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Animal welfare and the harp seal hunt in Atlantic Canada

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Abstract — Much attention has been given over the years to animal welfare issues surrounding the seal hunt in Atlantic Canada. However, very little information is available on this subject in the scientific literature. This article reports the results of observations made by representatives of the Canadian Veterinary Medical Association at the hunt in recent years and compares them with observations made by members of the International Fund for Animal Welfare. The conclusion is that the large majority of seals taken during this hunt (at best, 98% in work reported here) are killed in an acceptably humane manner. However, the small proportion of animals that are not killed effectively justifies continued attention to this hunt on the part of the veterinary profession.

Résumé — Le traitement approprié des animaux et la chasse aux phoques du Groenland dans l'est du Canada. Beaucoup d'attention a été attribuée, au cours des années, au traitement des animaux durant la chasse aux phoques dans l'est du Canada. Cependant, il y a très peu d'information disponible sur ce sujet dans la littérature scientifique. Cet article décrit les observations de la chasse faites depuis les quelques dernières années par des représentants de l'Association Vétérinaire Canadienne et les compare aux observations faites par des membres d'un groupe de protection des animaux (International Fund for Animal Welfare). Cet article conclut que la grande majorité des phoques pris durant cette chasse (au mieux, 98 % dans les travaux décrits ici) sont tués d'une manière acceptable du point de vue du traitement des animaux. Cependant, la petite proportion des animaux qui ne sont pas tués d'une manière efficace justifie une attention continue à cette chasse de la part de la profession vétérinaire.

(Traduit par Dr. P.-Y. Daoust)

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Introduction

Harp seals (*Phoca groenlandica*) and hooded seals (*Cystophora cristata*) are ice-breeding species that migrate annually between arctic and subarctic regions of the Atlantic. The northwestern population moves between Davis Strait in summer and whelping grounds in late winter, namely, northeast of Newfoundland (the "Front") and in the Gulf of St. Lawrence (the "Gulf"), usually in the vicinity of the Magdalen Islands. Females give birth in March; young harp seals are weaned after approximately 12 d and hooded seals after only 4 d; the young of both species are immediately abandoned by their mothers. These 2 species, but particularly the harp seal because of its large numbers, have been the basis of the seal hunt in Atlantic Canada for more than 200 y (1). The long white fur of newborn harp seals ("whitecoats"), which starts being shed at about 14 d of age, was particularly prized. Newborn harp seals gain weight (mainly fat) very rapidly, move little on the ice, and do not go into the water. It is, therefore, very easy to approach and kill them with a blow to the head, either with a regulation wooden club (60–100 cm long) or a regulation hakapik (105–153 cm long, with a metal ferrule with a slightly bent spike on one side and a blunt projection on the opposite side) (2). The hunt reached its greatest magnitude in the middle of the 19th century, when more than 400 000 pelts were landed annually; however, this level of overexploitation could not be sustained for long before the size of the stock and, consequently, the catches decreased (1).

The issue of animal welfare associated with the harp seal hunt was raised in Newfoundland as early as the first half of the 19th century (1), but it came to the forefront in the mid 1960s, when television brought pictures of the hunt to the general public. According to

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Malouf (3), "[i]nhumane practices in the seal hunt were apparently common prior to the 1965 hunt, when the first government regulations to prevent such practices were put into force." Subsequently, instances in which inexperienced hunters were allowed to join the hunt, such as in 1981 off the north shore of Prince Edward Island, also resulted in inappropriate killing procedures. A ban by the European Economic Community (EEC) on the importation of products from harp and hooded seals, starting in the early 1980s, led to the collapse of the hunt (4). In 1987, following the release of the report of the Royal Commission on Seals and Sealing (3), the Minister of Fisheries and Oceans established new regulations that prohibited the commercial hunt of whitecoats and "bluebacks" (young hooded seals, which do not shed their newborn coat until they are approximately 15 mo old). Currently, quotas for the hunt are set at 275 000 harp seals and 10 000 hooded seals. "Beaters" (young harp seals, approximately 3–4 wk old, that have completely shed their white coats) now constitute the bulk of the hunt. These animals are more wary than whitecoats and far more likely to move away and go into the water at the approach of sealers. Therefore, killing by fracturing the skull with a hakapik has become less practical, and sealers now often rely on shooting the animals with a rifle from their vessel. Ice conditions, which, in recent past, have varied considerably from year to year, also influence the nature of the hunt. Years of poor ice formation, with predominance of small ice floes, have led to a larger proportion of the animals being shot rather than struck with a hakapik.

