Euthanasia of beached humpback whales using explosives

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ABSTRACT

A method for the safe and effective euthanasia of large beached humpback whales using explosives is described. Five recent case studies involving live stranded humpback whales measuring 9.1–12.7m are described to show how the method was applied, and the capacity of the method to deal with the varying conditions encountered when dealing with large baleen whales. Issues relating to the wider application of this method to other species of baleen whale and large odontocete species are discussed along with key safety implications for the safe use of this method.

KEYWORDS: HUMPBACK WHALE; EUTHANASIA; ANIMAL WELFARE

INTRODUCTION

The live-beaching of a great whale presents a complex problem for wildlife managers and local government officials. It raises issues of animal welfare, public safety and the personal safety of the public officials involved. In some parts of the world, it is also often the subject of intense out-pouring of public opinion and sentiment and can result in extensive media scrutiny during and after the event. As with many complex problems confronting government agencies, this one can be effectively managed only through cooperation as there are invariably multiple jurisdictions involved with multiple pieces of legislation in play.

With the protection of humpback whales (*Megaptera novaeangliae*) in 1963 and southern right whales (*Eubalaena australis*) since 1935 (Tønnessen and Johnsen, 1982), there have been encouraging increases in the number of both species visiting coastal Australian waters (e.g. Bannister, 2008; IWC, 2011). With the recovery in the numbers of these species, there is an increased likelihood of these animals coming ashore due to natural and human induced causes (Bannister *et al.*, 1996; Coughran and Gales, 2010). Kemper *et al.* (2005) reported more than 20 species of cetaceans as live-beaching in South Australia, including three species of great whale (sperm *Physeter macrocephalus*, Bryde's *B. edeni* and fin *B. physalus*). In Western Australia during the period 1981–2010 inclusive, several species (humpback, Bryde's, southern right, fin, blue *B. m. musculus*, pygmy blue *B. m. brevicauda*, Antarctic minke *B. acutorostrata* and sperm whales) have been recorded live-beaching (Department of Environment and Conservation (DEC) unpublished data).

Relocating live large whales weighing in the tens of thousands of kilograms is difficult and dangerous even under calm sea conditions. During inclement weather, the task can become extremely hazardous especially if the whales are beached on rocky substrates. If the risks are too great to allow a rescue team to work, or the logistics of moving the animal are unviable, then serious welfare issues arise. In circumstances where the whale faces a lingering death, euthanasia becomes a valid option (IWC, 2010).

Euthanasia of small cetaceans has been achieved using a range of techniques, including barbiturate overdose (intravenous or intra-cardiac injection), lancing of major heart blood vessels and shooting (brain or heart shot) using large calibre centre-fire firearms (Needham, 1993). While these methods are useful for smaller species (<6m; see Øen and Knudsen, 2007), they are inappropriate or unfeasible for the euthanasia of larger species such as baleen whales (Blackmore *et al.*, 1997). Data presented to the International Whaling Commission via workshops on whale killing methods (e.g. IWC, 2003) suggest that the use of firearms cannot guarantee a quick or humane death in all circumstances, but can have emergency application in some cases (IWC, 2010). Whales of a number of species are shot with large calibre bullets (7.62mm, 9.3mm, 30.06, .375 or .458 inch) in a number of whaling operations and for euthanasia (IWC, 2003).

The use of explosive charges such as penthrite (pentaerythritol tetranitrate or PETN) in the hunting of whales is well documented. Typically 30g charges are delivered into a whale's body via 50 or 60mm boat-mounted harpoon guns, which fire harpoons weighing between 12–18kg (Øen, 1995a; 1995c; 1999). Harpoons are aimed at the thorax of the whales and can result in up to nearly 80% of the target animals dying instantaneously (Øen, 2002). Death usually results from blast-induced trauma to the vital organs, the central nervous system or the brain (Knudsen and Øen, 2003). The use of penthrite grenades on larger whales, such as bowhead whales taken during indigenous hunting, has resulted in times to death ranging from instantaneous up to a median time of 15 minutes (Øen, 1995b). Reference has been made in the published literature to the use of a range of methods for euthanasing large (>6m) whales (e.g. Dierauff, 1990; Hyman, 1990). The few publications that mention the use of explosives for the euthanasia of whales either provide no working details on specifics of the method, only mention the existence of field research (e.g. Needham, 1993), or largely dismiss the method for reasons not related to the capacity of the method to deliver a quick and humane death (e.g. Greer *et al.*, 2001).

