Chapter 6
Welfare Issues Associated with Small Toothed Whale Hunts: An Example, the 'Drive Hunt' in Taiji, Japan

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Abstract In this chapter, we discuss in detail an example of a small toothed whale hunt, with the aim of illustrating the methods used and the welfare questions that can arise in these cetacean hunts. Annually in Japanese waters, small cetaceans are killed in drive hunts with quotas set by the government of Japan. The Taiji Fishing Cooperative in Japan has published the details of a new killing method utilized in these specific hunts that involves cutting (transecting) the spinal cord. Reports claim that this method reduces the time to death. The method involves the repeated insertion of a metal rod followed by the plugging of the wound to prevent blood loss into the water. This method does not appear to lead to an immediate death. The method employed causes damage to the vertebral blood vessels and the vascular rete from insertion of the rod and leads to significant haemorrhage, but this damage alone would not produce a rapid death in a large mammal of this type. The method induces paraplegia (paralysis of the body) and death through trauma and gradual blood loss. We discuss in this chapter how this killing method compares to the recognized requirement for 'immediate insensibility' adopted in killing procedures utilized or considered acceptable in slaughter of farmed animals.

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6.1 Introduction

It is estimated that each year within Japanese waters up to 22,000 small whales, dolphins and porpoises (known collectively as ‘small cetaceans’) are killed in hunts that involve a range of techniques. Most of these small cetaceans are killed in a directed hunt for Dall’s porpoises (*Phocoenoides dalli*), but others are taken in a particular category of hunt known as ‘drive hunts’ or the drive fishery (Kasuya 2007; National Research Institute of Far Seas Fisheries 2009). Drive hunts also take place in other parts of the world, for example, the *grindadráp* (*Grind*) hunt of the long-finned pilot whales (*Globicephala melas*) in the Faroe Islands (Fig. 6.1). The main species taken in the Japanese drive hunts include common bottlenose dolphins (*Tursiops truncatus*), striped dolphins (*Stenella coeruleoalba*), Risso’s dolphins (*Grampus griseus*) or short-finned pilot whales (*Globicephala macrorhynchus*). These animals are herded at sea—using small fishing vessels, with underwater noise (this is referred to as the Oikomi method) (Brownell et al. 2008; Ohsumi 1972)—and driven into harbours or shallow coves which have been netted off. Here they are sometimes held for days and then killed (Fig. 6.2).

The Government of Japan sets yearly quotas that allow for up to 2000 dolphins and small whales to be killed in the drive hunts (Kasuya 2007). These hunts are conducted for several reasons: as a means of ‘pest control’ resulting from the perception that dolphins compete with local fisheries (Brownell et al. 2008; Morisette et al. 2012), to obtain meat for local human consumption, and to procure live

Fig. 6.1 Slaughtered animals on the beach after the *grindadráp* (Grind) hunt of long-finned pilot whales (*Globicephala melas*) in the Faroe Islands. *Image credit*: Hans Peter Roth

Fig. 6.2 Japanese drive hunt. Dolphins, herded at sea using small fishing vessels, with underwater noise, are driven into harbours or shallow coves which have been netted off where they are sometimes held for days, and then either selected for captivity or killed. *Image credits*: Hans Peter Roth

Fig. 6.2 (continued)

dolphins for marine parks and swim-with-the-dolphin programmes in Japan and internationally. After the captured dolphins are rounded up and some selected for marine parks, the remaining individuals are then killed, or occasionally, released (Vail and Risch 2006).

In 2000, fishermen began using a new killing method which Iwasaki and Kai (2010) report as an improved and more humane method of killing. Until the introduction of this new method, the primary tools used for killing were knives and spears, targeted at various parts of the dolphin or whale body. According to data published on the website of the Taiji Fishing Cooperative (Iwasaki and Kai 2010), this revised killing method—which is intended to sever the spinal cord at the junction between the occiput and first cervical vertebra—was tested from December 2000 to February 2001. When the hunt was carried out in 2008, the technique was applied comprehensively to the killing of striped dolphins, and from December 2009 a wooden wedge was driven into the wound to control bleeding and to prevent blood from 'polluting' the water (Iwasaki and Kai 2010).

