AN ANALYSIS OF BEHAVIOUR AND KILLING TIMES RECORDED DURING A PILOT WHALE HUNT

D Bowles† and J Lonsdale

Environmental Investigation Agency, 2 Pear Tree Court, London EC1R ODS, UK

† Contact for correspondence and requests for reprints

Abstract *Animal Welfare 1994, 3:* 285-304

Data are presented on a number of aspects of a drive hunt of a pod of long-finned pilot whales (Globicephala melas; *Traill*) *which occurred in the Faroe Islands in July 1992. Empirical data collected by observers are presented on aspects of the drive and killing phase of the drive hunt. These focus on the welfare implications of the two main pieces of equipment used in the hunt, the gaff and the knife. The body zone targeted by the gaff ranged from the melon to the dorsal fin. Ten of the 14 initial uses of the gaff recorded resulted in the whale being insecurely fastened and entailed further gaff strikes. Five case studies are presented of towing times, before cutting occurred but post-gaffing, when the whale was secured by the gaff to a boat (median: 66s). The number of gaff strikes on an individual whale ranged from zero to four (median: two). Fifty-seven per cent of cutting episodes using the knife were initiated behind the blowhole, 43 per cent on the whales' flanks. Data on the sequential use of the gaff and the knife are presented for seven whales. Data are also presented on the duration of the cutting episodes for these seven whales (median: 80s) and the total time elapsed from initial wounding until loss of voluntary movement occurred (median: 126s). Certain behaviours shown by the whale after the use of the gaff and knife are discussed and analysed in the context of the physiology, anatomy and social structure of pilot whales. Conclusions are presented on a number of welfare aspects of this hunt and compared with data from other whaling operations.*

Keywords: *animal welfare, drive hunt, Faroe Islands, killing efficiency, long-finned pilot whale, whaling*

Introduction

The technique of killing cetaceans in drive hunts, although previously occurring in places such as Newfoundland, Canada and the Orkney and Shetland Islands, UK, is now primarily restricted to the Faroe Islands and Japan (Sergeant 1962; Klinowska 1987). A drive hunt involves the communal driving of a pod of cetaceans into a designated bay, the intention being to force the pod to beach itself before killing can commence.

Historical records of drive hunts in the Faroe Islands, a group of islands lying midway between the UK and Iceland, extend back to 1584 although exploitation of the long-finned pilot whale may extend back more than one thousand years (Hoydal & Lastein 1993; Zachariassen 1993). Data collected from the hunt have been published on a number of

different issues. Published studies include analysis of the historical records (Zachariassen 1993); drive times and distances (Bloch *et al* 1990); review of pilot whales' socio-behavioural organization (Amos *et al* 1993), and pollutant burdens (Borrell & Aguilar 1993; Caurant *et al* 1993).

However, there has been no comprehensive study on welfare aspects of the hunt. The only previous study has focused on the length of slaughtering time for a number of drives (Bloch *et al* 1990), but this was on the time taken from the first whale killed to the last one. No data have been published on the length of time taken to kill individual animals in the hunt and little data on the use of equipment in the hunt.

The drive hunt in the Faroe Islands, also called the grind, is an opportunistic hunt primarily targeted on the long-finned pilot whale (*Globicephala melas*; Traill), although other cetacean species are occasionally taken including white-beaked dolphins (*Lagenorhynchus albirostris*), Atlantic white-sided dolphins (*Lagenorhynchus acutus*), bottlenose dolphins (*Tursiops truncatus*), harbour porpoise (*Phocoena phocoena*), bottlenose whales (*Hyperoodon ampullatus*) and orcas (*Orcinus orca*).

Due to the poor agricultural land of the Faroe Islands, the islanders have traditionally been dependent on the sea as a food source, and pilot whales have played an historically important role as part of the islanders' diet (Gibson-Lonsdale 1990). However the expansion of the local fishing industry, particularly since the 1960s, and its effect on rising living standards, has resulted in the Faroe Islands changing from a subsistence economy. As access to other food sources has increased, however, the islanders' dependency on the whale meat as food has decreased.

Regulations on pilot whaling in the Faroe Islands were first passed in 1832, and the hunt is now regulated by Executive Order 50 on Pilot Whale Regulations, drawn up in 1986 (Hoydal 1986). This designates the methods and equipment used in the hunt and the distribution of the meat from the kill, although it does not set quotas. The Regulations also name the licensed bays which can be used. These are periodically closed when the needs of the local community have been met and some of the bays have been closed permanently (Bloch *et al* 1993). At present there are 21 bays that are licensed. Equipment specific to the hunt has evolved, of which two pieces, the gaff and the knife, have been used extensively (Joensen 1976).

As the hunt is opportunistic, grinds can occur all year round, and in any one of the designated bays, although in practise factors such as the weather, tides, area where the pod was sighted and the accessibility of the bay result in the majority of hunts occurring in certain bays. Sixteen of the thirty-eight bays where grinds have occurred since 1725 account for 91 per cent of all hunts, and in the same period over 15 per cent of grinds have occurred in only one bay, Midvagur (Zachariassen 1993). There have been 47 grinds in the same time period at Funningsfjord, where the grind examined in this paper occurred, representing just under three per cent of grinds in the Faroe Islands (Zachariassen 1993).

The drive can be loosely divided into three phases:

Phase one: the pod is sighted either from land or at sea. Boats round the pod up in preparation for the drive, which occurs once the tide and climate conditions

are correct (Joensen 1976).

Phase two: the pod is driven by boats in a predetermined direction into one of the designated whaling bays.

Phase three: the pod is driven ashore and killed. The primary intention of this final phase is to increase the speed of the pod just prior to reaching the licensed area of the bay, and ideally stranding most of the animals high on the shore where they can be killed without having to be hauled ashore (Bloch *et al* 1990). The kill is usually completed more quickly if the whales are beached (Joensen 1976).

It is not uncommon for the pod to split during the final drive towards the beach making a successful beaching more difficult, and it is rare for the entire pod to be beached in one attempt (Gibson-Lonsdale 1990). Animals that are not beached at the first attempt are held in the shallows and occasionally attempts are made to beach them in secondary or subsequent drives. The entire pod is usually killed, though occasionally some whales are released (Bloch *et al* 1990). The size of the pod in a grind varies. In a study of all grinds from 1709-1992, the number in a pod ranged from 1 to 1,200 with a median of 110 (Zachariassen 1993).