The Department of Fisheries and Oceans Canada (DFO) has adopted a series of regulations aimed at promoting humane methods of killing seals. These regulations include, among others, the minimum and maximum dimensions of both the club and the hakapik, and the minimum caliber of rifle and minimum bullet velocity that can be used, and the stipulations that: 1) "[e]very person who strikes a seal with a club or hakapik shall strike the seal on the forehead until its skull has been crushed," 2) "[n]o person shall commence to skin or bleed a seal until the seal is dead," and 3) "a seal is dead when it has a glassy-eyed, staring appearance and exhibits no blinking reflex when its eye is touched while it is in a relaxed condition" (2). Various animal welfare groups have continued to monitor the hunt closely in order to verify compliance by the sealers and record violations. This monitoring process has focussed almost entirely on the hunt in the Gulf of St. Lawrence, as opposed to the hunt at the Front, which occurs in a geographically more remote area.

Although veterinarians became involved in the assessment of the welfare issues related to the hunt in the Gulf in the mid 1960s (5, cited in 3) and at the Front in the early 1970s (6, cited in 3), the Canadian Veterinary Medical Association (CVMA) became involved officially in this assessment in the late 1970s and early 1980s, coinciding with the move by the EEC to boycott the industry. In recent years, the CVMA again sent observers to the hunt, following submission by some animal welfare groups of videotapes that were alleged to demonstrate clear instances of animal abuse. The questions of interest to the CVMA Animal Welfare Committee were as follows: 1) Can seals be killed humanely by the methods in use? 2) If so, are the sealers using those methods correctly, so as to achieve this, most or all of the time? One issue of contention has been the "swimming reflex." When killed by acute trauma to the brain, harp seals, like other animals, often undergo a period of tremors or convulsions. These consist of strong lateral movements of the caudal portion of the body, described as "swimming reflex" (hereafter referred to as "reflex movements"), which have been interpreted by some animal welfare advocates as implying persistence of conscious life.

The vast majority of observations at the seal hunt, either by representatives of the CVMA or by other veterinarians, are in the form of internal reports that are not easily accessible. This article summarizes the activities of members of the CVMA to date in their attempts at evaluating objectively, from the perspective of animal welfare, the killing methods used during the seal hunt. The views expressed in this article are those of the authors and do not constitute an official position of the CVMA.

Materials and methods

From 1979 to 1984, groups of up to 5 veterinarians representing the CVMA attended part of the hunt in the Gulf, observed sealers as they killed whitecoats, and collected skulls from carcasses for more detailed examination (7–9). In 1999, authors Bollinger and Campbell made comparable observations on beaters in the Gulf, while Daoust and Wong attended part of the hunt at the Front. In 2001, Daoust attended part of the hunt in the Gulf and collected 7 skulls from carcasses of recently killed seals for more detailed examination.

Authors Daoust and Crook carefully reviewed 4 of 11 videotapes of the 2001 hunt in the Gulf, taken from helicopters by members of the International Fund for Animal Welfare (IFAW) and submitted on an unsolicited basis to the CVMA's Animal Welfare Committee. These videotapes were accompanied by a detailed log of observations on each seal and conclusions by members of IFAW about the occurrence of violations and abuses, or lack thereof. A summary of these conclusions included a category of 9 types of "violations and abuses" and another category of 8 types of "possible violations and abuses." This article focuses on 6 of the 9 alleged violations and abuses, more specifically those that are directly relevant to animal welfare issues. The 4 videotapes that were carefully reviewed (#1743, #1878, #1880, #1887) were selected, following consultation of the accompanying log of observations, in order to include as many as possible of the different categories of alleged violations. These 4 videotapes involved a total of 116 interactions between harp seals and sealers, or 37.4% of a total of 310 such interactions recorded in the 11 videotapes.