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This paper documents a highly effective and safe method of euthanasing humpback whales using explosives and the process that needs to be undertaken to safely apply it. Five case studies are presented to demonstrate the likely range of issues that can be expected in the field and some of the problems that have been encountered during the refinement of this methodology. This method was developed and refined over a 20 year period to the point where an instantaneous death can be delivered with minimal risk to the public and the wildlife management staff involved. The research was conducted by the Department of Environment and Conservation (DEC) on the lower west and south coast of Western Australia between 1990 and 2010.

MATERIALS AND METHODS

In Western Australia, the DEC is responsible for the administration of the Wildlife Conservation Act 1950 and managing fauna issues, including whales. In this capacity, the DEC has adopted the Australian Inter-Service Incident Management System, which provides a total systems approach to all incident management involving risk[1]. The state police department is responsible for the critical issues of public safety that emanate from public proximity to powerful animals and from the use of explosives, while local government authorities are responsible for public health issues associated with the management of each whale beaching incident.

The process that leads to a decision to euthanase a great whale is relatively straightforward and arrived at following a clinical assessment of each whale (Gales *et al.*, 2008), based on 'Behaviour Criteria' (alert, weakly responsive, non-responsive) and 'General Condition Criteria' (behaviour in water, respiration, heart rate, body temperature and reflexes) of each whale. While there can be difficulty in interpreting every one of the categories during each assessment, the wide array of parameters observed offers the best clinical assessment to determine the prognosis for each whale. Where there is doubt over interpretation, time is allowed in order to ascertain trends in condition. A whale may be in good physical condition but impossible to save. Under these conditions euthanasia is also important. The basic pathways to managers are straightforward and should not be complicated by public expectations and media influences that have no scientific basis.

In all cases reported here, every opportunity was taken to obtain independent veterinary advice either following on-site assessment or telephone discussions. During case 1, DEC staff consulted with a senior veterinary officer from the Western Australian Department of Agriculture and Food on site. For cases 2–5 inclusive, DEC staff on site consulted the senior veterinary officer at the Perth Zoo by telephone with regard to the prognosis and palliative care of the whales. Death of each whale was confirmed using the criteria described in case 1 and in case 5 a local veterinarian who was able to attend the site for the purposes of learning from the exercise was also able to confirm that an instantaneous death had been achieved from the detonation of explosives in that case.

Over the 20-year development period, some of the materials (type of explosive, detonator system) used have changed as technology has advanced. The most up-to-date materials being used are reported here, but the authors (DKC) can be contacted for details of the earlier types of materials used should that information be required.

[1] *http://knowledgeweb.afac.com.au/training/aiims* accessed 15 March 2010.

RESULTS FROM CASE STUDIES

Case 1

On 9 October 1990, a yearling male humpback whale live-beached at 1630h, 200m south of 'The Cut' at Koombana Bay (33°18'S, 115°31'E) Bunbury, Western Australia. An unfavourable prognosis from the attending veterinarian, deteriorating weather conditions and the size of the whale (length 9.11m, weight *ca* 10t) precluded any rescue attempt. A decision was made to euthanase the whale. On the evening of 10 October, an explosive charge was detonated over the area dorsal to the cranium and immediately to the rear of the blow-hole (Fig. 1). Six sticks of AN60 (0.2m long × 25mm diameter) explosive were used in this controlled detonation AN60 explosive has now been replaced by more advanced products such as Powergel Magnum® explosive (Orica Ltd). Detonation occurred as planned, resulting in a neat circular hole, approximately 300mm in diameter that completely removed the underlying skin, blubber, skeletal muscle and the top of the cranium. The brain showed evidence of severe trauma, indicating that the whale had most likely died instantly. Death was determined on the basis of a lack of corneal reflex, the relaxation of the jaw muscles, an absence of response to tactile stimulus of the tongue, an absence of visible signs of respiration and visual confirmation of significant damage to the brain. It was noted that the lower cranium was still intact indicating the appropriate amount of charge to achieve the desired result had been used. The force of the blast had been contained and directed downward and into the brain and apart from the blast wound there was no other physical damage to the whale.

Case 2

On the afternoon of 24 September 2008, a 10.5m, *ca* 15t sub-adult female humpback whale live-beached in shallow water 1km south of Jurien Bay (30°18'S, 115°02'E), Western Australia. The whale beached in shallow inshore waters after being washed in over a limestone reef and sustaining superficial injuries during this process. It came to rest in the shallows of a sandy bay in a weak and debilitated condition. Following an assessment of the animal's condition, it was determined that the whale was too weak to move and as it

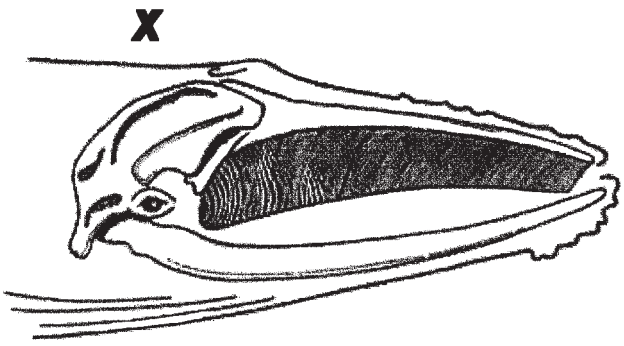

Fig. 1. Profile of humpback whale's head; X shows placement of charge.