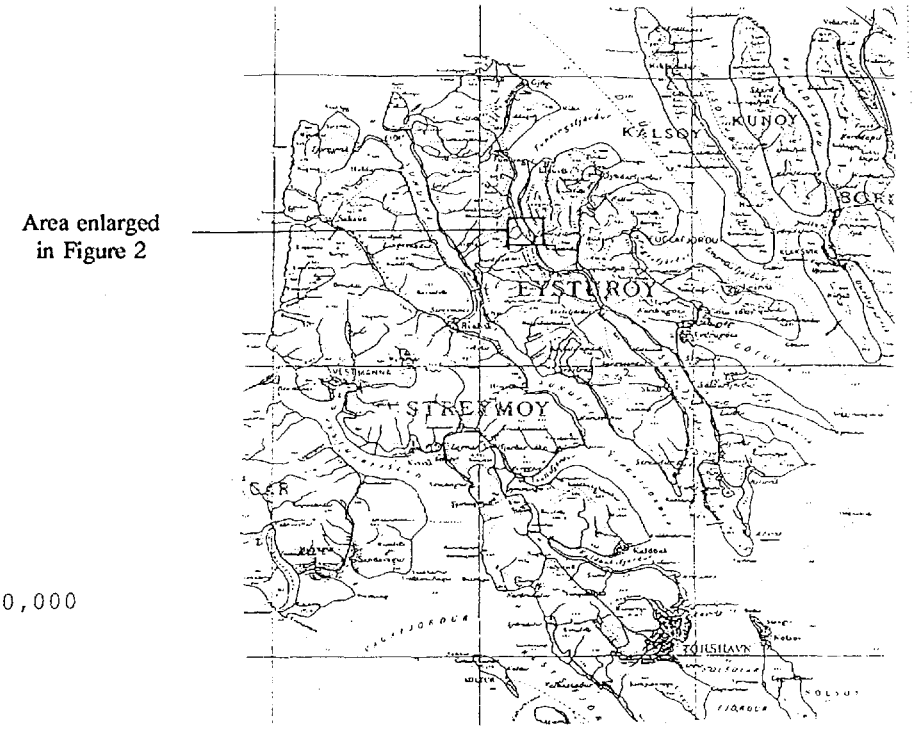

Figure 1 **The position of Funningsfjord in the Faroe Islands.**
(after Geodaetisk Institute 1983)

This paper examines the behaviour of pilot whales during one drive hunt, at Funningsfjord on July 2 1992 (Figures 1 and 2). Data are presented from phase three, as defined above. These include data collected during the initial drive and during the second and subsequent drives. Figure 2 shows the areas and sequence of the drives in the bay. Events in the securing and killing of the animals are documented sequentially and temporally, and compared with data gathered from other drive hunts. Certain conclusions are drawn on the efficiency of the methodology used in a drive hunt.

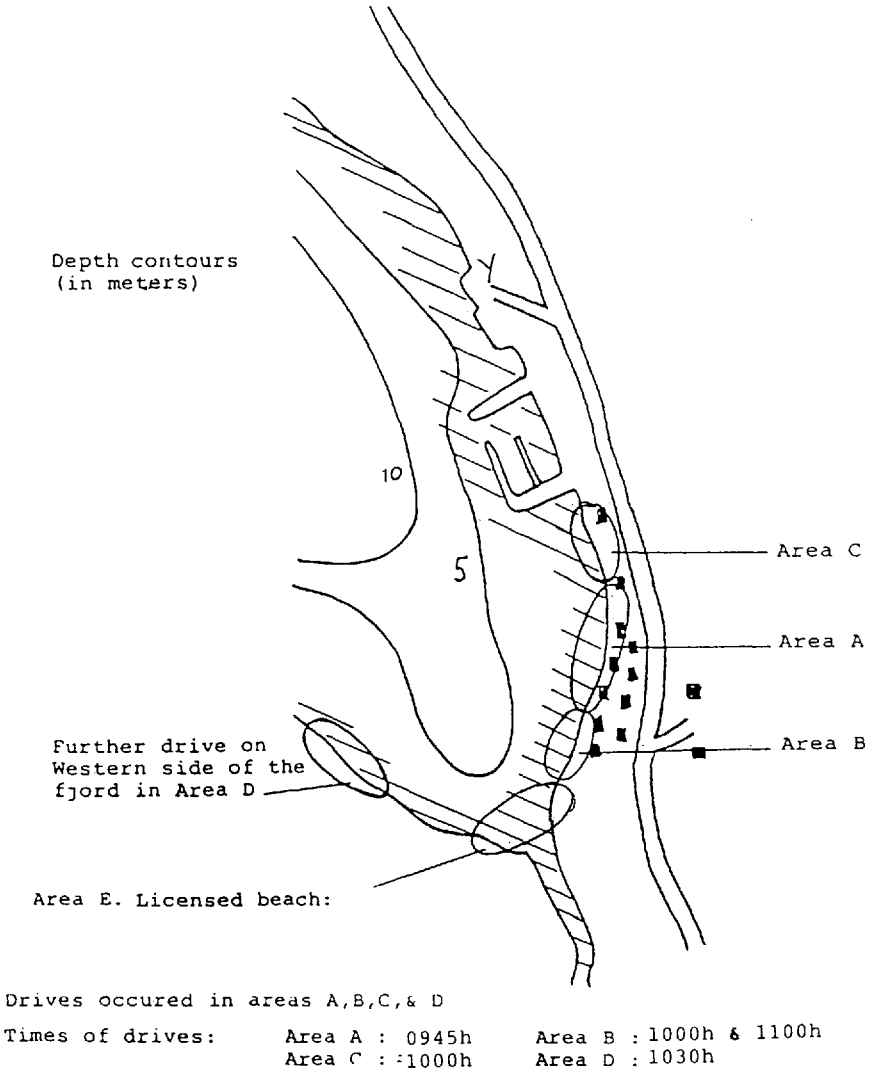

Figure 2 **The sites of the main drives in the hunt at Funningsfjord.**

Methods and equipment used in the drive hunt

There are two main instruments used to secure and kill the whales in the Faroe Islands – the gaff (soknarongul) and the knife (grindaknivur). Both are used during the beaching and killing phase. The use of other equipment in the hunt is restricted. Only the sheriff and foreman can carry the spear or lance (hvalvakn) in their boat, and the use of the harpoon (skutil) is banned. However, a number of devices are used during the drive to maintain the speed and direction of the pod. Stones (kast) are thrown into the sea, either loose or attached to ropes and echo sounders are also used (Bloch *et al* 1990).

The gaff, specifically designed for the grind, is an iron hook approximately 45cm in length, weighing about 2kg (see Figures 3 and 4). It has a rope attached to it, which is approximately 20m in length (Joensen 1976). The primary function of the gaff is to secure the whale, either to steady it before cutting commences or to drag those whales not beached in an accessible location into an area where cutting can begin. Historically it has also been used from boats to secure those whales remaining in the deeper water, which have not been beached or driven towards the shoreline. If the gaff is used from a boat, the rope attached to the gaff secures the animal to the boat. The whale is then towed by the boat until it is in a position close to land. The rope is then transferred to people on the shore, and the whale beached prior to being killed.