Results

Reports on the hunt provided by representatives of the CVMA during the years 1979 to 1985 did not include factual information about the exact numbers of animals that were observed being killed and skulls that were examined. Comments were of a general nature and

Table 1. Summary of observations of 167 harp seals struck with a hakapik or shot during the seal hunt, Gulf of St. Lawrence, March 2001

	Number
Calvarium completely crushed by blow	86
Left or right half of calvarium crushed	9
Calvarium not crushed, only fractured[a]	5
(subtotal)	(100)[b]
Animal shot only[c]	3
Animal shot and struck[d]	40
Killing process not observed[e]	12
Animal shot or struck and lost[f] (5.4%)	9
Animal still alive and conscious on deck[g] (1.8%)	3
Total	167

[a]Cases in this group include skulls with only nondisplaced fractures of the calvarium, and skulls where only the frontal portion of the calvarium had multiple fractures
[b]All these animals were considered dead when first seen on the vessel's deck.
[c]Skull and brain completely destroyed in 2 animals. The 3rd animal was shot in the neck and never moved
[d]It was not possible in these cases to distinguish damage caused by the bullet from that caused by the blow(s). Some of these animals (proportion undetermined) may not have been killed instantly by the bullet
[e]These animals were seen to be struck on the ice and brought on board, but details of the killing process were not closely observed and the skull was not examined by the author because too many carcasses were being processed at once
[f]Some of the animals struck may not have received a lethal blow
[g]All three animals were displaying a distinct state of "paralysis" (10) when first

indicated that striking the head with a heavy blow from a club or a hakapik was an efficient method of killing whitecoats. Specifically, "[m]ost skulls exhibited massive depression fractures causing extensive compression and tearing of the brain. Postmortem examinations were purposely carried out on skulls which exhibited minor evidence of cranial fractures. It was the opinion of the Committee that the level of direct and contrecoup hemorrhage was such that immediate unconsciousness was assured and the seal pups were insensitive to pain prior to exsanguination" (8). The observers considered that, when applied properly, a 1st blow was effective in rendering the pups unconscious, but they recommended that, for additional assurance, 3 blows be given, followed by exsanguination by means of severing the brachial arteries.

During the hunt in the Gulf in 1999, which was carried out mainly with the use of hakapiks, Bollinger and Campbell examined a minimum of 225 carcasses of beaters. At least 220 of these carcasses were of animals that had been killed prior to the observers' arrival on the ice floes. Skulls of all but 4 (1.8%) carcasses had multiple depressed fractures of the calvarium, with massive destruction of the underlying cerebral cortex. Of the 4 skulls without multiple calvarial fractures, 3 had fractures of the maxillary bones. The 4th skull showed no fracture, but a large subdural hematoma was found following removal of the calvarium. Therefore, these 4 seals may have been rendered unconscious by concussion after the blow(s), although the possibility that they would have retained or regained consciousness before being bled to death could not be ruled out. Only 5 seals were actually observed being struck. Two of these showed reflex movements that lasted 30 and 45 s, respectively. In both instances, subsequent examination of the skull showed massive fractures.

The hunt in the Gulf in 2001 involved the use of hakapiks and rifles in roughly equal proportions. During that hunt, Daoust boarded 4 different sealing vessels, where, during a total of 16 h, sealers were observed shooting seals from the vessels or striking their heads with hakapiks on the ice. Skulls of carcasses that were returned to the vessels to be bled and skinned were examined. A total of 167 animals shot or struck on the head and brought on board ($n = 158$) or lost ($n = 9$) were recorded. Table 1 provides a summary of observations on these animals. When seals were shot from vessels, sealers commonly struck them with their hakapik as soon as they reached them on the ice, whether or not these seals showed any evidence of life. In most cases (estimated $\geq 85\%$), the interval between the shot and the blow(s) (resulting primarily from the time required for the vessel to get close enough to the ice floe for 1 of the sealers to land) was ≤ 1 min. A certain proportion of animals (3 of 8, in one instance where exact records were kept) were still alive during that interval, as shown by the conspicuous movements of their head. Of 100 animals for which a record of the specific type of skull damage caused by strikes with hakapiks was kept, 86 had a completely crushed calvarium with complete destruction of both cerebral hemispheres; 9 had only the left or right half of their calvarium crushed, that is, with only 1 cerebral hemisphere completely destroyed; and 5 had only nondisplaced fracture(s) of the calvarium or multiple fractures involving only its frontal portion (Table 1). When seen on deck, all animals in these 3 groups were considered dead. None of them showed any sign of movement that could be interpreted as voluntary and, therefore, suggestive of consciousness, and none of them was breathing. In all animals, the cranial portion of the body was in a relaxed state, meaning that the neck was well extended, the front flippers were motionless,