The drive hunts have drawn a great deal of professional and public interest and concern internationally, particularly in relation to the killing methods used (Hemmi 2011; Reiss 2010). Similar killing methods developed over the past 10 years have also been utilized within the Faroe Island pilot whale drive hunts (Faroese Ministry of Foreign Affairs, Uttanrikisradid 2011) known as the *grindadrap* (or grinds), and these developments in hunting and killing methods have informed the methods utilized in the Japanese dolphin drive hunts (Iwasaki and Kai 2010). The following are excerpts from an English translation of Iwasaki and Kai's original *Improved Method of Killing Dolphins in the Drive Fishery in Taiji, Wakayama Prefecture* (Iwasaki and Kai 2010):

> Purpose: In the 'drive hunt' (Oikomi) in Taiji, dolphins were killed using a spear-type instrument (the conventional method, see below) and were harvested for food. However, in the Faroe Islands, methods to cut around the blood vessel plexus and cervical spine have been developed [the spinal transaction method: (Olsen 1999)]. This method results in a shorter harvest time, and is thought to improve worker safety. We report the results of the implementation of this method.
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> From December 2000 to February 2001, the spinal cord cutting method was applied to nine Risso's dolphins, four striped dolphins, and two spotted dolphins and one pilot whale. Harvest times were recorded, using the conventional method of killing for a striped dolphin as a control. The criterion for the time of death was the termination of movement and breathing as observed by the worker (fisherman). In December 2008, the technique was applied comprehensively to the killing of striped dolphins. In December 2009, control of bleeding was attempted by driving a wooden wedge into the wound.

In their results section, Iwasaki and Kai (2010) stated that 'The spinal transection method reduced the time to death'. Iwasaki and Kai (2010) also presented images showing the use of the rod and 'the control of bleeding by using the wedge'. They describe the appropriate cutting location as follows:

> Taking the width of a fist to be approximately 10cm, and based on photographs of the events, the appropriate cutting guide was considered to be behind the blowhole by one fist width for striped and spotted dolphins (10cm), one and a half fist widths for Risso's dolphins (15cm), and 2 fist widths for the larger pilot whale (20cm).

Iwasaki and Kai (2010) also report that other methods are employed in the killing:

> Placing a vinyl sheet over the rocks facilitated the transport of the striped dolphins to the killing area and also the full application of the spinal transaction technique. In addition, by driving a wedge into the cut, bleeding was controlled. Exsanguination occurred 10 to 30 minutes later at the time of gutting, and this did not affect the quality of the meat (for consumption).

Iwasaki and Kai (2010) concluded:

> Harvest time was shortened, improving worker safety. Bleeding was controlled by the wedge, and this opens up the possibility of commercial utilization of the blood and prevents pollution of the sea with blood. The individual who developed the spinal cord transection technique has pointed out that prevention of bleeding and internal retention of blood using the wedge risks prolongation of the time to death. An additional review to compare time to death with the Faroe Islands is required.

Based on this minimal data, Iwasaki and Kai (2010) claimed that the new method was more humane. This claim was based on a shorter time to death (TTD) recorded in four species where the spinal transection technique was utilized, compared to only one instance where the conventional spear method of killing was used on a striped dolphin. TTD is defined by Iwasaki and Kai (2010) as 'the termination of movement and breathing'.

6.2 Analysis of Video of the Small Toothed Whale Hunt

In analysis of the methods used to kill toothed whales in the Taiji hunt, Butterworth et al. (2013) analysed videotape footage of a striped dolphin (*Stenella coeruleoalba*) hunt conducted in Taiji, Japan, in January 2011. The hunting events visible in the video footage were documented, tabulated and timed using the time base available on the video material. These authors compared their observations and analysis to the data and assessment reported in Iwasaki and Kai (2010).

The results of the behavioural analysis of the video documentation of the killing method presented by Butterworth et al. are reproduced in Table 6.1. Still images derived from the video material were used to overlay outlines of cetacean anatomical structures in relation to the use of the rod and wooden plug (Figs. 6.3 and 6.4). Using external landmarks (rostrum, mouth, eye, blow hole dorsal and pectoral fins), it was possible for these authors to locate with some accuracy the path and track of the insertion of the rod (Fig. 6.3). The rod appeared to enter the skin in the midline of the animal and about 10 cm caudal (behind) to the blowhole. The ease with which the rod penetrates the tissues on the first 'push' suggested that it passed only through soft tissues at this time. The soft tissues in this location—immediately caudal to the skull—would be the skin, blubber, musculature of the dorsum and the suspension of the skull, some of these tissues being associated with the cervical vertebrae and with the attachments of the very large and powerful (swimming) muscles of the dorsal

Table 6.1 Video analysis of the timing of events during a dolphin drive hunt using the new killing device and procedure

