarations, charters, and so forth that reflect ethical conceptions that have not yet found their way into law.

35 D'Amato & Chopra, 1991, supra note 63.

36 For a full account this argument see Frazier Nash R, *The Rights of Nature: A History of Environmental Ethics* (University of Wisconsin Press, Wisconsin, 1989) at prologue; Singer P, *Practical Ethics:* second edition (Cambridge University Press, Cambridge, 1993); The extent of any legal right clearly depends on what the

law says, but also the extent to which the authority enacts it. By enacting laws and making decisions based on the laws, authorities activity create these rights. The fact that those who have the claims – the plants or animals concerned – cannot assert, insist or even understand the claims does not in any way detract from the legitimacy of the attribute legal right. For a full discussion of this issue see Taylor P, *Respect for Nature: A Theory of Environmental Ethics* (Princeton University Press, Princeton, 1986); see also Prideaux M, Small Cetaceans and World Politics: developing regimes for species survival (Centre for International Studies, University of South Australia, 2003).

37 World Parks Congress, 2003, The Durban Accord and Recommendation 5.22 Building a Global System of Marine and Coastal Protected Area Networks and Recommendation 5.23 Protecting Marine Biodiversity and Ecosystem Processes Through Marine Protected Areas Beyond National Jurisdictions, Vth IUCN World Parks Congress, World Conservation Union and World Commission on Protected Areas, Durban South Africa.

Section Four

Conclusions

15 Whaling and welfare

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Welfare and the IWC

Animal welfare as a scientific discipline incorporates applied aspects of ethology, bioethics and the concepts of suffering and well-being. Welfare, including health, has many different aspects and is defined by both the physical and psychological state of an animal, including how it feels. The welfare state of an animal can be described as good or high if the individual is fit, healthy and free from suffering.

Animals may suffer due to disease, injury, fear, or the frustration of basic needs. A 'need' is defined as a requirement fundamental in the biology of the animal, to obtain a particular resource or respond to a particular environmental or bodily stimulus. If a need is not provided for, then there may be an effect on physiology or behaviour. One basic need is that an animal should not suffer at the time of death.

The International Whaling Commission (IWC) has been considering issues relating to the welfare of hunted whales since 1957. During the annual meeting of the IWC that year, humane killing of whales was defined as the process by which the animal is rendered instantaneously insensible until death supervenes. In 1958, UNCLOS (the United Nations Convention on the Law of the Sea) adopted a resolution requesting that all states use the best means available to capture and kill marine life, including whales, in order to spare them from suffering to the greatest extent possible (UNCLOS 1958). The first IWC working party on humane killing was convened in 1959, when time to death was identified as the main test of humaneness (see chapter 5).

Whaling on the high seas

Despite years of discussion of humane killing issues at the IWC, including the adoption of at least 15 resolutions addressing the welfare of hunted whales, progress has been slow. Today severe welfare problems remain for cetaceans that are hunted in commercial and Aboriginal Subsistence Whaling (ASW) activities. In cases where the impetus has existed to bring whaling activities into line with common expectations and national legislation for the slaughter of other animals for commercial purposes, reaching these standards has proved problematic. This is demonstrated by Norway's limited success in improving the instantaneous death rate (IDR) during its commercial hunt for minke whales.

Norway contributes more than any other nation to the development of both its own and other

nations' whale killing methods. However, despite Norway's efforts, the best IDR reported to date during Norwegian whaling operations is 80.7 per cent (reported for the 2002 hunt). Consequently some 19.3 per cent of whales killed during this hunt clearly did not die instantaneously; indeed one whale broke free and lived for 1.5 hours and the average time to death (TTD) was two minutes 21 seconds (Øen 2003). This IDR statistic of 80.7 per cent is the highest recorded for commercial whaling since the Commission was established.

TTD and IDR statistics should only be considered as 'best estimates', rather than reliable data with a calculable margin of error. The current criteria used for determining death in hunted cetaceans (see chapter 11) are considered by many experts to be inadequate (Butterworth *et al.* 2003, RSPCA 2003) and are likely to underestimate the time to death and may also result in inflated IDRs. This potential source of error is further compounded by the fact that the recording of 'instantaneous death' during whaling activities is likely, in reality, to equate to at least ten seconds (Kestin 1995) after harpoon strike. This is due to the time taken to assess the behaviour of the whale, according to the current criteria, following the harpoon strike. How long, for example, does one wait to assess immobility? Consequently, it is likely that the margin of error in the statistics presented to the IWC by all whaling nations is considerable. These data should, therefore, only be considered as best estimates and the actual times to death for many cetaceans may be significantly longer than current data indicate.

Norway's whaling efforts use the most sophisticated and 'efficient' methods that are currently available. However, Norway still fails to kill around 20 per cent of whales within ten seconds. This falls far short of international expectations for the slaughter of other animals for commercial purposes, where humane treatment is required, both before and during the slaughter process and where the emphasis is placed on ensuring that the animal is rendered immediately insensible, using a stunning procedure, in order to avoid pain and suffering (Gregory and Lowe 1999). Furthermore, even in cases where whales are recorded as killed 'instantaneously' (according to the IWC criteria), the evaluation of 'instantaneous death' may take at least ten seconds, during which time some animals may still have been alive. In Japan's hunts for minke whales in Antarctica, the figures are even less satisfactory. In the 2002/2003 JARPA hunt, for example, 59.8 per cent of whales killed were recorded as not dying 'instantaneously' (Ishikawa 2003).