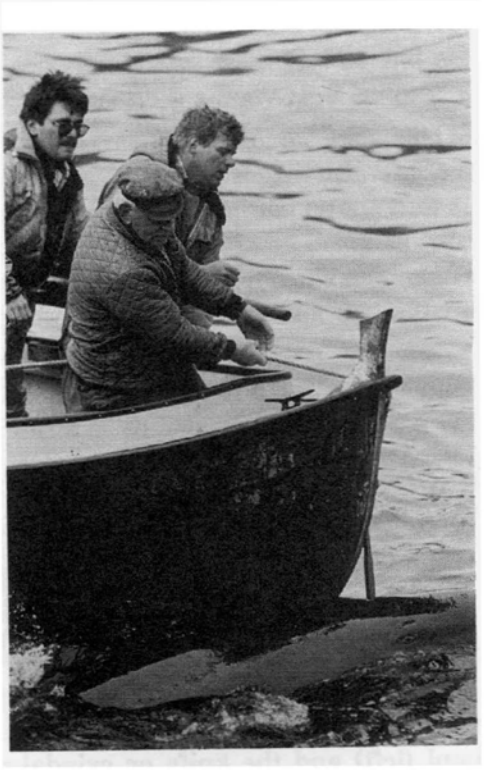

Figure 3 **Gaffed living whale secured to boat by gaff and rope.**

The gaff is thrust overarm into the whale's body. The intention is to strike around the area of the head although there are a number of variables which determine the actual location struck (Joensen 1976). These include the position of the whale (whether it is on the shore, stranded in the shallows or in deeper water); its position relative to the person using the gaff, and any movement, particularly of a sudden nature, that the whale may make.

The knife, with a 15cm long blade, is also a traditional instrument specifically designed for the kill (Figure 4). It is used on the whale in a sawing motion to cut through the blubber to reach the blood vessels and ultimately the spinal cord in the neck region (see Figure 8). The knife is used to exsanguinate the whale. Although common practice was previously to use the knife to excise a deep cut in front of the flipper to sever the carotid arteries (Sanderson 1991), it is now recommended to commence cutting one hand's breadth behind the blowhole of the whale, with the aim of severing the intra-spinal rete supplying blood to the brain (Anon 1994). Ultimately the knife may also sever the spinal cord, or a thrashing whale may actually break its own spinal cord (Joensen 1976).

The knife may be used in a series of cutting motions at one location in the whale, before it is withdrawn. This is defined as a cutting episode in the results presented below, and it can last for a number of seconds. The knife is used mainly from the shore and in the shallow water.

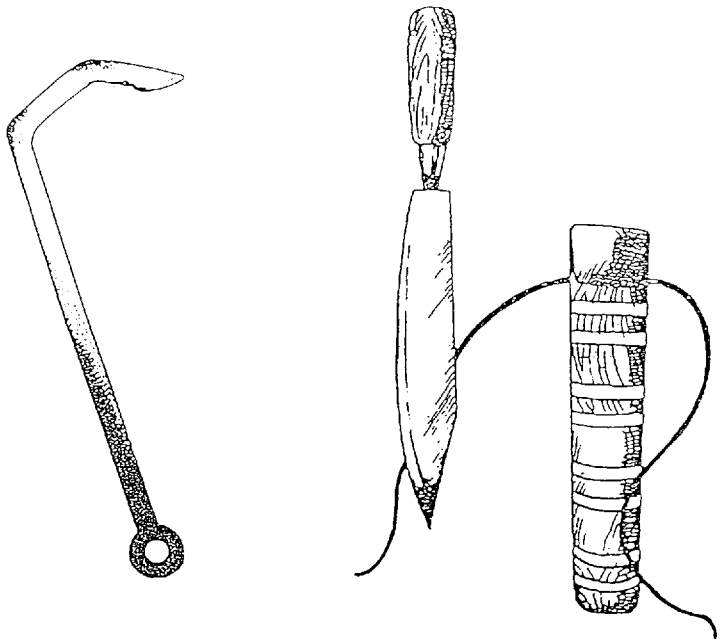

Figure 4 **Diagram of the two main instruments used in the hunt: the gaff or soknarongul (left) and the knife or grindaknivur (right); see text for lengths.**

As the hunt is non-commercial, there are no professional whalers (Bloch *et al* 1990). Training in the use of the gaff and the knife is done on an *ad hoc* basis, for instance knowledge is handed down from father to son. However, there are no restrictions in the Regulations governing pilot whaling on the numbers of people allowed to participate in the drive or kill phases of the hunt. The use of the gaff or the knife at a drive hunt is not limited to specifically designated people; the whaler using either piece of equipment is invariably the person closest to the whale intended to be killed.

Materials and methods

The Funningsfjord drive hunt involved the driving of a pod of approximately 100 long-finned pilot whales, of which 87 were subsequently killed. The pod was sighted and collected together at about 0800h on July 2 1992.

A team of six researchers including three cameramen was present at the hunt. This allowed the collection of filmed data on the drive and beaching/killing phases from a number of different localities and vantage points. Collection of the data on the drive started when the pod could be viewed by the team of researchers based at Funningsbotnur. On the initial and subsequent drives, data collection was taken from a number of locations close to the areas where drives were occurring (Figure 2). The distance from the researcher to the subject whale being filmed varied from less than five metres to approximately one hundred metres. Visibility was excellent at all times during the hunt and film was shot on 16mm and video Hi-8. Two video Hi-8 cameras and one 16mm film camera were used. A total of 50 minutes of film of the killing and securing phases were viewed and analysed. Film was examined using replay and freeze frame modes, on a Sony Hi-8 editor.

Sequential actions of the kill were timed using the integrated time code facility on the Hi-8 editor. Times were also synchronized with a stop-watch. These sequential actions were only timed when the subject animal could be identified on the film at all times. If the action had already commenced this is noted in the results as being an 'open-ended action'. The times for these open-ended actions or behaviours represent a minimum time period. The behaviours of individual whales were recorded during and after the initial drive and specifically noted after the use of the gaff and knife.

Data on the sequential use of the gaff and knife were only analysed when there was sufficient film after either piece of equipment had been used (Tables 1 and 2). If there was insufficient film shot, the data collected on the use of equipment on the live whale were only used in the analysis of the body areas of the whale targeted (Figure 6). Consequently more data are presented on body areas targeted by the use of the gaff (n: 35) and knife (n: 14) on the whale than timed sequential data (n: 7).

The following data were collected:

1. Success rates of securing the whale after the first use of the gaff (primary gaffing).
2. Location of the person using the gaff.
3. Number of times the gaff was used on an individual whale before loss of movement occurred.
4. Areas on the body of the whale targeted by the gaff and knife before loss of movement occurred.