Video timecode (s)	Duration (s)	Event	Comment
—	Prolonged (video does not capture start and end of this event)	Dolphins are secured by their tail fluke and dragged by boat	These animals are unable to swim effectively and so are being repeatedly pushed under the water by the action of dragging and by pressure of other animals tied up with them. The inability to control the timing of breathing (and enforced submersion) is causing profound distress and restricted escape movements in these animals. Some will be experiencing aspects of 'forced asphyxiation' due to their inability to reach the surface to breathe
02:37	Start	Dolphin 1—first forceful insertion of metal rod	The rod pushes into tissues rapidly. It appears unlikely that this first 'push' penetrates the bone. Severing the spinal cord at the first attempt (as claimed in the description of the method) is not achieved at this first insertion
02:40–02:44	3–7	Animal moves strongly and operative redirects and re-forces the rod at multiple angles repeatedly pushing it into the animal	The animal responds strongly to the first insertion of the rod, and the operatives have to hold the animal whilst the operative with the rod redirects the rod and repeatedly pushes it into the animal
02:44–02:48	7–11	The rod appears to hit hard (bony) obstruction, and the operative pushes the rod at different angles but does not achieve deep insertion of the rod	At this point, it appears likely that the rod makes first contact with the vertebral bones of the cervical (neck) vertebrae. The rod clearly requires very significant force to push further into the tissues at this time. At the end of a period of pushing, it is possible that the cervical vertebrae have now been damaged sufficiently to allow the spinal cord to also be damaged by the rod
02:50	13	Insertion of the wooden peg	The rod is withdrawn and a wooden peg inserted. This is intended to 'reduce pollution of the sea' with blood. If 'rapid bleed out' (as is required in animals slaughtered and killed in a slaughterhouse) is part of the killing process, then blocking the bleed out passage may slow down bleed out and prolong the time to death

(continued)

Table 6.1 (continued)

Video timecode (s)	Duration (s)	Event	Comment
03:17	40	Animal with wooden peg in puncture site visible	The animal is stationary at this time, but the wooden peg is clearly visible
03:48	71	Small vertical head movements	The animal starts to make regular rhythmic vertical head movements
04:10	93	Animal stationary	The animal stops moving
04:30	113	Slow rotational movements of the body seen	The animal now makes slow regular rotational movements
04:33	116	Vertical head movements	The animal makes regular rhythmic vertical head movements
04:39	122	Vertical head tremor	The head movements become rapid and repetitive
05:07	150	Major body movements start	The entire body now makes large-scale regular repetitive movements
05:24	167	Major body movements continue with thrashing fluke causing splashing	The repetitive movements now include the whole body and the tail fluke, and this thrashing throws up considerable spray. Because this spray is interfering with the operative (who is now using the rod on another animal)—another operative puts a rope around the thrashing animal's tail fluke. Both operatives are not showing attention to the movements of the animal other than to remove it from the 'work area'
05:25	168	Operative secures thrashing fluke and drags animal away from other operative	The powerfully moving animal is dragged out of the 'work area'—but its tail fluke movement brings it back towards the operative who is using the rod on another animal[a]
05:29	172	Vigorous thrashing of the flukes	
06:02	205	Animal motionless	The animal now becomes motionless
06:36	239	Mouth visible and making small regular and co-ordinated opening and closing movements	Regular small movements of the mouth are visible[a]
06:51	254 (4 min 14 s)	Opening and closing movements of mouth continue—end of available video material	Regular small movements of the mouth are visible[a]

Table with permission originally from Butterworth et al. (2013)

[a]If the stated criteria for establishing time to death (termination of movement and breathing) are applied, then this animal has not yet achieved death

Fig. 6.3 Dolphin skeletal and soft tissue and point of insertion of the metal rod. This image shows the overlay of skeletal and soft tissues on a striped dolphin (*Stenella coeruleoalba*). This overlay shows the relationship between the skeletal and soft tissues compared with the external anatomical features (eye, mouth, blow hole, dorsal fin and pectoral fin) and with the course and positioning of the metal rod. Image with permission originally from Butterworth et al. (2013)