Consider further that the main weapon used during both Norwegian and Japanese whaling operations is the penthrite grenade harpoon, a weapon specifically designed for killing minke whales. This weapon is also used to kill larger species, for which it has not been specifically adapted, such as Bryde's, sei and fin whales (Anon 2003). The same basic technology, with a slight increase in penthrite charge is also used by Japan for killing sperm whales (IWC 2003a). Sperm whales are not only much larger than minke whales, but also present a significantly different anatomy. This is likely to significantly influence the course of projectiles and energy delivered to the brain, and therefore, the efficiency of any killing method applied. In New Zealand, in recognition of the problems associated with the humane euthanasia of these very large animals, a specific device has been developed for euthanasing stranded sperm whales at close range (see chapter 10). To date, Japan has failed to report any data on the TTD or IDR from the sperm whale hunts that it recommenced in 2000.

The more 'traditional' killing methods used during Aboriginal Subsistence Whaling (ASW) are less efficient and therefore often fall short of even the relatively poor standards achieved during

commercial whaling. Times to death of over an hour are not uncommon (Table 3, chapter 6). ASW presents some of the most profound welfare concerns, yet the IWC has been slow to enforce even minimum welfare standards in these hunts. This, in part, may be due to the inherent conflicts with cultural aspects of the hunts that enforcement would entail. For example, the use of more modern equipment for chasing and slaughtering whales may conflict with the cultural integrity of these hunts. To avoid the abuse of this category of whaling it is vital that the IWC only considers ASW quotas for indigenous peoples with legitimate and traditional subsistence needs for whales. For example, in recent years, there have been attempts by whaling nations to blur the boundaries between some ASW and commercial hunts. For example, Japan argues that an exception should be made to the commercial whaling moratorium for special quotas to be allocated to whaling towns that have a tradition of small-scale coastal whaling. It can be argued that, in those ASW hunts where the use of more modern equipment is deployed, such as modern vessels and communication technology, that at the very least the killing methods should also be 'modern' to ensure that suffering is minimised. There are also significant inconsistencies in the manner in which individual ASW hunts are dealt with by the Commission, for example not all ASW hunts have a strike limit[1] (see chapter 6), a significant welfare consideration that relates to the potential for whales to be struck and lost.

Many thousands of small cetaceans are also hunted around the world on an annual basis. The methods used to kill these animals are varied, data on these kills are sparse, and these hunts are largely unregulated. As a result there are serious welfare implications for the species hunted and significant concern that the trade in small cetacean meat may help to maintain the market in cetacean products generally (see chapter 7). Debate continues within the Commission as to which cetaceans are within its competency. Whaling nations argue that there is no obligation to report data on small cetacean kills to the IWC. As a consequence, there is no 'centralised' oversight, evaluation or control of the killing methods used during most cetacean hunts and thousands of small cetaceans probably die at the hands of inexperienced hunters using substandard equipment or techniques. For example, Japan claims that the Baird's beaked whale, which is a large animal reaching 12.8 metres in length, is a small cetacean[2] that falls outside the competence of the IWC. Japan, therefore, declines to discuss the killing methods employed in these hunts, which are of particular concern in terms of welfare, not least because they may involve the use of the cold harpoon (see chapter 7). The Faroe Islands also kill pilot whales on an annual basis and opportunistically hunt the bottlenose whale (another large toothed whale[3]) and some dolphin species. The same killing methods and instruments are employed for bottlenose whales (and other cetaceans), as are used for pilot whales.

Assessment of killing and capture methods

The methods used to kill cetaceans for commercial or aboriginal subsistence purposes contrast sharply with the requirements, and widespread expectations, for the slaughter of domestic animals for food (see chapter 12). Furthermore, meticulous protocols have been developed for the efficient euthanasia of stranded cetaceans. The employment of 'best practice' is essential if the euthanasia of both stranded cetaceans and animals killed for commercial purposes is to be achieved with the avoidance of suffering. It is also not unreasonable to propose that such standards should also be applied to the slaughter of all cetaceans.

There is a considerable disparity between the accuracy implicit in the effective euthanasia of stranded cetaceans and the inferior methods used during whaling activities (see chapter 10). During all whaling activities the potential for accuracy is greatly hindered by the circumstances under which

these kills take place (see chapter 8). The significance of these variables and the inadequacies of the methods used result in the poor TTDs and IDRs that are commonly reported (see chapter 6).

The proximity of the vessel and the gunner to the whale is variable and is often far from optimal. The optimal distance for euthanasing a large cetacean, as demonstrated during the euthanasia of stranded cetaceans, is likely to be no more than an arm's length. During many whaling operations, the gunner must aim at a moving target, surrounded by a moving sea and from a moving platform (chapter 8).

There is also growing concern that the active pursuit of whales, may force the escaping cetacean to undertake a degree of exertion for which it is not evolutionarily adapted. This may induce what is referred to as 'exertional myopathy', which may manifest as lethal or sub-lethal disease or dysfunction. Thus, whales that are pursued, but avoid being struck and eventually evade capture, may suffer as a result of this pursuit. It is also possible that some may die as a result of induced exertional myopathy.

As a result, even if more efficient and more species-specific technology could be developed for killing cetaceans on the high seas, the fact that there may always be a percentage of whales that are either struck and lost, or that are pursued and lost without being struck, would remain a serious welfare problem.

Problems associated with the specific biology of whales

As described in chapter 4, cetaceans are unusual animals and their biology raises ethical as well as welfare concerns. We still know relatively little about many whale species. This lack of knowledge includes a poor understanding of where many populations begin and end, and even of basic cetacean biology and behaviour. Where knowledge is adequate, it is apparent that some species – for example, orcas, sperm whales and pilot whales – have highly developed social structures and there is a strong interdependence between individuals. Skills and specialisations can be seen to pass between generations and, these animals can be said to have cultures as well as societies. This means that the removal of individuals by hunting may have a significant impact on the wider population because their potential to pass on knowledge (as well as genetic diversity) is removed. Similarly, the removal of entire groups or populations may mean the removal of entire ways of life or cetacean cultures.