Table 2. Results of 116 interactions between harp seals and sealers recorded on videotapes during the seal hunt, Gulf of St. Lawrence, March 2001, and directly pertaining to animal welfare issues, as interpreted by members of the International Fund for Animal Welfare (IFAW) and by 2 of the authors[a]

		Daoust and Crook			
Alleged violations agree	IFAW	videotape inconclusive[c]	do not agree[d]	questionable/ possible[e]	
1. seal still conscious after having been shot ("shooting and leaving to suffer"[b])	24	1	11	4	8[f]
2. seal still conscious after having been struck on the head ("clubbing and leaving to suffer"[b])	7	1	2	4	0
3. hooking a live seal	10	0	7	1	2
4. bleeding a live seal	8	0	4	4	0
5. skinning a live seal	3	0	3	0	0
6. shot and lost	3	0	3	0	0
Total	55[g]	2	27	13	13[h]

[a]Videotapes #1743, #1878, #1880, and #1887 taken from helicopters by members of IFAW and submitted to the Animal Welfare Committee of the Canadian Veterinary Medical Association
[b]Terminology used by IFAW in the log accompanying the videotapes
[c]The videotape did not include the moment at which the seal was shot or struck on the head with a hakapik, nor the following several seconds. Therefore, the immediate reaction of the seal to the shot or strike could not be evaluated, and subsequent sequences failed to show evidence of the animal still being alive
[d]The seals showed no evidence of life after having been either shot or struck on the head with a hakapik. Movements displayed by some of these seals were entirely compatible with slight to moderate reflex movements ("swimming reflex")
[e]Observations suggesting that the animal may have still been alive (e.g. lack of blood coming out of the head, marked and prolonged convulsive movements, rolling motion, apparent contraction of body) were too dubious for agreement or were seen from too far a distance to be conclusive
[f]In these 8 cases, there was a time lapse after the seal was shot but not killed and before the vessel reached the wounded seal(s) and the killing process was completed. In 6 of these cases for which the duration of this interval could be precisely recorded, the average duration was 45.2 s (see text)
[g]These 55 alleged violations involved a total of 39 (33.6%) of 116 seals interacting with sealers

and both eyes had a "glassy-eyed, staring appearance," although a substantial number of animals in all 3 groups exhibited some degree of reflex movements. The corneal ("blinking") reflex was checked in a few animals and was not observed in any of them. Seven skulls with only one side of the calvarium crushed ($n = 2$), only the frontal bones crushed ($n = 3$), or nondisplaced fracture(s) of the calvarium that could not be felt readily on palpation ($n = 2$) were collected and frozen. Close examination of these skulls at a later date revealed multiple severe fractures that involved the floor of the cranial cavity in all cases and the occipital, or temporal, or both regions in some cases; all regions of the skull that would be difficult to palpate reliably in carcasses. In all cases, the brain showed varying degrees of laceration and hemorrhage, but none of these involved the medullary region of the brain stem.

Several animals were observed by Daoust to exhibit moderate to marked reflex movements and were subsequently confirmed to have completely crushed skulls, although few detailed records were kept on this particular point. In most cases, these reflex movements lasted approximately 20 to 30 s. A delay of at least a few seconds often occurred between the strikes and the beginning of the reflex movements. On occasion, they were seen to start once the animal was on deck. Three (1.9%) of 158 animals brought on board (excluding the 9 animals that were lost) (Table 1) were considered to be still alive and conscious when first seen by Daoust. This conclusion was based on the fact that all 3 animals displayed a distinct state of voluntary contraction of their whole body, which is known as "paralysis" and thought to represent a fear-induced passive defence response in this species (10). When struck on the head with a hakapik, all 3 animals immediately relaxed from their state of contraction.