Fig. 6.4 The use of the wooden plug in the killing process. This image shows the use of the wooden plug inserted in the wound after the metal rod is removed. This is done to prevent the blood from escaping the body. This technique will actually most probably prolong time to death. Image with permission originally from Butterworth et al. (2013)

region including the *longissimus* and *multifidus* muscles (Rommel and Lowenstein 2001). The authors report that in his region, immediately caudal to the skull are located portions of the *rete mirabile*—a specific adaptation of the vascular system of marine mammals which appears to function to buffer pressure (and perhaps pH and oxygenation levels) in blood circulation to the brain (Lin et al. 1998; Melnikov 1986; Nagel et al. 1968). Damage to the vertebral blood vessels and the vascular rete would probably lead to significant haemorrhage, but this alone would not be capable of producing a rapid death in a large mammal (American Veterinary Medical Association 2013; Anil et al. 1995; Daly et al. 1988). In the case of the use of the rod, after the operative has used the rod to cause tissue damage, a wooden peg was seen to be inserted into the hole created by the rod (see Fig. 6.4). The bony structures in the area which are likely to be penetrated by the rod during this procedure would be the spinous neural dorsal (upward pointing) processes of the cervical vertebra and the bony bodies of the first and second cervical vertebrae (C1, C2). Cetaceans have well-developed neural processes on their vertebrae as attachments for the powerful epaxial muscles that form part of the swimming musculature. The cervical vertebrae join the skull with a bony junction at the occipital bone via the occipital condyle (the joint with the vertebrae), and in this area the spinal nerves and spinal cord emerge from the skull and enter the spinal canal. The spinal cord is well protected within the bony bodies of the cervical vertebrae and runs in a bony tunnel with the dorsal and lateral processes of the vertebrae protecting it on the upper (dorsal) side and the vertebral body protecting it on the lower (ventral) surface. To penetrate the spinal canal, the rod would have to accurately enter the space between vertebrae (which provide overlapping bony protections) or to damage the cervical vertebral bone sufficiently to allow spinal cord severance. Either of these processes, if carried out with a rod after passage through muscle and other tissues, is unlikely to be applied with a high degree of precision. It appears from the video analysis reported by Butterworth et al. (2013) that the approach was seen to be to push the rod hard and repeatedly into the tissues and that eventually this would result in very significant damage and trauma and lead (eventually, but not immediately) to the death of the animal.

6.3 Item by Item Welfare Analysis of This Small Toothed Whale Hunt

The results of the analysis of the killing methods utilized in the Taiji dolphin drive hunt were reported by Butterworth et al. (2013) to be in sharp contrast and contradictory to the descriptions and conclusions presented in Iwasaki and Kai (2010). The following points are raised by Butterworth et al. (2013) to indicate their significant concerns with this killing method:

1. After being driven into a restricted area and confined, the animals are sometimes tethered to boats by their tail flukes and pulled to the killing area (Fig. 6.1, last image). The video shows animals that are unable to swim effectively and

that are being repeatedly pushed under the water by the action of dragging and by pressure of other animals tied up alongside. The inability to control the timing of breathing (due to forced submersion) may cause distress, and escape movements are evident in these animals. It is likely that some dolphins will be experiencing aspects of 'forced asphyxiation' due to their inability to control whether they are at the surface or forced underwater. Dolphins do have the capacity to breath-hold during planned diving activity and have specific physiological adaptations (storage of oxygen in blood and muscle, bradycardia (heart slowing) and redistribution of oxygenated blood within organs to conserve the use of oxygen) (Williams et al. 1999). However, with repeated forced shallow immersion (each submersion of unknown duration and not in the control of the animal), it is unlikely that the dolphins would initiate (or be able to initiate) true deep diving responses, and so it is surmised that treatment of this type (dragging and forced submersion) is likely to be very aversive. The video material available does not allow calculation of the duration of submersion, but it is clear from the behavioural responses that the animals resist this procedure and that some are already unconscious with their heads submerged or already dead (assumed drowned or suffocated by the process). This type of treatment would not be tolerated or accepted for commercially farmed animals being prepared for slaughter in the USA or Europe.

2. The dolphins are positioned in close proximity to each other during the killing process, and struggling and whistling (which is audible on the video material despite its remote filming origins) occur throughout the process. Dolphins are highly social mammals (Connor 2007) that show advanced cognition including self-awareness as demonstrated by their capacity for mirror self-recognition (Reiss and Marino 2001). They undergo a prolonged process involving not only the herding offshore but confinement, holding and eventual corralling to the shoreline, followed by killing in close proximity to conspecifics and other members of their social and family groups. The entire process can last many hours. The American Veterinary Medical Association recommendations state 'Euthanasia should be carried out in a manner that avoids animal distress. In some cases, vocalization and release of pheromones occur during induction of unconsciousness. For that reason, other animals should not be present when euthanasia is performed' (American Veterinary Medical Association 2013). 'The regulations and guidelines governing the humane treatment and slaughter of animals in the USA and the UK 'prohibit the killing of an animal in the presence of other animals' (Humane Slaughter Act 2003; The Welfare of Animals (Slaughter or Killing) Regulations 1995). From a scientific, humane and ethical perspective, the treatment of dolphins in the drive hunts sharply contradicts current animal welfare standards employed in most modern and technologically advanced societies.
3. The use of 'termination of movement' (Iwasaki and Kai 2010) as the determinant time of death in an animal with a transected spinal cord is not a credible measure of death for a mammal. Immobility (termination of movement) will be the natural final consequence of severance of the spinal cord; however, in any