5. Number of times the knife was used on an individual whale before loss of movement occurred.

The following timed sequential actions were collected:

1. 'Towing times': ordered sequences and times for five whales gaffed from boats or a quay, from the first striking of the gaff, through subsequent strikings to the first knife cut and attempt at exsanguination. This gives a 'towing time' when the whale was secured by the gaff to a boat or person on a quay, and brought into the shallows for beaching.
2. 'Exsanguination times': ordered sequences and times for seven whales from the first knife cutting episode until the loss of voluntary movement of the animal.
3. 'Total wounded time': ordered sequences and times taken for seven whales from the first strike of the gaff through the knife cutting episodes until the whale lost voluntary movement.

In studies on the evaluation of whale hunting methods, the criteria used to establish death are in accordance with those adopted by the International Whaling Commission in 1980, which define death as 'the times taken for the mouth to slacken, the flipper to slacken and all movement to cease' (Anon 1980). This definition has been used in studies evaluating efficiency of various cetacean hunting methods, although the majority of studies have been on large scale commercial whaling operations (eg Øen 1992, 1994). However, death or insensibility in a cetacean is difficult to determine from film. In this paper loss of voluntary movement in an animal was taken as the final stage in the timed sequences. In this definition, movement is defined as conscious voluntary movement. Any violent clonic convulsions, which occurred in a few whales, were assumed to occur after loss of sensibility and were excluded from the analysis.

Results

Use of the gaff

The gaff was used by whalers from a number of different locations. Figure 5 presents these data for primary uses of the gaff only. If the primary use of the gaff was not recorded on the film, but a whale was subsequently seen secured by the gaff to a boat, it is assumed that the gaffing also occurred from a boat, and recorded as such in the results. Thirty-six instances of primary gaffing were recorded. As Figure 5 shows, the highest number of primary gaffings were performed from boats. Of all first uses of the gaff, 80.5 per cent were by people either in boats or wading in the water. Seven of the 36 first gaff strikes were made by people standing on land, either on the shore or on a jetty.

The use of the gaff from boats increased after the initial drive. In the initial drive, which occurred in area A (Figure 2), a number of whales were beached, all of which were gaffed by people on the shore or wading into the water. In subsequent drives (areas B and D, Figure 2), the gaff was used from boats and by people on the shore and wading in the water. During one of the final attempts to drive the remaining whales in the bay onto land, a subgroup of about 15 whales was driven into area D (Figure 2). Of these, data were recorded from five animals, were the gaff was used either from boats or by people wading into the water.

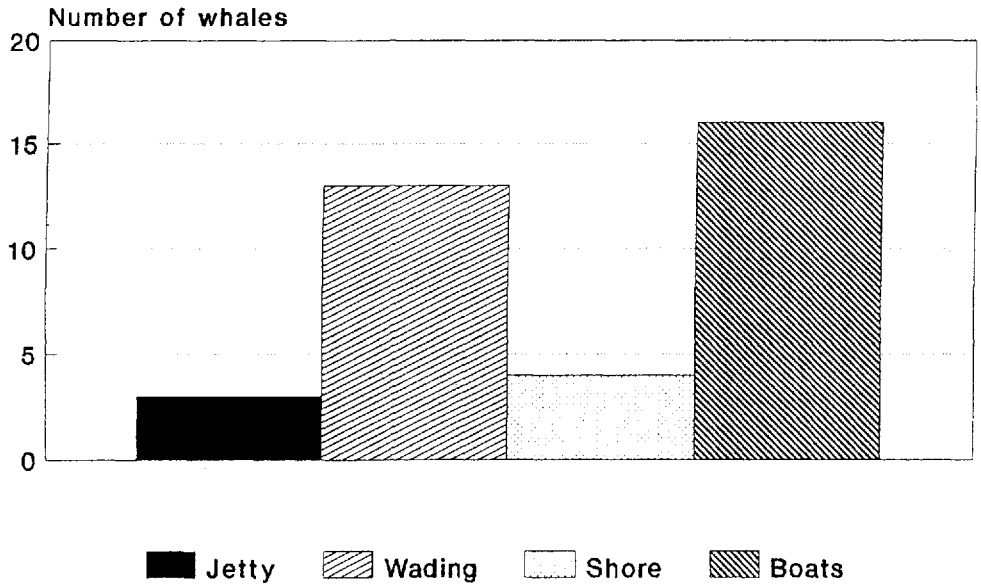

Figure 5 **Location of person performing primary gaffing.**

The gaff was struck into the whale by overarm throwing action in all recorded cases except two. In these cases the user stamped on it and pushed it into the whale with his foot. This person was standing on the jetty when the attempted use of the gaff occurred.

Fourteen instances of primary gaffing were recorded when the gaff was actually seen being struck into the whale (as opposed to when the gaff was recorded as having already been present) and there was sufficient film after striking of the gaff to determine success rates. In four of these cases the gaff was securely embedded in the whale and was not subsequently re-implanted before beaching and killing commenced. In the 10 other cases, further attempts were made using the same or additional gaffs. In six cases where secondary use of the gaff occurred, the first gaff was withdrawn because it had no purchase or it fell out. In the remaining cases an additional gaff was used on the whale with the first gaff still secured in it, either to steady the animal on the beach prior to exsanguination or in an attempt to beach it.

The number of gaff strikes used on a whale varied from zero to four (*n*: 15; median: 2; mean: 1.8). One whale from those recorded was killed without a gaff being struck into it, as it was beached on rocks in area D (Figure 2) and cutting could commence on the animal without any need to secure it further. The use of only one gaff strike was recorded on four whales. Two gaff strikes were recorded for eight whales, one whale was gaffed on three separate occasions and one was gaffed four times using two different gaffs. In the last case, the whale was gaffed, was then re-gaffed and towed into the shore, gaffed for a third time prior to cutting, and gaffed by a second person when it started to thrash around once the cutting had commenced.

All body areas of the whales targeted by the gaff are shown in Figure 6. Thirty-five gaff strikes were recorded where the body area targeted was clearly visible. Of these, 30 were aimed at the whale's dorsal area, and five struck on the lateral area. Due to the morphology of the whale, the three gaffs that were struck by the dorsal fin went into the side of the whale. Two other whales had gaffs struck into their flanks.

As Figure 6 shows, four of the 35 strikes recorded occurred in the area anterior to the blowhole, including on the melon of the whale (the bulbous part of the forehead), and two gaffs were struck into the blowhole itself. The remainder of strikes were posterior to the blowhole, with the furthest strike recorded adjacent to the dorsal fin.

Table 1 details the towing time for five whales. During the towing time the whale was secured to the boat by the gaff's rope and towed into the nearest point where killing could commence. There was also one occasion (Case 3) when an unbeached whale was gaffed from a jetty and 'towed' inshore by people standing on the jetty. The median towing time for these five whales was 66 seconds (mean: 77s).