Table 2 provides a summary of the outcome of killing procedures in the Gulf recorded on videotapes in 2001, as interpreted by members of IFAW and by authors Daoust and Crook. In the 4 videotapes examined by both parties, members of IFAW considered that 55 violations pertaining directly to animal welfare issues and involving 39 (33.6%) of 116 seals had occurred. Daoust and Crook agreed with 13 (23.6%) of these 55 alleged violations, involving 12 (10.3%) of 116 seals. In 8 cases of allegedly "shooting and leaving to suffer," the time that the seal was "left to suffer" after having been shot but not killed refers to the time taken by the vessel to reach the ice floe carrying the seal(s) that had been shot and for the killing process to be completed. In 6 of these 8 cases, the average interval between the seal being shot and being struck with a hakapik or, in one instance, being shot and hooked (in order to be brought on deck) and then bled and skinned without being struck, was 45.2 s (range, 12–111 s). In the remaining 2 cases, for which the final outcome was not recorded on the videotape, the interval between the seal being shot and the vessel reaching it was 15 s in one case and 22 s in the other. In 2 cases of allegedly "hooking a live seal," the animal contracted its body in a manner compatible with "paralysis" and, thus, consciousness. One of these 2 animals had been shot, but presumably not killed, and had been hooked from the vessel in order to be brought on board, where it was subsequently bled and

Table 3. Reports of observations at the seal hunt in the Gulf of St. Lawrence (Gulf) and northeast of Newfoundland (Front) that included quantitative information pertaining to the results of the killing methods, as reported in Malouf (3). Most or all animals were assumed to be newborn, and all animals except 1 were harp seals. All animals in the Gulf were killed by a blow to the head. Animals at the Front were killed by shooting

Author, year	Report to	Comments
Simpson, 1967	Nature 214:1274	Gulf. 56 (36.4%) of 154 skulls had unfractured crania.
Walsh, 1967	International Society for the Protection of Animals	Gulf. 18 (3.5%) of 512 skulls did not appear to have been fractured, 3 (0.6%) appeared to have been fractured only on the nose, and the rest (95.9%) appeared to have been properly fractured.
Schiefer, 1968	Frankfurt Zoological Society	Gulf. 651 (93.6%) of 695 carcasses had skull fractures and/or brain hemorrhages and were probably dead or unconscious before skinning. Another 1.7% were probably unconscious. It could not be determined whether the other 4.7% were unconscious at the time of skinning.
Ronald, 1977	Canadian Federation of Humane societies	Gulf. 0% of more than 400 skulls were unfractured.
Jordan, 1978	Royal Society for the Prevention of Cruelty to Animals	Gulf. The skulls of 7 (53.8%) of 13 pups examined had not been fractured.
Rowsell, 1977	Commission on Seals and Sealing; Canadian Federation of Humane Societies	Front. 10 (13%) of 76 seals (75 harp, 1 hooded) shot would not have been rendered unconscious instantly.

skinned without having been struck. Details of the videotape were not sufficiently clear to determine whether this seal was still alive when it was bled and skinned. An interval of 54 s elapsed from the time that this seal was shot and wounded to the time that the bleeding and skinning process started. In the other case, an interval of 18 s elapsed between the 1st blow, hooking the seal in order to pull it away from the edge of the ice floe, and the 2nd or multiple blows. Three seals were clearly shot and subsequently lost. A large proportion (87%) of the sealers recorded on the 4 videotapes failed to palpate the skull or check the corneal reflex before proceeding to hook or bleed the seal or go to another seal.