mammal (including humans), severing the spinal cord does not immediately lead to death, and this is apparent in the continued life of many human and animal patients following spinal injury. Evaluation of death when livestock are slaughtered is based on the cessation of central neurological function and respiratory activity or that the animal has been effectively exsanguinated (bled out) (American Veterinary Medical Association 2013; Commission of the European Communities COM 2006; FAO Animal Production and Health 2004; Humane Slaughter Association 2001).

4. Termination of breathing (Iwasaki and Kai 2010) is not (in the short term and certainly in the periods described in the translation above) an appropriate indicator of death in marine mammals, which have enormous capacity for breath-holding (Joulia et al. 2009), with dives of up to 40 min recorded in some of the dolphin species (Miller et al. 2006; Noren and Williams 2000; Snyder 1983; Kooyman et al. 1999). The striped dolphin does not usually breath-hold for periods of longer than 15 min, and Iwasaki and Kai (2010) claim that death can be assessed after breathing has stopped for as short a period as 5 (Risso's dolphin), 8 (spotted dolphin) or 25 (pilot whale) seconds. These periods (times of up to 25 s) are well within the 'breath-holding' capacity of many mammals and a very short breath-hold for a marine mammal.
5. The sample size for the 'control' animal (one striped dolphin) described in the paper proposing the method (Iwasaki and Kai 2010) is unlikely to be sufficient to draw any meaningful conclusions, particularly in light of the availability of a large number of animals to study for these authors.
6. The method describes the times taken for an animal to die (as defined using termination of movement and breathing) to be as short a period as 5 (Risso's dolphin), 8 (spotted dolphin) or 25 (pilot whale) seconds—with average times of 13.7 (Risso's dolphin), 9 (spotted dolphin) or 25 (pilot whale) seconds. The data derived from the analysis of a striped dolphin killed using the rod (Table 6.1) indicates that the animal was still moving after 254 s (4 min 14 s). The disparity between the published results (Iwasaki and Kai 2010) and those from this observation based assessment is considerable and calls into question the confidence that can be attributed to the data provided in the Iwasaki and Kai (2010) report.
7. Damage to the vertebral blood vessel and the vascular rete from insertion of the rod will lead to significant haemorrhage, but this alone would not produce a rapid death in a large mammal. After the operative has used the rod to cause tissue damage, a wooden peg is inserted into the hole created by the rod (Iwasaki and Kai 2010). It is likely that this would impede bleeding and so it is also possible that this process prolongs the time for the animal to die (Katsura et al. 1994). This risk is acknowledged by Iwasaki and Kai (2010) who state—'The person who developed the spinal cord transection technique has pointed out that prevention of bleeding and internal retention of blood using the wedge risks prolongation of the time to death'. This calls into question the contention that this new killing method results in reduced TTD.
8. Analysis of the video evidence suggests that the operator must make repeated 'pushes' of the rod into the tissues close to the back of the skull. The video

shows the animal making vigorous movements during the insertion of the rod and subsequently making powerful muscular movements at times after the rod has been withdrawn. This evidence strongly suggests that the method is immediately invasive and distressing and does not bring about immediate insensibility, as the brain itself remains unaffected. Complete and rapid (immediate) cord transection could result in destruction of sensory (pain) pathways, but what is observed in the animals studied is neither immediate nor appears to induce effective and assured cord transection, and so there can be no assurance that pain elimination is achieved. After a period of violent insertion of a rod into sensitive tissues, the animal becomes paraplegic (paralysis of the body) and dies through trauma and gradual blood loss. This method of killing does not conform to the recognized requirement for 'immediate insensibility' and would not be tolerated or permitted in any regulated slaughterhouse process in the developed world (American Veterinary Medical Association 2013; Commission of the European Communities COM 2006; Food and Agriculture Organization Animal Production and Health 2004; Humane Slaughter Association 2001).