Because they are adapted to an exclusively marine way of life (cetaceans being the larger of only two orders of mammals that complete their lifecycles in the water), these animals also have a number of physiological and anatomical peculiarities that further compound welfare issues.

Determining when whales are dead

Perhaps the greatest concern relating to the welfare of hunted cetaceans is the fact that the current criteria used for determining death in cetaceans are inadequate (Butterworth *et al.* 2003) (see chapter 11). It is likely that whales suffer more prolonged deaths than the current data suggest, but until a scientifically proven means of determining death in cetaceans is established, individual whales may be declared dead while they are still alive. In some cases, it is possible they may even die while being winched aboard a processing vessel. It is also possible that an individual whale could be paralysed by the harpoon strike and may initiate a physiological dive response, in an attempt to escape this attack. Such an animal would then present as 'motionless' and not breathing (since it may be holding its

breath). Using the current criteria this whale could then be recorded as dead and be hauled on to the flensing deck whilst still alive.

The IWC criteria tend to be used in an exclusive fashion by whaling nations i.e. the presence or absence of a single measure is used, rather than the inclusive assessment of several criteria, as is common practice for assessing death in other species. Furthermore, Japan typically uses motionless as the main criteria for determining death, although this is not, in fact, one of the IWC criteria (chapter 11).

Many species of cetacean are adapted for extended dives (Anon 2003) (see chapter 4) and consequently harpoon strikes to the thoracic region (which might be considered lethal for terrestrial mammals due to the injury caused to the lung and heart tissue) may not have the same immediate effects for cetaceans, due to their capacity for functioning using tissue-stored oxygen reserves.

The 'special case' of special permit whaling

Japan continues to issue special permits for the killing of whales in scientific research programmes. However, there has never been unequivocal approval of any of these research proposals by the IWC's Scientific Committee. Furthermore, the Commission has expressed considerable concern through several resolutions on scientific whaling, including, most recently, a call on "*the government of Japan to halt the JARPA program, or to revise it so that it is limited to non-lethal research methodologies*"[4]. A critique of one such programme, the 'JARPN' programme, by a number of scientists from the Scientific Committee during the 2002 Annual Meeting (IWC 2002b) revealed that:

- there are no meaningful quantifiable measures by which to judge the research;
- lethal sampling is not essential to the research, as biopsy sampling could provide genetic and dietary information;
- Japan describes JARPN II as a "*multi-species modelling approach to whale management*"; yet no such approach has been agreed by the Commission.

Concern was further reflected in the statement submitted by 40 scientists from the Scientific Committee to the 55th Annual Meeting of the IWC in Berlin, in response to Iceland's proposal to initiate special permit whaling:

> *"The proponents have failed to supply adequate justification for the proposed sample sizes, and have offered no performance criteria for how the work's 'feasibility' will subsequently be determined*".

Also:

> "*We reiterate that the major objectives of the Icelandic proposal are either not relevant to the management of whales under the Revised Management Procedure (RMP), or that the subset of information which is relevant ... can be – and routinely are – obtained with far greater efficiency by well-established non-lethal methods".*

And:

> "*As members of the Scientific Committee, we are seriously concerned by what we see as the increasingly frequent abuse of Article VIII of the International Convention for the Regulation of Whaling by some member nations. This has important ramifications for the IWC and the work of the S.C. Member governments that promote poorly conceived research whaling programmes place their scientists in the untenable position of having to defend these proposals in order to support the agendas of their governments*" (IWC 2003b).

It is conceivable that during special permits whaling operations, aspects of the 'sampling' method render these hunts less humane that conventional commercial whaling. For example, special permits issued by Japan may allow the use, in certain circumstances, of the cold harpoon[5], the weapon that was banned for commercial whaling by the Commission over 20 years ago as a result of concern over the protracted times to death which result from its use. Furthermore, Japan has stated that the harpoon is aimed at the thoracic region of the whale during special permit whaling as this provides a larger target area than the head (IWC 1999). It may also be the case that the requirement for preserving the ear-plugs of whales taken during Japanese special permit whaling may influence this choice of targeting the harpoon at the thorax and only targeting the head with the rifle during secondary killing. In which case, this 'sampling' technique may have a negative impact on time to death.

It is now common practice within the scientific community for research involving animals to be subject to independent ethical review. It is also common that this ethical review process should seek, as a key aim, mechanisms for reducing the number of animals involved (chapter 13). Japan and Iceland have failed to submit their research to an ethical review process, and have not presented any mechanism for reducing the numbers of animals involved. In fact, the number of animals taken under special permit by Japan is increasing significantly. The expansion of the JARPN programme to include both more individual animals and a greater variety of species does not accord with the basic principles of 'Replacement', 'Reduction' and 'Refinement'.

Special permit whaling presents a unique case, since the products of this research are sold commercially and thus a degree of economic incentive is implicit. Japan has proved unwilling to subject the data from its special permit whaling operations to comprehensive peer review. It can be argued that the science of special permit whaling is fundamentally flawed due to the fact that commercial, political, social and cultural factors appear to significantly influence the experimental design of this research. The research priorities appear to pivot around justifications for the resumption of commercial whaling, rather than a desire to evaluate the many threats that cetacean species now face. This political drive has been most profoundly felt in Japan's 'Whales eat Fish' argument. In simple terms, Japan claims that whales need to be culled in order to reduce their impact on global fish stocks, ultimately to benefit human fishers. This is now a primary focus of much of the current research. However, many scientists specialising in ecosystems dispute the validity of Japan's claims, stating that the biggest single threat to the world's fish stocks is over-fishing by humans. Moreover, an IWC Modelling Workshop on Cetacean-Fisheries Interactions concluded that the current early state of development of computer models and the existing poor data quality mean that reliable management advice cannot be given on the impacts of cetaceans on fish, or visa versa, at this stage (IWC 2002a).