At the Front in 1999, all seals examined by Daoust and Wong were shot from vessels or small speed boats, and most of them had been killed by the time the observers arrived on site. Of 47 carcasses examined, 35 (75%) had been shot in the head (skull and brain completely destroyed ($n = 28$), mandible and base of cranial cavity destroyed ($n = 5$), snout and frontal region of cranial cavity destroyed ($n = 2$)). Six (13%) animals had been shot in the neck, with complete transection of the cervical portion of the vertebral column. Three (6%) animals had been shot in the ventral region of the neck with destruction of soft tissues, including major blood vessels, but no bone fracture. Two of these 3 animals were seen by the observers as they were shot. One appeared to die instantly, because it immediately stopped moving, and only its tail was twitching when it was brought on board, several seconds later. The other was seen from a distance; it showed some convulsions after being shot and fell off the ice floe into the water; it was dead and motionless, when retrieved a few minutes later. The remaining 3 (6%) animals had been shot in the thorax or abdomen; 1 of them was found alive by itself on an ice floe and was immediately killed with a hakapik by a DFO officer.

Discussion

Attempts at improving the effectiveness of methods used for the commercial killing of animals, whether they be domestic livestock or wild fur-bearers, have been ongoing for several decades. Similar efforts have been made for animals in humane society shelters and pounds. The ultimate goal is to ensure that the potential for pain and suffering is minimized as much as possible. According to the most recent report of the American Veterinary Medical Association's panel on euthanasia (11), "[p]ain is that sensation (perception) that results from nerve impulses reaching the cerebral cortex via ascending neural pathways. ...If the cerebral cortex is nonfunctional because of hypoxia, depression by drugs, electric shock, or concussion, pain is not experienced." This panel also recognized that "[p]ainless death can be achieved by properly stunning the animal, followed immediately by exsanguination." According to Lopes da Silva (12), unconsciousness requires disturbance of both cerebral cortices and of the mesencephalic reticular formation. Following a high-velocity blow to the head, this disturbance may be caused directly by traumatic injury or via distortion waves through the nervous tissue induced by the blow (13).

Malouf (3) cited a few reports that provided quantitative information pertaining to killing methods at the seal

hunt, only 1 of which (14) is available in refereed literature (Table 3). The proportion of animals alleged to have been improperly killed, based on the extent of skull damage, varies widely in these reports (0% to 53.8%). However, as pointed out by Malouf (3), the absence of a skull fracture does not imply consciousness at the time of bleeding, since a severe concussion or cerebral hemorrhage is sufficient to induce unconsciousness or even death in the absence of skull fracture. In humans with blunt traumatic head injury, coma and death may occur with minimal or no contusion as a result of microscopic diffuse brain damage, such as diffuse axonal injury, ischemic brain damage, brain swelling, and diffuse vascular injury (15). In the present study, the skulls of 7 seals collected in the Gulf in 2001 that, on superficial examination, had potentially insufficient damage to cause unconsciousness turned out to have severe fractures of the floor of the cranial cavity. These 7 seals had shown no vital signs, including no evidence of breathing, when brought on deck. Although the medullary region of the brain stem of these 7 seals was morphologically intact, the presence of a fracture of the floor of these skulls suggests a severe concussion and functional inactivation of this part of the brain.

In 2001, a group of 5 independent veterinarians was commissioned by IFAW to observe the seal hunt in the Gulf, at the same time and in the same general location as Daoust. These veterinarians observed the killing process from helicopters and also landed on ice floes to examine carcasses left behind by the sealers. Based on their report (16), submitted to the CVMA's Animal Welfare Committee, 13 (17%) of 76 skulls evaluated by visual examination and palpation had no detectable lesions; 19 (25%) skulls had minimal to moderate lesions (hair-line and nondisplaced fractures involving 1 cortical hemisphere, or compression fractures involving bone overlying only 1 cortical hemisphere); and the remaining 44 (58%) skulls had severe to extensive lesions (compression fractures overlying both cortical hemispheres, some with visually apparent compressed brain tissue). Loss of consciousness at a high level of probability was considered to have been associated only with skulls with severe to extensive lesions. The amount of damage to the brains from 3 skulls with moderate lesions that were examined in more detail was considered "not consistent with resulting in a level of unconsciousness." The veterinarians' report did not acknowledge the possibility that these seals had been rendered unconscious from concussion prior to being bled. Their observations are also at variance with those of Daoust, who, at the same time and in the same location, recorded that 86% of skulls had been completely crushed by strikes with hakapiks. His presence on board of sealing vessels may have incited sealers to hit the seals' skulls more vigorously. However, 2 y previously, Bollinger and Campbell had recorded that 98.2% of the skulls examined were completely crushed, and almost all were from animals that had been killed prior to their arrival.