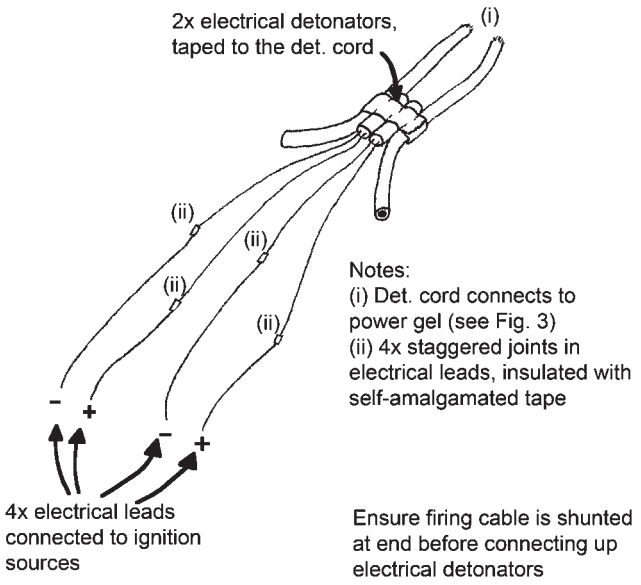

Fig. 2. Arrangement of wiring harness and electronic detonators and detonation chord.

had not made any attempt to dislodge itself from the shallows, it was unlikely to survive any rescue attempt. Due to the size and weight of the animal and the fact that it was lying on the bottom, it would probably sustain additional physical injury and expose staff to a high workplace risk if attempts were made to tow or move the animal back out into deeper waters.

As the stranding was a natural event and there were no immediate public safety concerns, the initial decision was made to allow nature to take its course. DEC officers were on site to ensure that there was minimal disturbance to the whale and to re-assess the situation as needed. A media statement was released by DEC on the morning of 25 September 2008 informing the media of the incident and the management strategy in place. Whilst media response to the strategy was mostly positive, there were some calls from the public, including some international calls, wanting to know why the DEC was not taking more direct action to either 'rescue' the whale or to 'put it down' to prevent it suffering[2].

DEC chose to maintain the palliative care strategy, and to re-assess the position and consider other options in the coming days. On the morning of 30 September 2008, following a re-assessment of the whale, a decision was made to euthanase it using explosives.

Five sticks of 125g Powergel Magnum® explosive with two electric detonators connected to two electric firing cables were used in this detonation (Figs 2–6). The initial detonation on the afternoon of 30 September 2008 made a crater approximately 200mm in diameter in the whale's head. The whale was only stunned; no externally visible damage had occurred to the cranium or brain, and a short time later it became active. A 0.300 inch Winchester Magnum rifle was used to place five rounds into the area to the rear of the blow-hole aimed in the direction of the brain. This had no visual effect other than to cause a significant amount of arterial bleeding. A second explosive charge, double the size of

[2] *http://latimesblogs.latimes.com/outposts/2008/10/hard-times-for.html* accessed 15 March 2010.

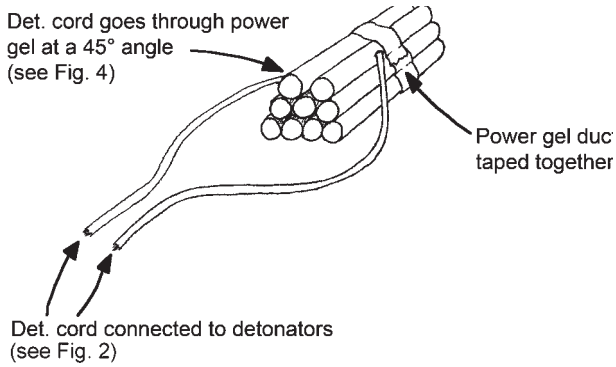

Fig. 3. Configuration of Powergel and detonation chord.