The future of whaling

There is currently no strict independent monitoring or regulation of whaling activities. There is also no independent verification of the data collected in relation to welfare. This significantly hinders robust scientific analysis of the various welfare aspects of whaling activities.

It is also possible that whaling may develop further outside of the auspices of the IWC (the only international body with the relevant mandate). NAMMCO[6] has been developed by the whaling nations in the North Atlantic as a management body (see chapter 7) and Japan has explored the

possibility of establishing a similar body in the Pacific. To some extent it may appear that the development of such bodies is a political ploy; a threat to the IWC if it does not develop in the direction that the whalers desire. The question then arises as to how such bodies would take welfare matters into account.

The face of whaling in the 21st Century is changing. There is already considerable ongoing whaling activity occurring outside of the IWC and significant attempts to blur the distinction between aboriginal and commercial hunts. New categories of whaling are evolving to fill the niche of conventional commercial whaling. One such category is special permit whaling (see chapter 13). It is also feared that a change in Japanese law to permit the commercial sale of whales caught in nets may provide an incentive for fishermen (who have neither the training, nor the equipment), to kill rather than release 'bycaught cetaceans'. The consumption of whales caught in nets is permitted in other countries conducting whaling (see chapter 6). Other technological changes may include the use of noise to drive the animals[7].

The products of bycaught whales and whales taken under special permit are sold commercially in Japan, helping to stimulate the market for cetacean meat. This further promotes the market in cetacean products, which is also filled by small cetacean hunts and further fuels the desire to trade cetacean products internationally.

Welfare potential of whaling operations

A killing method that is truly painless and causes minimum distress to the animal can be classified as 'humane slaughter' and, therefore, a process with the potential for high welfare. From the analysis in chapter 12, it is clear that there are a number of factors inherent in current whale killing methods that mitigate against the potential for high welfare. These include the initial pursuit, and the difficulties involved in hitting a distant, largely submerged, moving target from a moving platform at sea. The killing methods themselves are often not well adapted for the species taken, or the variability of size between individuals of the same species. The significance of these variables and the inadequacies of the methods used are reflected in the poor instantaneous death rates, and average times to death, and the need for secondary killing methods during all types of whaling operation.

In summary, when assessing the welfare potential of whale killing methods using accepted principles of humane slaughter, it is clear that current whaling operations have a low welfare potential, and are likely to cause pain and suffering in many hunted cetaceans.

Other mammal hunts

Whaling is sometimes compared to other mammal hunts and proponents of commercial whaling may even suggest that whaling compares favourably with such other hunts. Comparisons of this nature are highly contentious, inappropriate and outside of the scope of this book. However, two things are noted: First, most whaling is unlike the majority of other mammal hunting because it is a government-sanctioned and financially supported activity. Therefore, governments can be expected to shoulder the responsibility for the associated welfare concerns.

Second, a culture of change can be identified in the hunting of some other mammals, whereby best management practices (BMPs) are being adopted with the intent of giving attention to animal welfare, safety for huntsmen, the public and other wild animals. These BMPs demonstrate that

methods can be improved where there is a will and where the situation allows for this. If improvements cannot be adequately demonstrated, then clearly it remains legitimate to stop hunting activity in the particular area in question. Public views about the treatment of animals are subject to change over time. In some cases, society may conclude that the steps, which can be taken to improve techniques for killing animals, are not likely to create methods that could ever be described as best practice. Harpooning as a method for catching and killing cetaceans is not likely to be susceptible to radical improvements in effectiveness. It seems likely, therefore, that society worldwide will identify this practice as unacceptable, and move toward its prevention by robust global agreement.

Conclusion

The enforcement of any regulation of welfare standards during the slaughter of cetaceans on the high seas is likely to be problematic, particularly without independent inspection and review. However, it might be possible to instigate measures, which could, to a certain extent, improve the efficiency of current whaling operations. Such measures could include:

- operating closed seasons;
- ensuring independent data collection;
- ensuring weapons are sufficiently powerful to cause immediate loss of consciousness or death and are specifically adapted for the species taken;
- enforcing struck and lost caps for all hunts;
- limiting the pursuit time for individual animals; and
- improving methods for determining the onset of death and irreversible insensibility.

However, such measures are unlikely to overcome completely the serious animal welfare problems inherent in whaling or bring whaling up to the standards of humane slaughter required for other species killed commercially for food. These measures could only represent absolute minimum requirements during a phase-out period. Mitigation measures could also include a mechanism for qualitatively assessing whaling in terms of injury caused, including assessing behavioural changes during pursuit, capture and slaughter, and providing an assessment of potential suffering, rather than focussing exclusively on TTD.

Until improved criteria for determining death in cetaceans are developed, data on TTD and IDR are not likely to be credible and should not be considered as scientifically reliable, but rather as approximations, which may significantly underestimate the suffering incurred for some individual animals. Time to death further, provides no means of determining the extent of injury caused.

This review of the scientific and practical evidence on whaling and welfare reveals that whaling methods have inherent severe welfare problems. The low welfare potential of whaling is greatly influenced by the many variables involved in all whaling operations. These include; gunner accuracy, power of the primary and secondary weapons used, prevailing weather conditions, proximity and orientation of the vessel to the whale, species specific factors (i.e. how well the weapon used has been adapted for the characteristics of the species taken) and individual characteristics of the cetacean, such as age, sex, and health, which all influence both the pursuit and the slaughter.