The calvarium of the skull of harp seals and hooded seals, at least up to 1 y of age, is very thin as compared with that of terrestrial mammals of comparable size, such as raccoons and dogs (personal observation, Daoust). Therefore, the skulls of these seals can be crushed easily by 1 or a few blows from a hakapik, destroying both underlying cerebral hemispheres. Complete collapse of the calvarium can be verified quickly and reliably by palpation through the skin and blubber. In an experiment involving 3 young hooded seals (bluebacks), Blix and Øritsland (17) showed that a single blow to the head produced an immediate and irreversible disappearance of brain activity, as recorded by an electroencephalogram, although respiration and heart beats continued for several minutes. In this instance, exsanguination was not considered a necessary procedure but an extra precautionary measure. Current federal regulations consider that the absence of corneal reflex in seals is one of the criteria of death (2). Actual brain death, as compared with simple loss of consciousness, is defined as complete irreversible loss of brain stem function, including cessation of circulatory and respiratory functions (18). Disappearance of the corneal reflex implies at least severe depression of brain stem activity. During surgical anesthesia, this plane of depression, although potentially reversible, is considered to have reached a dangerously low level (19). However, livestock (sheep and calves) experimentally stunned by nonpenetrative percussion lost their corneal reflex, which returned together with the righting reflex within 20 s to 2 min (20), indicating that loss of the corneal reflex is not a definite sign of irreversible unconsciousness. The CVMA has recommended to the DFO that, when a wooden club or hakapik is used, the sealer should check by palpation that the skull is completely crushed, to ensure that the unconsciousness is irreversible.

The frequent occurrence of strong swimming actions in seals killed by trauma complicates the determination of their death from a distance, for example by videotape. These reflex movements may last considerably longer in seals than in terrestrial animals because of the unique adaptation of their musculature to diving, including a much larger store of oxygen associated with the higher concentration of myoglobin (21). Moreover, the pattern of this reflex activity can be erratic and does not necessarily decrease gradually in intensity from the time of death. For example, sheep and cattle stunned by nonpenetrative percussion collapsed with signs of tremors, followed by slow hind leg movements that increased in frequency and could develop into vigorous hind leg kicking (20,22). Complete immobility immediately following a blow to the head should actually alert the sealer to the possibility that the animal is still conscious, especially if this immobility is accompanied by contraction of the body. This fear-induced "paralysis" is a typical behavior of harp seals (10) and hooded seals (personal observation, Daoust); other authors (cited in 3) have commented on the possibility that such immobile seals might be interpreted as dead by inexperienced sealers and, therefore, might still be conscious when skinning begins.

The videotapes recorded by IFAW members during the 2001 hunt in the Gulf represented a useful tool to review the hunting methods in relation to environmental conditions and to assess the quality of the hunt in general. In several instances, however, insufficient details were available on individual seals to permit an objective

assessment of their state of consciousness following a rifle shot or a strike with a hakapik. In a large proportion of the cases of concern to IFAW members (24 out of 55), this concern was based on the apparent failure of the hunter to kill the seal instantaneously with the initial rifle shot. In 8 (33%) of these 24 cases, Daoust and Crook agreed with IFAW members that the seal had not been killed instantaneously (Table 2). When specifically timed, thanks to the good quality of the videotapes and details of the accompanying logs provided by IFAW, it was determined that an average of 45.2 s elapsed between the animal being shot and a sealer killing it with a hakapik or, in one instance, being brought on board without being struck. The best way to reduce this interval would have been for the hunter to shoot the animal again from the vessel. However, the erratic movements of the wounded animal, coupled with the bobbing movements of the vessel, would not guarantee the immediate success of a 2nd shot. No interval between an animal being shot and losing consciousness will ever be acceptable to some people. Conversely, others may consider that, in cases when the animal is not killed by the initial shot, an average interval of 45.2 s between being wounded and dying is acceptable from a humane perspective. For comparison, in the section of the Agreement on International Humane Trapping Standards (23) dealing with traps designed to kill a trapped animal of the target species, the designated time limit to irreversible loss of corneal reflexes in a least 80% of the animals caught in the trap varies from 45 s in ermine (*Mustela erminea*), to 120 s in pine marten (*Martes americana*), to 300 s in 17 other species of North American and European fur-bearing animals. This comparison shows that the killing process at the seal hunt compares well with what is currently agreed upon internationally for trapped animals. Notwithstanding, the Agreement on International Humane Trapping Standards (23) also requires that the parties involved continue research with a view to lowering the threshold requirements agreed upon.