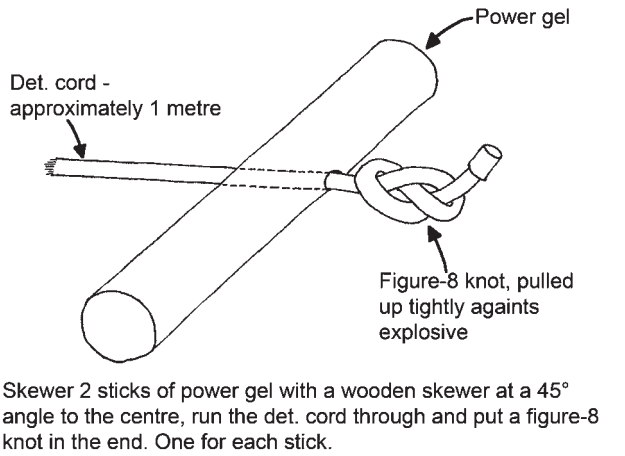

Fig. 4. Initiation charges and placement of detonation chord through the uppermost stick of Powergel.

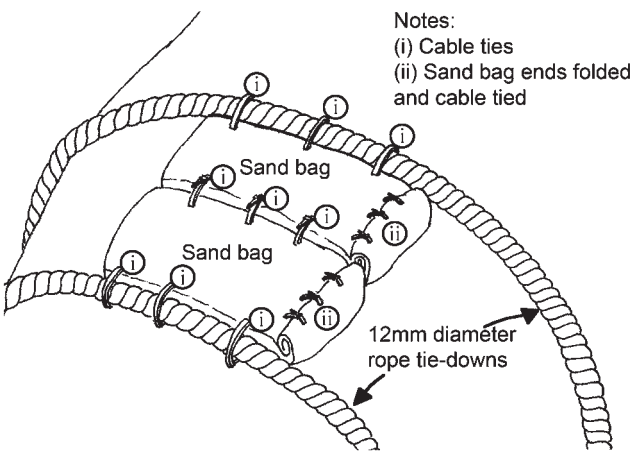

Fig. 5. Placement of tamping bags and tie-down ropes on the dorsal surface of the head immediately to the rear of the blowholes.

the first, was quickly prepared and detonated in the same area as the first charge. The second charge caused an approximately 500mm diameter hole in the whale's head removing all blubber and tissue dorsal to the cranium along with the dorsal part of the cranium and causing severe trauma to the brain, apparently killing the whale instantly. Death was confirmed using the criteria described in case 1.

Case 3

On the morning of 20 October 2009, a 9.8m, *ca* 15t, sub-adult female humpback whale live-beached in shallow water