Many cetacean species are migratory, or occur across international boundaries. Therefore, no single government may claim to have absolute sovereignty over these migratory or transient species. There are robust legal precedents for the protection of cetaceans under domestic legislation, emerging

international customary law and existing international and regional treaties (see chapter 14). Treaties and customary law do not function independently, but act to define each other and experts agree that both have equal legal capacity. The 'protection' for cetacean species now intrinsic to many legal agreements, often extends beyond a conservation mandate to encompass measures for addressing the welfare of cetaceans, by also protecting them from injury or harassment. Conservationists now recognise that consideration of welfare aspects can often be fundamental to effective conservation programmes. It is also possible to interpret some aspects of existing treaties as providing cetaceans with a unique degree of protection, which also encompasses both moral and ethical considerations[8]. Experts also consider that in the future it is likely that emerging customary law will further enhance the welfare aspects of such international agreements. In view of the inherently poor welfare potential of whaling there is a strong argument that the international community should embrace these emerging standards by ceasing all whaling activities.

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Footnotes

1 The 'strike limit' is the total number of whales that may be 'struck' with a harpoon, or other weapon, in a hunt.

2 By contrast, the minke whale, Japan's primary target species, only reaches a maximum length of 10.7m.

3 Male bottlenose whales can reach 9.8m in length and their weight can be more than twice that of a pilot whale.

4 Resolution on Southern Hemisphere Minke Whales and Special Permit Whaling. IWC/55/28. Resolution adopted during IWC/55, 2003.

5 "*The cold grenade harpoon shall not be used unless it is permitted by the Director-General of the Fisheries Agency as necessary for the implementation of research and unless it is used as the second harpoon in order to shorten the time to death of the whale which was struck by an explosive grenade harpoon*". (Item 5, Special Permit No. 14-SUIKAN-1299, April 2003.)

6 North Atlantic Marine Mammal Commission.

7 For example in October 2003, during a drive hunt for dolphins in Taiji, Japan, witnesses reported that sound was used to panic the dolphins so that they could more easily be corralled (WSPA 2003).

8 For example Article 65, United Nations Convention on the Law of the Sea.

16 Summary of conclusions

Modern day whaling activities give rise to serious animal welfare concerns. Is it likely, therefore, that humane standards could ever be achieved during whaling operations? The evidence presented in this review strongly suggests that this is improbable.

- The adaptations of cetaceans to the marine environment may have significant implications for their welfare during whaling operations. Adaptations for diving may make it difficult to determine when these animals are dead.

- The current IWC criteria for determining death in cetaceans are inadequate.

- In many cases, current killing methods are not adequately adapted for the species being killed. Differences between species may greatly increase the margin for error in killing methods and may influence the time to death (TTD) and associated suffering.

- The common use of secondary killing methods, such as the rifle, during whaling operations reflects the inefficiency of primary killing methods. There are currently no specific criteria for determining when a secondary killing method should be applied.

- There are significant differences in the efficiency reported from different hunts and even the best statistics indicate that at least 20 per cent of whales killed for commercial purposes do no die instantaneously. Furthermore, in a practical whaling situation, 'instantaneously' is likely to equate to at least 10 seconds after the harpoon strike.

- Recent data show that, for commercial and scientific whale hunts, the average estimated time to death is over two minutes.

- Aboriginal Subsistence Whaling (ASW) presents some of the gravest welfare concerns, yet the Commission has been slow to address these issues. Times to death in ASW hunts of over an hour are not uncommon.

- Struck and lost whales represent a significant welfare problem. Struck and lost cetaceans may suffer significantly in both the short- and long-term as a result of exhaustion and their injuries.

- Whalers attempting to achieve a fatal shot, either with a harpoon or rifle, often must do so at considerable range, and need to overcome poor visibility, rough sea states and vessel motion. The accuracy of the gunner (or marksmanship) will also impact on the ability to kill a cetacean swiftly.

- The exertion imposed on whales during pursuit may fall outside the species' adaptive range. Pursuit during whaling activities has the potential to induce stress, which may manifest as a series of lethal and sub-lethal pathologies. The effects of pursuit may also be significant for cetaceans that are struck and eventually killed as well as for those that evade capture.

- The complex social behaviour of cetaceans may mean that the killing of one animal from a social group may have a significant effect on others. Consideration should be given to the impact of whaling operations on the welfare of remaining individuals in the social groups targeted, and the possible long-term effects on the culture of populations.

- When assessing the welfare potential of whale killing methods using accepted principles of humane slaughter, it is clear that current whaling operations have a low welfare potential, and are likely to cause severe pain and suffering in the hunted animal.

- It is appropriate that an ethical review process should be established under the auspices of the IWC, to review the large-scale lethal whaling programmes currently being conducted under special permit.

- International customary law and existing international treaties, recognise the need to protect cetacean species. Such protection encompasses some welfare issues by protecting these species from injury or harassment. It can be argued that some of these agreements also afford cetacean species a degree of moral or ethical consideration. However, the ICRW, through its Commission (IWC) currently fails to adequately regulate the welfare aspects of whaling operations.

Overall conclusion

Modern day whaling activities give rise to serious animal welfare concerns. A number of factors inherent in current whaling practices render it unlikely that truly humane standards could ever be achieved. On grounds of animal welfare alone, therefore, all whaling operations should be halted.