9. Rapid exsanguination is usually required after stunning for either humane slaughter or euthanasia. The method described in this paper is not designed primarily for bleed out—in fact, the use of the wooden plug will, to a degree, reduce the capacity for bleeding from damaged blood vessels. This method appears to be primarily focused on causing gross neural tissue damage to the spinal cord and potentially the brainstem. This will cause, initially, immobilization and eventually death due to lack of co-ordination of respiratory and motor function. The method described does not conform to any recognized mechanism for bringing about death in accepted humane slaughter or euthanasia practice in large mammals.
10. The results presented in this paper provide strong evidence that the claims regarding the improved killing method described in Iwasaki and Kai (2010) are not substantiated. Also, this killing method cannot be considered humane as it does not fulfil the recognized requirement for immediacy and in fact may result in a prolonged aversive application of a violent and traumatic physical process followed by slow death by spinal paralysis and blood loss. This method would not be recognized or approved as a humane or acceptable method of killing for mammals in any setting.

6.4 Discussion of the Video Analysis Findings

Because the hunts are extremely controversial and hidden beneath tarpaulins that are pulled over the shoreline of the killing cove, independent video footage documenting the killing method can only be obtained through remote surveillance from public spaces. New tarpaulins and other visual obstacles had been constructed during the 2011 hunting season, further limiting access to viewing points around the killing cove. The video independently documenting the killing method used for this analysis was procured from an investigative journalist representing Atlantic Blue, a German organization. The authors were provided with two clear video accounts of the killing method being utilized in December 2009 and January 2011. Because the video footage from January 2011 was of higher quality and represents the most 'current' methods in use, it was utilized for this analysis. The absolute paucity of this kind of material makes multiple analyses impossible, and so this analysis focuses on one good quality video example where the entire process from instigation to apparent end point is visible in a continuous frame without obstruction. The authors are not familiar with any other wildlife hunts that are specifically shielded from view in this manner.

As Iwasaki and Kai (2010) reference the development and testing of this method since 2000, the authors of the Butterworth et al. (2013) paper state that they are confident that the video sample is representative of current methods being utilized in the dolphin 'drive hunts' in Taiji. Additionally, from the available video material, the paper describes how it is apparent that the same process is applied to many animals (not all observed throughout the whole process in the video material), and this analysis is representative of the approach being used on many animals. The range of social attitudes towards the killing of wild species around the world raises a number of important ethical questions. These authors go on to consider that suffering is 'undesirable, and that humans should do all that is practical to ensure that suffering is minimized at the time of death for domesticated animals which humans farm, use or consume'. They then go on to consider that 'it appears logical and consistent to also acknowledge that suffering should also be avoided for wild mammalian species' (Commission of the European Communities COM 2006; Mellor and Littin 2004). The challenges presented in achieving the same standards for killing wild animals as exist for domesticated animals have, unfortunately, led to a systematic dilution or reduction in the standards permitted for the killing of wild species.

There are precedents for applying scientific knowledge and concern for animal welfare to policy decisions regarding commercial fishing and hunting practices. In the mid-1980s, increased scientific and public concern in the USA about the welfare of dolphins caught as by-catch during tuna purse seine fishing operations led to US senate subcommittee hearings and the ultimate decision to ban the use of purse seine procedures in the eastern tropical Pacific. Studies were conducted as part of a larger research programme mandated under the 1997 International Dolphin Conservation Program Act (IDCPA) that investigated whether the eastern tropical Pacific tuna fishery was having a significant adverse impact on these dolphin stocks, known collectively as the Chase Encirclement Stress Studies (CHESS). Stress-response protein profiles and various other health parameters in offshore spotted and spinner dolphins revealed acute stress response in chased and captured dolphins, including heart lesions and other tissue damages (Forney et al. 2002). Legislative policy changes are reflected in the Marine Mammal Protection Act (MMPA) and entitled the Dolphin Protection Consumer Information Act and International Dolphin Conservation Program Act (IDCPA), recognizing the desire of congress, the public and corporate interests to incorporate dolphin protection and welfare into practice through regulations addressing the tuna fishery and product labelling standards (US Marine Mammal Protection Act 1972). Policy changes included a ban on the use of purse seine fishing in the eastern tropical Pacific and protected dolphins from being encircled by fishing boats, trapped in the purse seine nets and crushed in the fishing gear. Policy changes occurred at the corporate level in the tuna industry and offered the consumer the right to know about the fishing practices used in this commercial fishery.