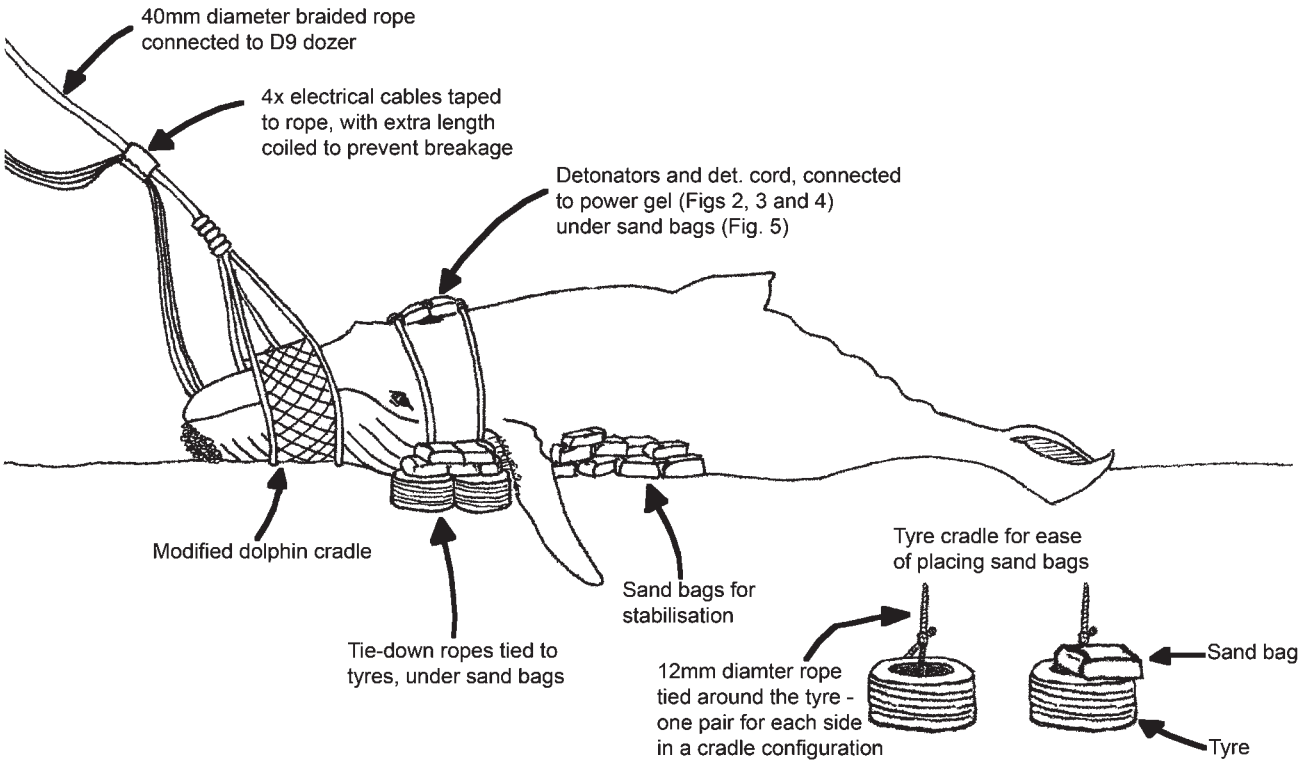

Fig. 6. Overall plan of materials used to secure whale, support wiring harness and placement of charge.

500m east of Windy Harbour (34°50'S, 116°02'E), Western Australia. The whale beached in shallow inshore waters after being washed in and sustaining superficial injuries during this process. It came to rest in the shallows of a sandy bay in a weak and debilitated condition. Following an assessment of the whale's condition it was determined that the whale was too weak to move and as it had not made any attempt to dislodge itself from the shallows, it was unlikely to survive any rescue attempt. Due to the size and weight of the animal and the fact that it was lying flat on the sand and almost high and dry on a low tide, it would likely sustain additional physical injury and expose staff to a high workplace risk if attempts to move the animal back out into deeper waters.

As the stranding was a natural event and there appeared to be no immediate public safety concerns, the initial decision was made to allow nature to take its course. DEC officers were on site to provide palliative care (covering the animal with wet cloth to protect it from the sun) and to ensure that there was minimal disturbance to the whale and to re-assess the situation as needed.

The whale was constantly monitored by DEC staff and veterinary assessments were carried out. The whale's general condition and prognosis was deemed very poor and a decision was made on 21 October 2009 to euthanase the whale using explosives on the morning 23 October 2009 if the animal was still alive at that time. Fourteen sticks of 125g Powergel Magnum explosive were used in this detonation. Detonation occurred as planned, resulting in a neat circular hole approximately 300mm in diameter that completely removed the skin, blubber, skeletal muscle and the top of the cranium (Fig. 7). The brain suffered severe trauma caused by the blast along with fragments of the upper cranium, apparently killing the whale instantly. Death was confirmed using the criteria described in case 1, above.

Case 4

On the evening of 12 January 2010, a 12.7m male humpback whale beached at Kennedys Beach (33°54'S, 122°51'E), Western Australia. It was assessed late that night and was still alive by the morning of 13 January 2010. Its body condition was very poor and the post-cranial depression was such that a pronounced hump was visible posterior to the blowholes. A significant depression was visible along the lateral flanks and a significant sub-dermal protrusion of the scapulae was visible. By 14 January more than 30% of its dorsal body surface had blistered from exposure to the sun. By late on 14 January 2010 it was obvious this animal was terminal and with high temperatures (>40°C) forecast over the ensuing days the decision was made to euthanase the whale using explosives. The challenge with this case was the fact that this animal would be the largest animal the technique had been applied to. With increased size and body mass there was an expectation that the dorsal bone structure of the cranium would be more substantial and that a larger explosive charge would be required. The charge consisted of 22 sticks of 125g Powergel Magnum, assisted by two 50g

Fig. 7. Photograph of the dorsal head area of the whale from case 3 after detonation of the explosive charge.

boosters. At 1610 hours on 15 January 2010, the charge was detonated, instantly killing the whale. The blast penetrated the upper cranium, causing severe trauma to the brain but did not sever the head from the body, leaving the bottom half of the skull intact. Death was confirmed using the criteria described in case 1, above.

Case 5

On 19 August 2010, a 9.5m, 15t (weight post death) humpback whale beached on a sandbar within the port of Albany (35°03'S, 117°53'E) on the south coast of Western Australia. This whale was in a debilitated condition but still quite active. On high tide this whale could have swum into deep water but never attempted to do so. Its condition was slowly deteriorating, but the site and the activity of the whale did not allow for safe management for palliative care or early euthanasia. This whale was monitored daily by DEC staff until the tide, weather conditions and activity levels of the whale were deemed manageable. On 1 September 2010, the decision was made to euthanase the whale using explosives.