Table 1 **Time between stages and towing times (s) for five whales.**

Case	1st gaffing	Time to 2nd gaffing	Time to first knife incision (towing time)
Case 1	Already gaffed (boat)	92	108
Case 2	Already gaffed (boat)	–	45
Case 3	0 (from jetty)	45	62
Case 4	Already gaffed (boat)	–	104
Case 5	Already gaffed (boat)	21	66

Use of the knife

The body area targeted by a whaler for cutting varied according to the position of the whaler and the position of the whale. Fourteen instances of the use of the knife were recorded. Of these, eight started on the dorsal surface, about 6cm behind the blowhole, and six started on the flanks. On a number of occasions the whaler started to cut into the flank of the target animal before continuing the cut in an arc over the dorsal surface.

The number of cutting episodes was analysed in seven whales, see Table 2. Four of these whales (Cases 3, 5, 6 & 7 in Table 2) were killed using one cutting episode. Three whales required further uses of the knife until voluntary movement ceased. Once cutting commenced, two of the three whales started struggling, which either knocked the whaler off balance or made it impossible to continue that cutting episode, and the knife was withdrawn from the whale. In the remaining case, the whaler cut down the flank of the whale, and then started cutting on the opposite side before finally starting a third incision on the whale's dorsal surface. The reason for this appeared to be an inability to make a deep enough cut to sever a major blood vessel. One of these whales was recorded as being cut in three different areas, and in another case there were at least five different cutting episodes.

https://doi.org/10.1017/S096272860001705X Published online by Cambridge University Press

Table 2 **Time (s) to loss of movement in seven whales from the first knife incision.**

Case	First knife incision	Time to 2nd knife incision	Time to loss of movement
Case 1	0	14	78
Case 2	0	25	102 *
Case 3	0	–	19
Case 4	0	27	184
Case 5	0	–	73 *
Case 6	0	–	84
Case 7	0	–	80

* open-ended action: the whale was still moving when the film ended, so these figures are minimum times to loss of movement in the animal from the start of the cutting.

As Table 2 shows, the time elapsed between the first cutting episode and the loss of voluntary movement in seven whales ranged from 19s to 184s (median: 80s). The times presented in Table 2 do not represent the total time that the knife was being used on a particular whale. A whaler could cut into a whale and leave it, to commence cutting another one before loss of voluntary movement had occurred in the first whale. The longest time recorded for a single cutting episode, when the knife was actually cutting into the whale, was 20 seconds.

Use of the gaff after the knife

This action was unusual and was recorded on only one whale in the kill at Funningsfjord. This whale was caught in a jetty and had been gaffed three times before cutting started, 56s after the first gaff had been struck into the whale. This produced a thrashing reaction in the whale. The second knife cutting episode occurred 27s later, followed by the second gaffing after a further seven seconds. The whale was then dragged further up the beach where cutting re-commenced. The total time from the first strike of the gaff until the whale lost movement was 240 seconds. This was the longest time period recorded for a whale from initial wounding until loss of movement occurred. The shortest recorded time was 60 seconds (median: 126s; *n*: 7).

Whale behaviour

Several distinct behaviours were recorded during the driving, post-driving, beaching and killing phases:

1. Spy hopping. The whale was positioned vertically in the water with its head above the water line. This was recorded twice, both times in animals which remained in the bay after an initial drive had failed to beach all the whales in the pod.

2. Tail lobbing. The whale was positioned vertically in the water, its tail protruding above the water. This behaviour, recorded five times, was displayed by whales in conjunction with other whales displaying spy hopping behaviour, and was again displayed only by those animals which remained in the bay after an initial drive had failed to beach all the whales in the pod.
3. Expiration under water. This was also recorded after the initial drive and beaching, when the social cohesion of the pod had broken down and whales were swimming in an irregular fashion. Attempts were being made at this time to collect those whales in the pod that had not yet been beached in an attempt to drive them towards the beach. The behaviour was seen on two occasions.
4. Behaviour during use of the gaff and knife. The behaviour of a whale altered once it had been struck and wounded by the gaff. Some whales when gaffed from boats attempted to swim in the opposite direction to the boat, resulting in the whale towing the boat. Whales frequently attempted to dive after being gaffed. Other whales that were gaffed on the beach reacted with violent thrashing movements, arching their backs in an attempt to dive.

Once cutting began, a common reaction in the whale was a strong arching of the back accompanied by a rearing of the head. Some whales also adopted a rhythmic sculling or sideways curling of the tail. These movements appeared shortly after cutting began and were therefore probably conscious behaviours. In those sequences where the eye was visible, it appeared to be closed during early cutting sequences, opening when the whale was still and probably dead.

As exsanguination proceeded, with strong flows of dark venous blood, the whales gradually lost movement. Following this, after a short period of quiescence, some whales developed a very powerful convulsion, with the tail violently thrashing the water. This could be a clonic type reflex convulsion occurring after supraspinal control had been lost and was thus excluded from the behaviour analysis.

Discussion

Use of the gaff

The welfare considerations of using an implement such as the gaff on a whale will be dependent on a number of factors including the number of times a gaff is used on an individual animal, the time from initial use of the gaff until death and the body area of the whale targeted by the gaff. There is a greater database presented from the Funningsfjord drive hunt on the finite recordings of numbers of gaff wounds and body areas targeted, so these will be discussed first.

The data recorded show that the use of the gaff is widespread. There was only one recorded instance of a whale being killed without the gaff being used. The total number of gaff strikes recorded on a specific whale ranged from zero to four, with most whales being gaffed twice (*n*: 15; median: 2).

In just under three quarters of the cases where the success of the gaff could be evaluated, subsequent uses of the gaff were necessary, either because it had been insecurely positioned in the whale or to steady the whale prior to exsanguination. This was due to the movement of the whale, particularly when it was gaffed in the water, and probably the smoothness and toughness of the whale's skin, which could make it difficult to obtain a secure purchase.

When the gaff was used from a boat, the movement of the boat and the independent movement of the targeted whale could result in a lower success rate of the use of the gaff.

Although this database is relatively small (about 14% of the total number of whales killed in the hunt are analysed), it represents the only data yet published on the number of times the gaff is used on individual live whales in a drive hunt in the Faroe Islands. The only other data previously recorded were on the total number of gaff wounds from 39 whale carcasses from a grind in 1986 (Gibson *et al* 1987). These wounds were examined and counted after a grind had been completed and the whales had been brought to shore in preparation for butchering and sharing. The number of wounds in this study could be positively biased, as gaff wounds could have been inflicted on a whale that was already dead in an attempt to bring it ashore. However although the range of number of wounds reported by Gibson *et al* (1987) is higher, the median number of wounds is similar to that recorded in this paper (range: 0-10; median: 3; *n*: 39).