Glossary

ACCOBAMS	Agreement on the Conservation of Cetaceans of the Black Sea, Mediterranean Sea and Contiguous Atlantic Area (Regional agreement under CMS)
ASCOBANS	Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas (Regional agreement under CMS)
ASW	Aboriginal Subsistence Whaling
Black powder	Explosive used in the grenade tip of the explosive harpoon (prior to the development of the penthrite grenade harpoon).
Bycatch	Takes of cetaceans in fishing nets, either incidental or directed.
Cetacea	Order of wholly aquatic marine mammals including whales, dolphins and porpoises. Also referred to as 'cetaceans'.
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMS	The Convention on Migratory Species
Cold harpoon	Also described as a non-explosive harpoon (i.e. with no grenade tip).
Commercial whaling	In this review commercial whaling is the term used to refer to all whaling activities that are conducted for the purpose of commercial gain.
Electric lance	Method used for applying electricity to cetaceans.
Exertional Myopathy (EM)	Syndrome resulting from pursuit related stress.
Humane Killing	Defined by the 1980 Workshop on Humane Killing as causing death without pain, stress or distress perceptible to the animal.
IATA	International Air Transport Association
ICRW	International Convention for the Regulation of Whaling (1946)
IDR	Instantaneous death rate
IUCN	The World Conservation Union
IWC	International Whaling Commission
JARPA	Japan's Special Permit Whaling operation in Antarctica.
JARPN	Japan's Special Permit Whaling operation in the North Pacific.
Lose	To either 'strike' or 'take' but not to land.
Morbidity	The state of being diseased or the incidence of clinical cases of a disease within a given population.
Mysticeti	The 'filter feeding' whales, which use baleen plates hanging from the roofs of their mouths to filter small prey species from mouthfuls of ocean water. Includes species such as; minke, sei, fin, bowhead and Bryde's whales.
Odontoceti	The toothed cetaceans including all dolphins, porpoises, orca, sperm whales, beaked whales, narwhal and beluga.
Penthrite	Explosive used in the grenade of the penthrite grenade harpoon.
SLR	Struck and lost rate
Special permit whaling	Whaling activities conducted under 'special permit' issued by the contracting government, also referred to as 'scientific whaling'.
Strike (struck)	The ICRW defines 'strike' as to 'penetrate with a weapon used for whaling'.
Take	The ICRW defines 'take' as to 'flag, buoy or make fast to a whale catcher' – in this review 'take' is also used to refer to the killing of small cetaceans.
TTD	Time to death
UN	United Nations
UNCLOS	United Nations Convention on the Law of the Sea
UNEP	United Nations Environment Programme
WKM	Whale Killing Methods

Appendix I

Global coalition members

This report has been produced on behalf of a global coalition of animal welfare societies, which includes:

All Life in a Viable Environment, *Japan*

Alternativa Para La Liberacion Animal, *Spain*

American Humane Association, *USA*

American Society for the Prevention Of Cruelty To Animals, *USA*

Amigos dos Gatos do Algarve, *Portugal*

Anglican Society for the Welfare of Animals, *United Kingdom*

Animal & Bird Welfare Society, *India*

Animal Defence League of Canada, *Canada*

Animal Health Trust, *United Kingdom*

Animal Refuge Kansai, *Japan*

Animal Welfare Association Rescue Education, *Guatemala*

Animal Welfare Society of Lesvos, *Greece*

Animalia – Federation for the Protection of Animals, *Finland*

Animals Angels, *Germany*

Antigua And Barbuda Humane Society, *Antigua*

APRAM, *Spain*

Asociacion Audaluza para la Defence de los Animales, *Spain*

Asociacion Cubana Para La Proteccion De Animales Y Plantas, *Cuba*

Asociacion Defensora De Animales, *Colombia*

Asociacion Proteccion y Defensa del Animal, *Argentina*

Associacao de Amparo aos Animais, *Brazil*

Associacao de Proteccao de Animais Abandonados Quintinha des Animais, *Portugal*

Associated Humane Societies of New Jersey, *USA*

Association of Humane Societies NJ, *Spain*

Association pour la Protection de Animaux Au Senegal, *Senegal*

Auckland SPCA, *New Zealand*

Azerbaijan Society for the Protection of Animals, *Azerbaijan Republic*

Bahrain SPCA, *Bahrain*

Bellerive Animal Welfare, *Switzerland*

Bombay SPCA, *India*

Born Free Foundation, *United Kingdom*

Campaign Whale, *United Kingdom*

Care For The Wild International, *United Kingdom*

Centre For The Ethical Treatment of Animals, *Russia*

Chaine Blue Mondaile – Blauwe Wereldketen, *Belgium*

Compassion in World Farming, *United Kingdom*

Compassion Unlimited Plus Action, *India*

Costa Blanca Feral Cat Trust, *United Kingdom*

Cretan Animal Welfare Group, *Greece*

Defence Social Fund for Animals, *Russia*

Defense Protection des Animaux Refuge De Thiernay, *France*

Deutscher Tierschutzbund EU, *Germany*

Drustvo Prijatelja Zivotinja Pancevo, *Serbia and Montenegro*

Drustvo Za Zastitu Zivotinja Rijeka, *Croatia*

Dyrebeskyttelsen Norge, *Norway*

Dyrenes Beskyttelse, *Denmark*

Dyrenes Venner, *Denmark*

Dzivnieku Draugs, *Latvia*

Ekaterinburg Public Society for the Protection of Animals Rights, *Russia*

Environmental Investigation Agency, *United Kingdom*

Equine Protection and Management Research Project, *Japan*

Farm Animal Welfare Network, *United Kingdom*

Fethiye Friends of Animals Association, *Turkey*

Fondation Brigitte Bardot, *France*

Fondation Ligue Francaise des Droits de L'Animal, *France*

Foreningarna Djurens Vanners Riksorganisation, *Sweden*

Friends of Animals, *Greece*

Friends of Dogs, *India*

Friends of the Cat, *Greece*

Friends of the Cyprus Donkey, *Cyprus*

GAIA, *Belgium*

Global Action in the Interests of Animals, *Belgium*

Hellenic Animal Welfare Society, *Greece*

Help in Suffering, *India*

Helsinki Humane Society, *Finland*

Hong Kong SPCA, *Hong Kong*

Hope for the Stricken Society, *Uganda*

Humane Society International, *USA*

Humane Society of the United States, *USA*

Hungarian Society for the Protection of Animals and Nature, *Hungary*

International Association Against Painful Experiments on Animals, *United Kingdom*