The whale was on a sand bar approx 1.2km from the nearest shoreline and it was noted to be lying on its left side. The right pectoral fin was in less than 0.5m of water whilst the left was in approximately 1m. The whale's blow-holes were submerged which meant it had to raise its head to breathe. The whale's breathing rate increased when first approached but settled down to a slower rate after a short period.

There were several factors associated with this case that had not been encountered in previous cases, necessitating minor modifications to the standard procedure. As the whale was resting on its side, in a left leaning aspect, it was not possible to place the charge to the rear of the blow-holes above the cranium as in cases 1 to 4, above. The whale was raising its head to breathe and there was some concern that this movement may dislodge the charge and sand bag tamping.

As the whale was so far from a beach it was difficult to stabilise the whale's head. An attempt was made to position sand bags under the whale's jaw to support it, without success. The whale would not leave its head up long enough to allow the sand bags to be safely positioned beneath the mandible. Truck tyres and a number of sand bags were positioned on the left side of the whale to stabilise the animal. It was decided to try putting a sand bag on the whale in the position of the charge to see if the sand bag would move when the whale lifted its head. The sand bag did not move in response to this activity, so more sand bags were positioned on the right side of the whale's head, in a line between the eye and to the rear of the blow-holes. These sand bags did not move so it was decided to go ahead with the placement of the explosive charge and detonation on 2 September.

Little information was available on the likely thickness of the lateral part of the skull that was presenting in the dorsal aspect, or the precise distance from the skin to the cranium from the position. Accordingly, three extra sticks of Powergel were used in the charge. The total charge consisted of 15 sticks of 125 gram Powergel explosive. The sticks were taped together forming a pyramid. These were initiated by two lines of detonation chord running through the stick at the apex.

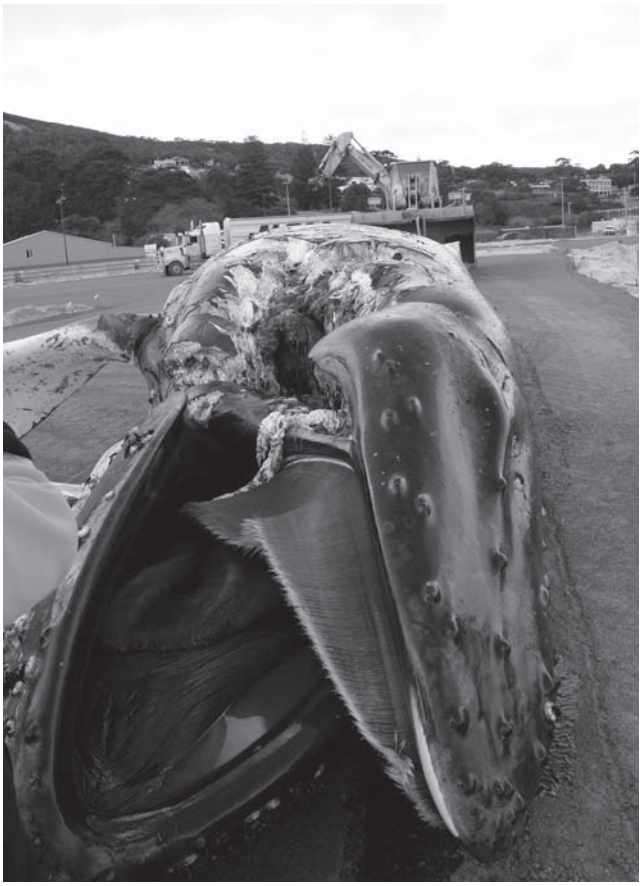

Fig. 8. Photograph of the lateral head area of the whale from case 5 after detonation of the explosive charge.

Due to the fact that no heavy machinery could be located close to the whale, no bulldozer blade was available to use as a blast shield. Initiation of the charge by a timed safety fuse was considered, however this would have required leaving a burning detonation chord for two minutes with the possibility of the whale smelling the black powder smoke and becoming agitated and dislodging the charge. A decision was made to detonate the charge electrically from behind a dinghy 50m away. The tamping sand bags were checked to ensure that only wet sand had been used for filling and that there was no chance of 'fly' from the charge. The wet sand in the bags was used to further assist in containing the explosive force to the target area. Two electric detonators were connected to the firing cable in parallel and then taped to the two lines of detonation chord. The area was checked to ensure no unauthorised people had entered the exclusion area and that it was safe to fire the charge, an air horn was sounded and the charge fired. Upon examination of the whale it was found that the charge had been successful with a 1.0m × 1.5m elliptical hole punched through the blubber and right dorso-lateral section of the skull, causing severe trauma to the cranium and brain (Fig. 8).