This implies that the use of the gaff did not differ markedly between the two kills, and the majority of whales killed in a grind are struck with the gaff, often repeatedly, before exsanguination occurs. If the gaff is used on a whale before the whale is exsanguinated by use of the knife, this implies that it will lengthen the time period when the animal is wounded.

The results show that the areas struck by the gaff are mainly located on the anterior part of the whale's body, particularly around the head (Figure 6). These data emphasize that it is the head of the whale which is the main body area visible and exposed when the whale is gaffed in the water or the most accessible body region when the whale is in the shallows and the gaff is used from shore or in the shallows.

The increase in the use of the gaff from boats after the initial attempted beaching is probably due to the confused and disoriented behaviour exhibited by the whales at this time, shown by the increase in behaviours such as tail lobbing and spy hopping. This increases the difficulty of re-assembling the pod for subsequent drives, and increases the determination of the whalers to kill any remaining whales. Even 10 hours after the first whales had been killed, whalers were attempting to gaff the remaining whales left in the fjord from boats. None of these attempts was successful.

In the two cases where a time was recorded from initial use of the gaff, through the use of the knife and until the whale ceased movement (Case 3, Table 2) or was no longer recorded (Case 5, Table 2), the time from the first gaff wound until the first knife wound represented 68 per cent and 62 per cent respectively of the total time the whale was wounded (ie until it lost movement). This confirms that a whale is wounded from the gaff for a considerable percentage of total time that it is wounded before loss of movement occurs. If the gaff is used on more than one occasion this will also increase the time that the animal is wounded.

The topography of the bay and the size of the pod determine the location of use of the gaff. The beaches and approach to Funningsfjord make driving and beaching a large pod in one attempt difficult. The beach licensed under the Faroese Regulations is located at the head of a long fjord, containing a number of salmon cages, and is small allowing only small numbers of whales to be beached at one time (area E, Figure 2).

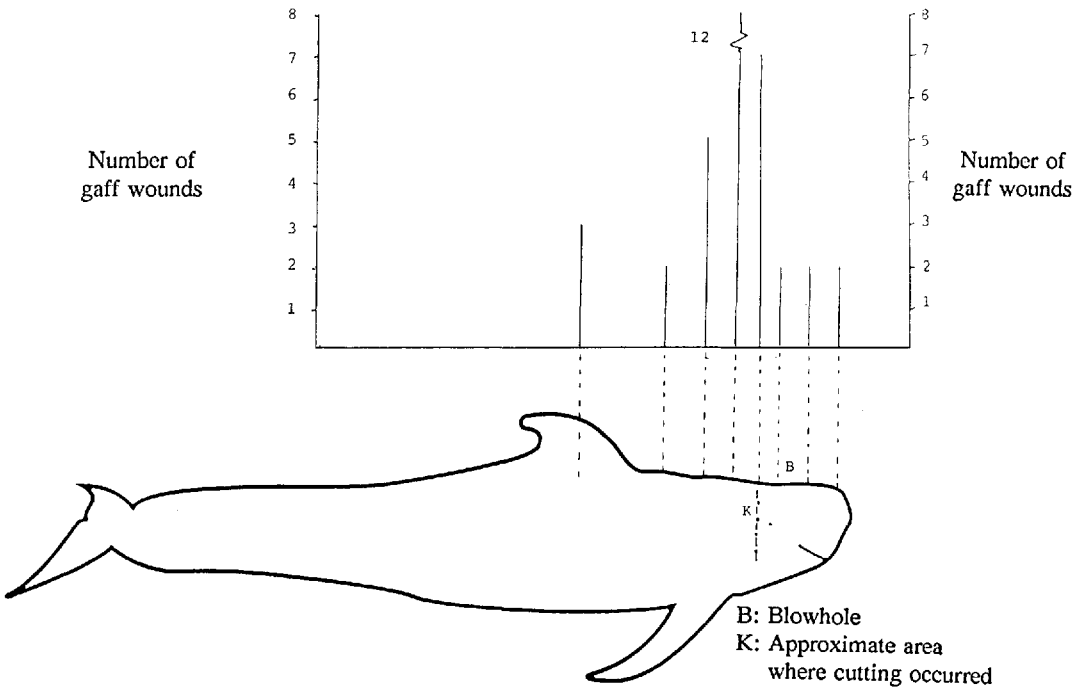

Figure 6 **Positioning of all gaff strikes on whales in the hunt (*n*: 35).**

The gaff was used on whales in the first drive by men on the rocky shore or wading into the water. Some gaffs were struck by people standing in water up to one metre in depth. The gaff was also used by men wading in the shallows on those whales driven into the jetty area (area C, Figure 2). Whales floundering in this area were dragged up a concrete slipway by a rope attached to the gaff before being killed. A third attempted drive resulted in a group of about 15-20 whales being driven towards the part of the fjord which was rocky and accessible only down a steep slope (area D, Figure 2). Due to difficulties of beaching, the gaff was used on whales by people in boats, on rocks or wading into the sea. It would be more difficult to get an accurate strike on a whale in these areas, due to the difficulty of approach and the topography, than if the whale was beached on a larger beach area. This is confirmed by information from other drives, showing that drives occurring on larger beaches have involved fewer uses of the gaff from boats, and at a drive that occurred in a bay without any beach, where all the uses of the gaff were from boats or rocks (Thornton & Gibson 1986).

https://doi.org/10.1017/S096272860001705X Published online by Cambridge University Press

Use of the knife

The degree of success in producing a quick kill on a whale if a knife is used, is dependent, amongst other factors, on the depth and place of the cut and the skill and experience of the whaler. Any struggling from the whale after it has first been wounded increases the difficulty of the whaler in using the knife in a controlled and directed manner. It will also increase the chance of secondary or subsequent cutting episodes.

Three of the seven whales recorded being cut required more than one use of the knife. This is also consistent with the only previous data published on knife wounds on whales from a pilot whale kill in 1986 (Gibson *et al* 1987). Of 39 whale carcasses analysed by Gibson *et al* the number of knife wounds ranged from one to six (median: 2; mean: 2.7). It is less probable that the data on knife wounds counted on carcasses are positively biased, as there would be no reason to use a knife on a whale to secure or land it after it had already died.

There is, as expected, a relationship between the number of cutting episodes and the time to loss of movement in a whale. The whale that lost movement most quickly after the first knife incision (under 20s) endured only one cutting episode. Three of the six other whales recorded, endured more than one cutting episode; two of these cases represented the longest times that a whale was wounded before loss of movement occurred.

The position of the knife cut on the whale's body will also be important in determining the length of time until death. The anatomy of a long-finned pilot whale, similar to other cetaceans, is unusual amongst mammal species, as the brain is supplied with blood along the thoraco-spinal retial system, which lies within the spinal canal (Burne 1952; Blackmore *et al* 1994). The common carotid arteries do not supply blood to the brain, so severing them by cutting through the neck will not result in instantaneous death, as the brain will continue to be supplied with blood through the spinal rete arteries until a severe drop in pressure occurs caused by the draining of a large proportion of blood from the whale (Anon 1992; Blackmore *et al* 1994).