Irish Society for the Prevention of Cruelty to Animals, *Ireland*

Istanbul Hayvan Sevenier Dernegi, *Turkey*

Japan Animal Welfare Society, *United Kingdom*

Jeevashram Foundation, India

Karuna Animal Welfare Association of Karnataka, *India*

Kenya SPCA, *Kenya*

Kyrenia Animal Rescue, *Cyprus*

League Against Cruel Sports, *United Kingdom*

Lega Pro Animale, *Italy*

Liga de Protection Al Caballo – League for the Protection of Horses, *Chile*

Liga Portuguesa Dos Direitos Do Animal, *Portugal*

Louisiana SPCA, *USA*

Massachusetts SPCA, *USA*

Nadace na ochranu zvirat, *Czech Republic*

National Canine Defence League, *United Kingdom*

National Council SPCA, *South Africa*

National Zoonoses and Food Hygiene Research Centre, *Nepal*

Nederlandse Vereniging Tot Bescherming van Dieren, *Netherlands*

NOAH – Federation of Israel's Animal Welfare Groups, *Israel*

Ontario SPCA, *Canada*

Organizacija za Postovanje i Brigu o Zivotinjama Fakulteta Veterinarske Medicine, *Serbia and Montenegro*

Palawan Animal Welfare Association, *Philippines*

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Schweizer Tierschutz, *Switzerland*

Scottish SPCA, *United Kingdom*

Serbian Animal Protection Society, *Serbia and Montenegro*

Shree Akhil Bharatiya Hinsa Nivaransangh Institute of the Protection of Dumb Animals, *India*

Sociedad Protectora de Animales y Plantas de Granada, *Gibraltar*

Sociedad Protectora de Animals del Peru, *Peru*

Society for the Prevention of Cruelty to Animals, *Bosnia-Herzegovinia*

Society for the Protection of Animals Abroad, *United Kingdom*

Society for the Protection of Stray Animals, *Greece*

Society for the Support of Animal Shelters of the University of Patras, *Greece*

Sophia-Vereeniging tot Bescherming van Dieren, *Netherlands*

SPCA, *Namibia*

Suomen Elainsuojeluyhdistys, *Finland*

Svenska Djurskyddsforeningen, *Sweden*

Sveriges Djurskyddsforeningars Riksforbund, *Sweden*

Svoboda Zvirat, *Czech Republic*

Swaziland Animal Welfare Society, *Swaziland*

Thai Animal Guardians Association, *Thailand*

The Association for the Welfare of Dogs Nicosia Dog Shelter, *Cyprus*

The Cat Welfare Society of Israel, *Israel*

The Tramps Fund, *Gibraltar*

Towarzysto Op Nad Zwierzetami Zarzad Glowny Head Office, *Poland*

Towarzystwo Pogotowie dia Zwierzat, *Poland*

Trinidad and Tobago SPCA, *Trinidad & Tobago*

Ukrainian Society for the Protection of Animals, *Ukraine*

Ulster SPCA, *United Kingdom*

Unione Antivivisezionista Italiana, *Italy*

Vegetarier Bund Deutschlands, *Germany*

Visakha SPCA, *India*

Voice4Animals, *Korea*

Whale and Dolphin Conservation Society, *United Kingdom*

White Cross Animal Protection Society, *Hungary*

Wild Animal Rescue Foundation, *Thailand*

Wildlife on Lesvos, *Greece*

World Society for the Protection of Animals, *International*

Appendix II

Colour plates

Taken during a Japanese whaling expedition in the Southern Ocean, Antarctica, 1993.

Figure 1. Catcher ship.

Figure 2. Sea state and weather conditions are likely to significantly impact on the efficiency of whale killing. Here, the sea surface is starting to freeze as 'pancake ice'.

Figure 3. This deck-mounted cannon fires a harpoon tipped with an explosive grenade.

Figure 4 Whaler taking aim on board catcher ship.

Figure 5. Since the dorsal fin of this minke whale is clearly visible, it is likely that the harpoon would strike the last third of the whale's body, some distance from the vital organs.