OVERVIEW OF THE PROCESS

Circumstances at each site where whales beach vary and as such the range of equipment used, in particular heavy and light vehicles, differ slightly[3].

[3] The recommended equipment list to successfully and safely euthanase whales is available from the principal author (DKC) on request.

Public safety and information

In cases where whales have beached in close proximity to populated areas, DEC routinely requests the local police (assisted by State Emergency Service (SES) personnel) to secure and control the site before any operations begin on the whale. The presence of uniformed officers provides a distinct advantage in obtaining crowd compliance with requests to keep a required distance from operations involving heavy and light machinery, potentially inclement sea conditions, firearms and explosives. In remote areas where access to police and SES personnel is not always possible, the DEC incident controller delegates crowd control responsibilities to authorised DEC staff. Authorised DEC staff have powers under state legislation to compel members of the public to comply with given directions. The public are excluded to ensure safety rather than prevent them from gaining an appreciation of the events that are to take place.

Prior to any work related to the preparation or placement of the explosive charge, a briefing is provided to all essential personnel, members of the public (if present) and any media representatives. The briefing covers issues such as the species of whale involved, the conservation status of the whale, the animal welfare issues at hand (including any independent veterinary advice available), why the whale cannot be saved or returned to the sea, what course of action will be taken to end the whale's suffering and what will be asked of the public/media in order to ensure the safe operation of the euthanasia protocol.

The process

It is important to shape the explosive charge into a triangular pyramid (see Fig. 3) to ensure maximum explosive force is directed downward onto the smallest area of the whale's head, directly above the cranium. For very large whales such as the one described in Case 4, it is recommended that two 50g boosters be added on top of the charge to ensure optimal detonation of the explosive charge and to direct the blast downwards. The boosters are installed with two lines of detonating cord and detonate before the primary charge. The electrical firing cables should be shorted out to discharge any static current within the wiring system, and the charge watched closely to ensure it is not dislodged from the main explosive charge, and that the charge does not move from its central position over the mid-line of the whale's head (Fig. 5). The electrical firing cables are laid out back to the bulldozer or protective sand dune (Fig. 6). Two electric detonators are connected to two electrical firing cables using self-amalgamating tape. The electric detonators are then taped to the detonating cord using plastic electrical tape.

Heavy machinery (e.g. D9 or D65EX bulldozers) is used to achieve four important functions. The first is to assist in manoeuvring the whale into a position on the beach where it can be stabilised. The second is to provide a secure point of attachment for the wiring harness to keep it clear of rocky substrates, surging wave action and personnel. The third function is to provide protection to the shot-firing team from the effects of the blast, and the final function is to remove the whale carcase from the beach, if necessary.

All non-essential persons are moved 500m back from the detonation site prior to the explosive charge being prepared or placed on the whale. All essential personnel take cover behind the heavy machinery (if available) or the first line of sand dunes present on the beach, prior to the trigger mechanism being connected to the wiring harness. A transmission on the universal emergency and calling marine radio frequency (marine VHF channel 16) is made once all non-essential personnel are moved 500m back from the site and prior to the commencement of the preparation of the explosive charge.

After this point in the process, no electronic communication devices, including mobile telephones, are used or left on to ensure that the explosive charge is not detonated prematurely. It is important to note that electronic communications from aircraft over-flying the site could present a real risk of premature detonation. Military aircraft (or base installations) typically generate much stronger electronic transmissions than commercial or private aircraft and may make the use of electrical detonating systems impractical under some circumstances. Under such circumstances the charge should be detonated using a non-electric system.

Once the charge has been prepared and secured on the whale the shot-firer then provides a visual signal to the police/SES (if present) to activate their flashing emergency lights and siren. The shot-firer then takes cover behind the heavy machinery or sand dune, arms the system and detonates the explosives. No personnel are permitted to approach the whale carcase until the shot-firer has determined the site safe.

DISCUSSION

Current use of explosives in killing whales at sea is limited to penthrite grenades (typically 30g charges) that are attached to whale harpoons. The harpoons are fired into the body of the whale and typically penetrate 600–700mm before the delayed fuse mechanism detonates the explosive (Knudsen and Øen, 2003). The method described in this paper uses up to 2,750g of Powergel explosive placed strategically above the cranium to achieve a better and more reliable outcome on beach stranded whales.