Thus those six knife cutting episodes recorded which started on the side of the target whale would not have resulted in severing the blood supply to the brain and would not have resulted in instantaneous death. Eight of the 14 cutting episodes were made behind the blowhole, which may have resulted in severing the spinal rete arteries. The quickest time recorded (19s) from first knife cut to loss of movement was for a cut in this area. Any cut that does not occur in this area will not result in a quick death. It is interesting to note that the time until loss of movement for the quickest cut was still 19s. Even if the cut is quick and in the correct place, there will be a length of time taken for the knife to cut through the blubber and flesh of the pilot whale before the spinal rete arteries are severed (see Figures 7 and 8).

There have been few previous records of times taken from the first knife cut until death for individual whales in Faroese pilot whale hunts. Unpublished information from Olsen in 1988 showed times to death (defined as loss of blinking reflex) to be short; the highest figures reported were for those whales killed by unilateral severing of the blood vessels. All times were under one minute, whereas only one of the recorded times in this kill was less than one minute.

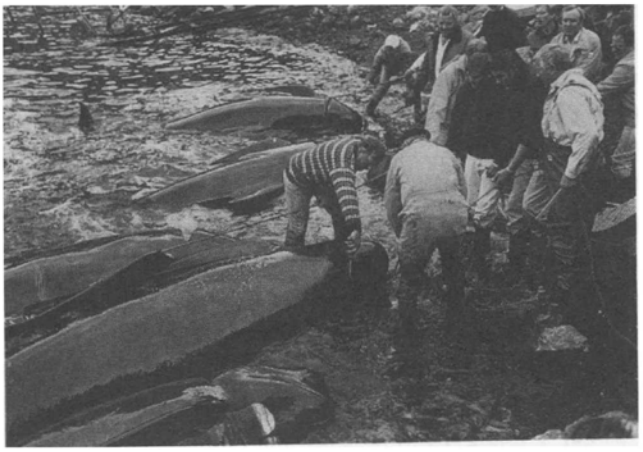

Figure 7 **Arteries cut, the beached whale will bleed to death.**

Figure 8 **Starting to cut into a living whale.**

https://doi.org/10.1017/S096272860001705X Published online by Cambridge University Press

Conclusions

From the results outlined above, the following conclusions can be drawn:

1. After the initial drive, there was an increase in behaviours such as spy hopping and tail lobbing by whales that had not yet been beached.
2. The gaff was used from boats, shore and by people wading into the water. When it was used from boats there was a towing time: for five whales recorded, this ranged from 45s to 108s (median: 66s; mean: 77s).
3. Fourteen primary strikes of the gaff into whales were recorded where success could be evaluated. Four resulted in the whale being securely fastened. In the other cases, additional strikes of the gaff were required to secure the whale.
4. The median number of gaff strikes recorded on a whale was two (*n*: 15; range: 0-4).
5. The body areas struck by the gaff were from the melon to the dorsal fin. Five of 35 strikes were on the side of the whale. Four strikes were on the melon of the whale.
6. The behaviour of the whale changed after it had been struck by the gaff. Whales gaffed in the water from boats were seen to dive and swim in the opposite direction to the boat.
7. The time from the first gaff strike to the loss of movement in seven whales ranged from 60s to 240s (median: 126s; mean: 141s).
8. Fourteen cutting episodes using the knife were recorded. Eight started behind the blowhole and six on the side of the whale.
9. The time from the first knife cut to loss of movement in seven whales ranged from 19s to 184s (median: 80s; mean: 88.6s)
10. The behaviour of the whale changed after cutting commenced. Whales that were being cut reacted with a strong arching of the back and rearing of the head.

Animal welfare implications

The International Whaling Commission (IWC) has examined whaling in relation to animal welfare considerations for almost two decades. In guidelines established in 1980, the IWC recommended that the ideal standard of a humane kill should require the animal to be killed without causing pain, stress or distress perceptible to the animal. It then stated that any humane killing technique should aim to render an animal insensitive to pain as swiftly as is technically possible (Anon 1980).

There are animal welfare implications in all phases of a drive hunt as described in this paper. The drive can occur over several hours. Data from 43 drives in a period from 1986-1988 revealed that the time taken to drive the pod to the shore ranged from 15min to 10h 45min (mean: 2h 22min) and pods have been kept in a bay overnight before being killed (Bloch *et al* 1990). As the hunt in the Faroe Islands usually involves the killing of all the members of a pod, killing will be occurring whilst other pod members remain in the water. The increase in stress-related behaviours such as spy hopping and tail lobbing reported in this paper indicates that distress occurs at this stage. These behaviours have also been noted in long drives when the drive has been stopped, again indicating distress (Bloch *et al* 1990).

However, it is the final stage, where the animal is secured, beached and killed which has many indicators relevant to evaluating the degree of humaneness in the hunt. The aim of the drive is to beach the pod so that the killing can be finished quickly and individual killing times reduced (Bloch *et al* 1990). The high incidence and multiple use of the gaff and the four separate drives attempted in the grind at Funningsfjord show that this aim was not achieved in this drive.

The multiple use of equipment used to secure and kill the whales (72% of whales recorded had more than one gaff strike, and 42% of whales recorded had more than one knife cutting episode), demonstrates a welfare problem. In this grind both pieces of equipment were used on all the whales recorded except one, and the gaff and knife were used on more than one occasion on a number of whales.

The results also show a non-specific targeting of both pieces of equipment. The fact that multiple gaff strikes were made on a target animal underlines the difficulty of achieving a secure fastening on a whale's body using a gaff. Nearly half the uses of the knife were not targeted on the area of the whale where access to blood vessels and the spinal cord would result in a quick kill.

The result is a reduction in the percentage of whales being killed quickly and an increase in the time that a whale is wounded. The shortest time recorded from when the gaff was first struck into a whale until loss of movement occurred was 60 seconds. This can be contrasted with a percentage of instantaneous deaths (defined as under 10 seconds in the Norwegian data) achieved in other whaling hunts. In the pelagic whaling operations targeting the minke whale (*Balaenoptera acutorostrata*), explosive harpoons are used as the primary killing method. Of 226 minke whales hunted by Norway in 1993, 50.4% died instantaneously (Øen 1994), as did 29.4% of 330 minke whales hunted by Japan in 1993 (Government of Japan 1994) and 45% of 264 minke whales killed by Norway in 1984, 1985 and 1986 (Øen 1992). Given the methods used in the Faroese drive hunt and the fact that the animal is usually secured before exsanguination takes place, an instantaneous death of any whale may be unachievable in this hunt.