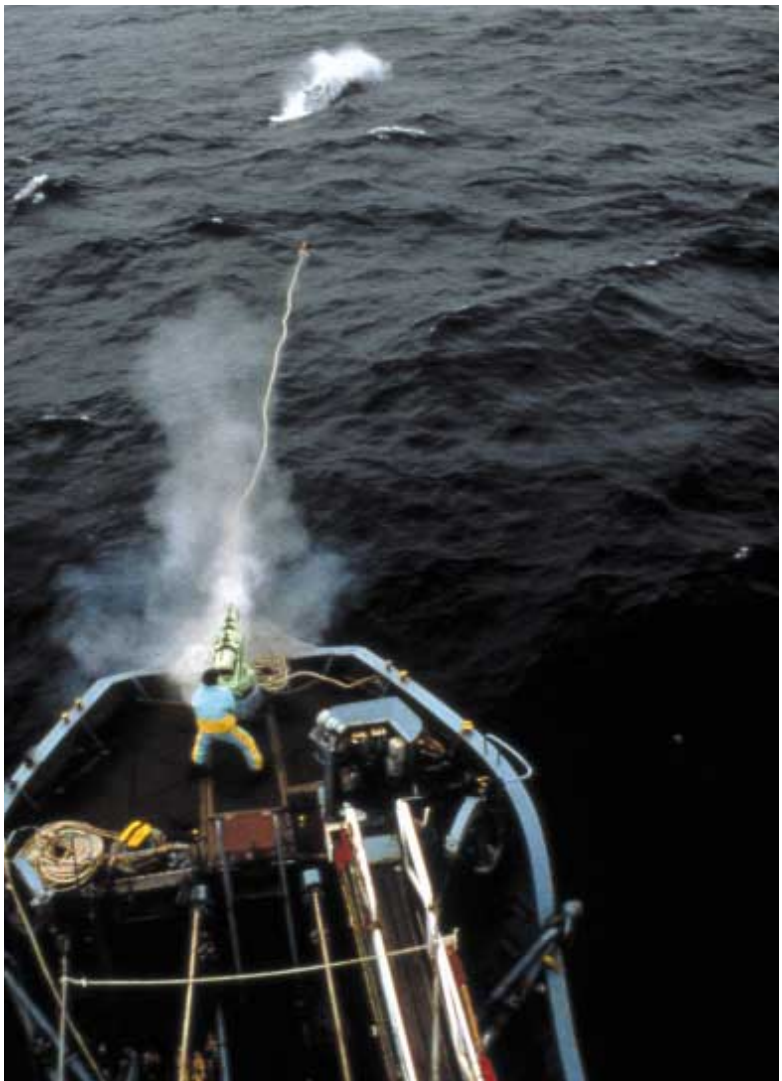


Figure 6. Harpoon in flight towards minke whale.

Figure 7. Minke whale being tied to the side of the catcher ship, prior to delivery to factory ship.

Figure 8. Minke whale being winched onto ramp of factory ship.

Figure 9. Tissue samples being taken from minke whale.

Figure 10. Minke whales on flensing deck of factory ship, showing the 'production line' aspect of special permit whaling operations.

Figure 11. Minke whale being measured prior to flensing.

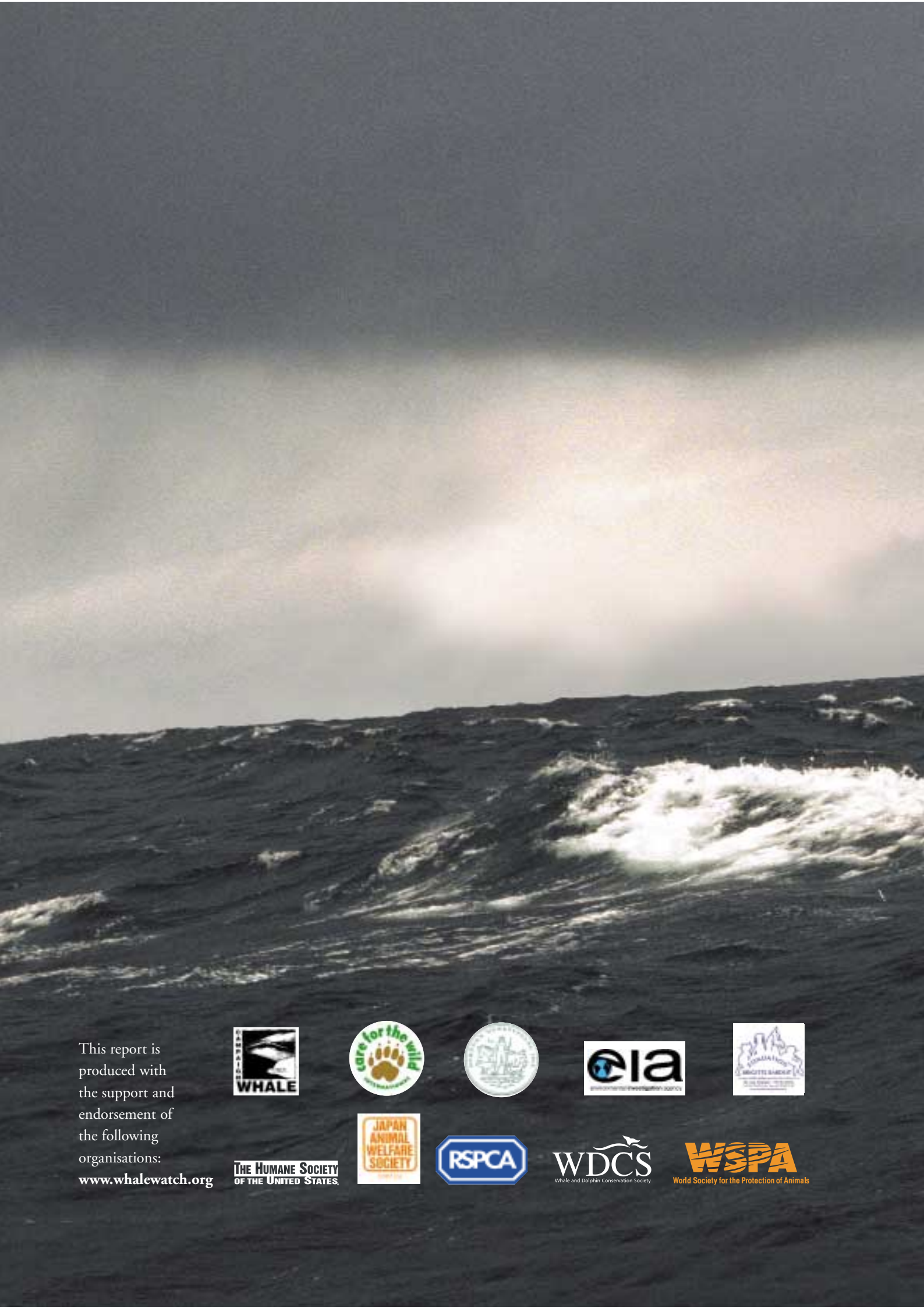
Figure 12. Measuring minke whale foetus (special permit whaling does not select out pregnant or lactating females).

Figure 13. Processing minke whales on the flensing deck of factory ship.

Figure 14. Close-up of figure 13.

Figure 15. Minke whale being flensed on board factory ship.

Figure 16. Whalers with large chunks of whale meat on the flensing deck.



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THE HUMANE SOCIETY OF THE UNITED STATES

WDCS
Whale and Dolphin Conservation Society

WSPA
World Society for the Protection of Animals