Explosives work by the virtual instantaneous conversion (detonation) of a mixture of chemical compounds into gas and heat. This detonation of the explosive is achieved by sending a shock or detonation wave through the explosive compound. A detonator is used to initiate the detonation wave which once started will propagate through the explosive at speeds of up to 8,000ms^{-1}. The gas volume produced by a 30g penthrite charge is between 768–790L. The more gas produced by the explosive the greater the destructive power of the explosion. Military bombs confine the gas produced by the explosive detonation in iron cylinders allowing it to build up. In civilian utilisation of explosives such as mining, the gases are contained by placing the explosive in a bore hole and positioning 'tamping' over it. The greater the pressure build-up, the more productive the blast (i.e. the more rock that will be fractured and dislodged). If the blast is not contained or directed in some manner the gases will take the least line of resistance, dissipating into the atmosphere mainly as heat and noise with little blast effect.

Powergel is a more stable explosive and is less expensive than penthrite. Powergel has a reasonably high velocity of

detonation of 6,337 ms^{-1} compared with penthrite's 7,400–8,300 ms^{-1} (dependent on the density of the penthrite). When euthanasing stranded whales it is not possible to contain the explosive charge inside the animal and neither can the explosive charge be placed in a metal container in the manner of traditional military style bomb, which when shattered would cause dangerous fragments that could be propelled for quite some distance (1000m). The dying whales do not always choose to beach themselves in places that allow a 1,000m safety envelope for wildlife authority staff to operate with. The combination of layered sand bags containing wet sand as tamping to 'contain' the explosive gases produced, along with the larger amount of explosive (compared to the small amount of penthtrite) and the careful shaping of the charge, addresses the issue that the majority of the explosive gases will escape when used in the manner described here. The sand from the disintegrating sandbags, with its low mass and very small particle size will not be propelled by the explosion any more than 30m from the blast site.

In Western Australia a shot-firer's licence, issued by the Department of Mines and Petroleum under the provisions of the Explosives and Dangerous Goods Act 1961, is required to handle and use explosives. The safe and efficient use of explosives requires considerable expertise, for which DEC relies heavily on outside personnel and agencies, including the military. Matching legislation will most likely need to be complied with in other jurisdictions. Most members of the police or military who have experience with explosives have learnt to use these materials on inanimate structures such as concrete, metal and the like. The physical properties of these inanimate materials respond very differently to the biological materials of blubber, muscle and bone. It is our experience that there is a strong tendency to underestimate the amount of explosive charge necessary to achieve a humane death of a living great whale.

The potential clearly exists to use this implosion technique on a range of large whale species. There is a wide range in head shape and the volume of tissue mass dorsal to the cranial anatomy within different whale species (and possibly even within species and between the sexes). The example provided in case 5 demonstrates that this method has application when the explosive charge needs to be placed on a section of the head other than directly above the cranium and posterior to the blow holes. Beached whales are encountered in a wide range of physical conditions, and this can greatly influence the amount of explosive required to ensure destruction of the cranium and brain. Further field trials involving already deceased animals are strongly recommended. This is particularly important if the technique is to be applied to odontocete whale species such as the sperm whale. The results of any such field trials, whether successful or not, should then be communicated to the wider scientific community either through publicly available fora such as the International Whaling Commission workshops on whale killing methods and/or through peer-reviewed journals.

During Case 2, a media helicopter presented a serious safety breach by over flying the site as the charge was being set on top of the whale's cranium as electrical detonators were at that time in place within the charge. Presumably the pilot was unaware of the risk of premature detonation caused by electronic devices such as aircraft electronic transmitters and radios. Clearly serious thought needs to be given to how to manage any aircraft movement in close proximity to field operations involving the use of electrical detonators. There may also be situations where the safe use of explosives, especially when combined with electrical detonators, will not be possible and alternative euthanasia methods will need to be considered or nature allowed to run its course.

Management of cases such as these would benefit from professional advice from suitably qualified veterinarians. In many parts of Western Australia where these types of stranding events occur, it is not possible to access the services of a veterinarian, other than by telephone or radio. Added to this is the problem that few veterinarians have any practical experience in the treatment or palliative care of cetaceans, and in particular baleen whales. It is our experience that being able to receive any advice available provides reassurance, but an inability to access quality advice from a veterinarian should not be considered an impediment to applying this technique.

The management of beached whales evokes strong public emotions. It is important that public perceptions and lack of appreciation for the facts surrounding beaching events do not prevent responsible wildlife agencies from making science-based decisions about the welfare of beached whales. There is ample opportunity to apply palliative care actions such as covering whales with damp cloths to prevent blistering from exposure to the sun. However, just because a whale is larger than most animals that the public has experience with does not in any way mean that it should be treated any differently. Large animal euthanasia involves issues dictated by physics, and euthanasia by explosives is a feasible and safe response to the issue. The data presented here clearly demonstrate that euthanasia of large humpback whales (and potentially other species) can be achieved safely and humanely with modern commercial explosives. The broader application of this method should be investigated whenever opportunities present, ideally via field trials on already deceased animals.

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