A number of factors determine the length of time taken for a whale to be killed in the Faroe Islands: the topography of the whaling bay, the number of whales in the pod, the number of whalers present (and thus the ratio of whalers to whales) and the proficiency of the whalers (Bloch *et al* 1990). The difficulties resulting from the topography of Funningsfjord have already been described and may have exacerbated the problems of successfully beaching the whales. As the pod split into groups a successful beaching of the entire pod did not occur, increasing the total duration of the killing phase which lasted for approximately two hours in several phases (see Figure 2 for times of the main drives).

However, most of the animal welfare problems in this hunt are associated with the high degree of multiple uses of equipment and low targeting efficiency of the equipment on the whale. This implies a low degree of proficiency on the part of the whalers. Other whale hunts, such as the Norwegian minke whale hunt mentioned above, have an obligatory training and educational programme for all gunners and licence holders (ie all those that use the equipment in these hunts). This programme includes shooting trials and tests of equipment (Øen 1994).

In the Faroe Islands, although regular meetings are held with the sheriffs and foreman in each whaling district (Anon 1988), there is no organized regular training or test of whalers' proficiency prior to a grind. Indeed anyone can partake in the hunt without prior notification or experience. Regular drives do not occur at Funningsfjord. Forty-seven grinds have occurred in the bay since 1725, making it tenth ranked of the whaling bays in the Faroe Islands for regularity of grinds (Zachariassen 1993), and the previous drive to the one documented in this paper occurred on January 21 1988.

The data presented in this paper lead to the conclusion that a serious welfare problem does exist in the drive hunt that occurs in the Faroe Islands. Further data on welfare considerations in the Faroese drive hunt, particularly on the use of the equipment, are required before a complete assessment of the reasons for the welfare problems outlined above can occur.

Acknowledgements

We gratefully acknowledge the technical assistance and guidance of Steve Kestin (University of Bristol) on interpretation of data and animal behaviour and anatomy.

References

Amos B, Bloch D, Desportes G, Majerus T M O, Bancroft D R, Barrett J A and Dover G A 1993 A review of molecular evidence relating to social organisation and breeding system in the long-finned pilot whale. In Donovan G P, Lockyer C H and Martin A R (eds) *Biology of Northern Hemisphere Pilot Whales* pp 209-219. Report of International Whaling Commission Special Issue 14. IWC: Cambridge

Anon 1980 Report of the workshop on humane killing techniques for whales. *IWC/33/15.* International Whaling Commission

Anon 1988 Response from the Danish Government on the methods used in the Faroese pilot whale hunt. *TC/40/HK5.* International Whaling Commission

Anon 1992 Report of the workshop on humane killing techniques for whales. *IWC/44/18.* International Whaling Commission

Anon 1994 Report of the Humane Killing Working Group. *46/18.* International Whaling Commission

Blackmore D K, Nutman A, Barnes G R G, Madie P, Davies A S, Bowling M C, Donoghue M and Kirk E J 1994 Preliminary investigation of techniques for killing whales. *IWC/46/HK4.* International Whaling Commission

Bloch D, Desportes G, Hoydal K and Jean P 1990 Pilot whaling in the Faroe Islands. *North Atlantic Studies Vol 2 Nos 1 & 2:* 36-44

Bloch D, Desportes G, Mouritsen R, Skaaning S and Stefansson E 1993 An introduction to studies of the ecology and status of the long-finned pilot whale (*Globicephala melas*) off the Faroe Islands, 1986-1988. In Donovan G P, Lockyer C H and Martin A R (eds) *Biology of Northern Hemisphere Pilot Whales* pp 1-53. Report of International Whaling Commission Special Issue 14. IWC: Cambridge

Borrell A and Aguilar A 1993 DDT and PCB pollution in blubber and muscle of long-finned pilot whales from the Faroe Islands. In Donovan G P, Lockyer C H and Martin A

R (eds) *Biology of Northern Hemisphere Pilot Whales* pp 351-359. Report of International Whaling Commission Special Issue 14. IWC: Cambridge

Burne R H 1952 *Handbook of Cetacean Dissections.* British Museum: London

Caurant F, Amiard-Triquet C and Amiard J C 1993 Factors influencing the accumulation of metals in pilot whales (*Globicephala melas*) off the Faroe Islands. In Donovan G P, Lockyer C H and Martin A R (eds) *Biology of Northern Hemisphere Pilot Whales* pp 369-391. Report of International Whaling Commission Special Issue 14. IWC: Cambridge

Geodaetisk Institute 1983 *1:200 000 map of the Faroe Islands.* Geodaetisk Institute: Denmark

Gibson J, Thornton A and Currey D 1987 *Pilot Whaling in the Faroe Islands.* Environmental Investigation Agency: London

Gibson-Lonsdale J J 1990 Pilot whaling in the Faroe Islands – its history and present significance. *Mammal Review 20:* 44-52

Government of Japan 1994 Report on humane killing of Antarctic minke whales for the 1993/4 season. *IWC/46/HK5.* International Whaling Commission

Hoydal K 1986 Recent changes to Faroese legislation on whaling. *TC/38/HK4.* International Whaling Commission

Hoydal K and Lastein L 1993 Analysis of Faroese catches of pilot whales (1709-1992) in relation to environmental variations. In Donovan G P, Lockyer C H and Martin A R (eds) *Biology of Northern Hemisphere Pilot Whales* pp 89-107. Report of International Whaling Commission Special Issue 14. IWC: Cambridge

Joensen J P 1976 Pilot whaling in the Faroe Islands. *Ethnologica Scandinavica 63:* 932-973

Klinowska M 1987 Preliminary list of catches, live strandings and sightings of the pilot whale (*Globicephala melaena*) in the British and Irish islands. *SC/93/SM2.* International Whaling Commission

Øen E 1992 Norwegian penthrite grenade for minke whales: hunting trials with prototypes of penthrite grenades in 1984 and results from the 1984, 1985 and 1986 seasons. *IWC/44/HK5.* International Whaling Commission

Øen E 1994 Hunting methods for minke whalers in Norway. Report from the 1993 scientific and traditional catch. *IWC/46/HK1.* International Whaling Commission 1992

Sanderson K 1991 *Whales and Whaling.* Department of Fisheries: Torshavn, Faroe Islands

Sergeant D E 1962 The biology of the pilot or pothead whale *Globicephala melaena* (Traill) in Newfoundland waters. *Bulletin 132, Bulletin of Fisheries Research Board of Canada.* FRBC: Ottawa

Thornton A and Gibson J J 1986 *Pilot Whaling in the Faroe Islands.* Environmental Investigation Agency: London

Zachariassen P 1993 Pilot whale catches in the Faroe Islands, 1709-1992. In Donovan G P, Lockyer C P and Martin A R (eds) *Biology of Northern Hemisphere Pilot Whales* pp 69-89. Report of International Whaling Commission Special Issue 14. IWC: Cambridge