Most hunters recorded on videotapes taken by IFAW members during the 2001 hunt in the Gulf failed to palpate the skull or check the corneal reflex before proceeding to hook or bleed the seal, or go to another seal. Some sealers claim that they can feel the collapse of the calvarium as they strike the seal. Nonetheless, the presence of an incompletely crushed skull in 14% of seals killed with a hakapik (Table 1) and the occasional occurrence of live seals being hooked and brought on board should justify a more diligent adherence to either of these 2 simple tests. Exsanguination without delay also remains an important safety measure to ensure that a seal rendered unconscious by a blow to the head will never regain consciousness. According to Malouf (3), "[i]f the requirements for checking the blink reflex and for immediate exsanguination were invariably observed, virtually no animals would be killed in other than an extremely humane way."

The wide open nature of the habitat where the harp seal hunt occurs has made it particularly amenable to intense scrutiny. Yet, because of this wide open environment, coupled with the relatively docile behavior of the target animals, the seal hunt has the potential to be among the most humanely conducted hunts of wild animals, whether for commerce or sport. We believe that, currently, the large majority of seals taken during this hunt are killed in an acceptably humane manner. During the 2001 season in the Gulf, 3 (1.9%) of 158 seals brought on board of the sealing vessels and directly observed by Daoust had not been killed, and in 1 (0.86%) of 116 interactions between seals and sealers observed on videotapes by Daoust and Crook, the seal also did not appear to have been killed before being hooked and brought on board. This small proportion of animals that are not killed efficiently justifies continued attention to this industry's activities, preferably by members of the veterinary profession, who are best equipped to assess the humaneness of the killing methods. A welfare audit of 41 beef slaughter plants in the United States in 1999 revealed that the percentages of cattle stunned with 1 shot from a captive bolt stunner were 100% at 5 (12%) plants, 99% at 10 (24%) plants, 95 to 98% at 22 (54%) plants, 90 to 94% at 2 (5%) plants, and $<$ 90% at 2 (5%) plants (24). All cattle where the 1st shot missed were immediately restunned. The author emphasized the need for continuous auditing in order to prevent deterioration of handling practices. Ultimately, the quality of the seal hunt will depend on appropriate and enforceable regulations, adequate supervision and monitoring by DFO officers, and the training and ethics of the sealers.

Veterinary medicine, particularly as it relates to domestic livestock, has gradually broadened its interests from a focus on the prevention and treatment of diseases in individual animals to the concept of herd health. This should also apply to wildlife health. The issue of the humane harvest of harp and hooded seals must continue to be of concern to the veterinary profession, as should the status of their respective populations. A recent report on seal management indicates that the current total allowable catch of 275 000 harp seals for the Gulf and Front is within the estimates of replacement yield for this region, but it recommends a cautionary approach in the management of this and other wild living marine resources (25). A return to years of overexploitation must be avoided.

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CORRECTION

In the July 2002 issue of the *CVJ,* CVMA member Dr. Walt Ingwersen was mistakenly listed as a participant of the PetLynx Advisory Council (Evans L. PetLynx and the Canadian Federation of Humane Societies Create a National Lost and Found for Pets [news]. Can Vet J 2002;43:521). While PetLynx (together with other microchip companies) has provided partial sponsorship for Dr. Ingwersen's activities as chair of the CVMA Microchip Committee in the past, Dr. Ingwersen has no formal affiliation with PetLynx Corporation.

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