Another precedent for such policy changes occurred in the UK in the case of the well-established cultural practice of hunting red deer (*Cervus elaphus*) with hounds. Increased scientific and public concern for the welfare of red deer during the prolonged hunts prompted a study to be commissioned by the National Trust to assess the physiological effects of the hunts on the deer (Bateson and Bradshaw 1997). The physiological state of hunted vs. non-hunted but humanely killed red deer was compared and the results showed '(i) depletion of carbohydrate resources for powering muscles, (ii) disruption of muscle tissue, and (iii) elevated secretion of endorphin. High concentrations of cortisol, typically associated with extreme physiological and psychological stress, were found. Damage to red blood cells occurred early in the hunts'. The authors concluded that 'red deer are not well-adapted by their evolutionary or individual history to cope with the level of activity imposed on them when hunted with hounds'. These scientific findings led to the banning of this type of hunting practice in the UK (The Hunting Act 2004).

Animals used for commercial purposes have been afforded the status of sentient beings under the Treaty of Amsterdam, amending the Treaty of the European Union (The Treaty of Amsterdam 1997). Therefore, there exists a moral and legislative obligation to exercise a high standard of care for animals under the control of humans. It would seem appropriate that those animals that fall under human control during systematic hunts at the time of their death be treated following the accepted international principles described by the Treaty. As humans determine when and where these animals die, there is an ethical obligation, as well as a practical opportunity, to control the method of death to minimize pain or suffering (Mellor and Littin 2004). Based on available scales for pain, including both the National Institutes of Health and British Pain Society numeric scales, this method would register as extremely aversive—at the highest level of gross trauma, pain and distress (National Institute of Health Pain Consortium 2007; The British Pain Society 2017).

Within Japan, domesticated animals are afforded protection under the Act on Welfare and Management of Animals, where guidelines to minimize pain and suffering are outlined for species such as horses, cattle, sheep, pigs, dogs and other animals under human care (Japan Ministry of the Environment 2007). Dolphins and whales are not protected by this law, nor are they afforded protection under the Wildlife Protection and Hunting Law which manages the keeping and custody of wild mammals in Japan and outlines procedures for the protection, management and hunting of wild mammals in Japan through the oversight of the Ministry of Environment. Instead, dolphins and whales fall under the jurisdiction of the Fisheries Agency under the Department of Agriculture, which affords them little protection. This is in marked contrast to the protection for dolphins and whales in legislation in other parts of the world such as New Zealand and the USA. The US Marine Mammal

Protection Act (MMPA) of 1972 affords full protection from the ‘taking’ or deliberate killing of marine mammals, except under certain conditions for scientific research, enhancement for survival or recovery and public display (MMPA 1972). In New Zealand, intentional or deliberate killing of marine mammals, notably within commercial fisheries, is prohibited, and similar provisions are provided by the Marine Mammal Protection Act (New Zealand Legislation Marine Mammal Protection Act 1978).

In contrast, and looking to other whale and dolphin hunts in Japan for comparison, Japan conducts ‘special permit whaling’ hunts for five species of large whales in the North Pacific and minke and fin whales in the Southern Ocean. These hunts occur in open water, at sea, and the killing methods are applied from a vessel. The proximity between the whale or dolphin and the hunter during drive hunts contrasts significantly with open sea whaling. During drive hunts, killing occurs when the hunter and the animal are next to each other on the stable ground of the shore. In contrast, whaling occurs at a distance, with the whale swimming in a moving sea and the hunter aims at the target from a moving platform. The killing methods also differ significantly, due in part to the difference in size of the animals (large baleen whales, rather than dolphins or smaller toothed whales).

The primary killing method used during Japanese whaling is a penthrite grenade harpoon that is aimed at the thorax. The objective is to cause sufficient blast-induced neurotrauma to render the whale ‘instantaneously’ insensible or dead (Knudsen and Øen 2003). Data show that for the Japanese hunt for minke whales (the smallest species killed during Japanese special permit whaling) in the Southern Ocean during the 2003–2005 seasons, 44% of harpooned minke whales (N = 880) were reported to have died ‘instantaneously’ (Ishikawa 2005). In some cases where whales do not die ‘instantaneously’, a secondary killing method is applied. Depending on the species, this may either be another grenade harpoon or a rifle. The rifle is aimed at the head, whilst the whale is still attached to the harpoon line at the front of the vessel. Since the meat procured from these activities is sold for commercial purposes, it is legitimate to compare both special permit hunting and drive hunts with the standards required for other commercial meat production, such as those provided by the World Organization for Animal Health (OIE) recommendations for the slaughter of animals for food (OIE Terrestrial Animal Health Code 2011). Whilst the OIE recommendations are focussed on the slaughter in slaughterhouses of various domesticated terrestrial species, it is not unreasonable to extend the principles such that mammals slaughtered outside slaughterhouses should be managed in such a manner that their restraint and slaughter should avoid causing undue stress.

What is particularly unusual about these drive hunts is the proximity of the hunter to the animal that they are killing, which provides an opportunity for a swift death with potentially less margin for error than hunting at sea. For example, euthanasia of injured or moribund dolphins stranded on the beach is usually conducted by a veterinarian or a trained individual with a rifle at very close range. Best practice for cetaceans in extremis has been developed in order to administer the swiftest and most humane death. However, the authors do not recommend the use of rifles for killing cetaceans captured during these hunts, for a number of reasons. Firstly, whilst rifles are a recommended euthanasia procedure for stranded cetaceans in some stranding protocols, the RSPCA guidelines for veterinarians attending stranded cetaceans (RSPCA 1997) do not recognize rifle shooting as the preferred method. Instead, these guidelines only recommend the use of rifles for toothed cetaceans up to 4 m in length if euthanasia drugs are unavailable. Secondly, there are many differences between an individual 'mercy killing' associated with euthanasia of a stranded cetacean and the frequent and consecutive commercial killing of dolphins on the shore. The use of rifles as a humane euthanasia method for stranded cetaceans is only recommended on the basis that the operator, usually a veterinarian, using the rifle is well trained in such procedures, and that the outcome is documented. Such caveats to the use of rifles could theoretically be applied to the use of rifles during a drive hunt, but it is in the authors' view that it is highly unlikely that even with a highly skilled operator administering the shot, there would be a humane outcome for each dolphin.

Unlike a stranded dolphin that is shot because it cannot be refloated, dolphins caught in drive hunts are not moribund, but instead are usually conscious, panicked and moving, thus increasing the likelihood of error in bullet placement to the brain. In addition, during the dolphin drive hunts, the footage shows that some of the animals are secured by their tailstock. This is a particularly aversive practice due to the risk of the dolphins drowning as a result of forcing the head and blowhole under the water. In this respect, there exist no useful comparisons with other terrestrial mammal drives or hunts. In addition, since a primary sense in these highly social mammals is hearing, the impact of hearing other cetaceans—and specifically members of their social group—being killed has the potential to further compound the negative effects of this hunting method.

The process of spinal transection carried out in a fully conscious large animal is likely to be profoundly distressing, traumatic and painful and to create unnecessary suffering and distress. The AVMA Guidelines on Euthanasia (AVMA 2007) suggest that cervical dislocation can be considered a potential method for euthanasia of rabbits weighing no more than 1 kg and in other small mammals of less than 200 g. The dolphins observed in this study weigh in the region of 200 kg and would not be considered suitable candidates for cervical dislocation under any laboratory or zoo veterinary guidelines. Additionally, the use of the puntilla (a knife designed to sever the spinal cord) is not permitted in slaughter processes in developed countries (Tidswell et al. 1987).

Pain is most often attributed to a physical condition, whereas discussions of suffering require consideration of the psychological and emotional capacity of the animals being slaughtered. Japan's own slaughter guidelines for livestock, which do not apply to the drive hunts and other whale and dolphin killing methods used around Japan's coastline, require the inducement of loss of consciousness and 'methods that are scientifically proven to minimize, as much as possible, any agony to the animal' (Japan Ministry of the Environment 2007). These guidelines also define 'agony' as pain and suffering due to the excitement of the central nervous system by stimulating pain, fear, anxiety or depression, all arguably elements of suffering in higher vertebrates. The systematic mistreatment of dolphins and whales, allowed and sanctioned by a highly developed country such as Japan, is in striking contrast to EU, the USA and even existing Japanese legislation which aims to protect the welfare and ensure the humane treatment of farm, domestic and laboratory animals.

6.5 Conclusions

In conclusion, despite profound differences in their body form, dolphins, like our closest relatives the great apes, are sentient, highly social mammals that exhibit complex cognitive abilities (Herman 2006), possess self-awareness as demonstrated by their ability for mirror self-recognition (Reiss and Marino 2001) and demonstrate epimeletic (helping and caregiving) behaviours (Connor and Norris 1982). Japanese scientists have been international leaders in great ape research, and their scientific knowledge has been used to provide the rationale to increase protection of the great apes. In 2006, Japan placed an unofficial ban on invasive chimpanzee research.

Our scientific knowledge of dolphins could and should result in similar protections against the suffering and distress resulting from this current method utilized in drive hunts. Existing scientific knowledge and understanding of cetacean anatomy, physiology, social behaviour and cognition should inform local and global animal welfare policies on the treatment of these species. There thus appears no logical reason to accept a killing method that is clearly not carried out in accordance with fundamental and globally adopted principles on the commercial utilization, care and treatment of animals.

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