Animal Welfare aspects of the killing and skinning of seals[1]

Scientific Opinion of the Panel on Animal Health and Welfare

(Question No EFSA-Q-2007-118)

Adopted on 6 December 2007

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PANEL MEMBERS

The Scientific Panel for Animal Health and Welfare (AHAW) of the European Food Safety Authority adopted the current Scientific Opinion on 6 December 2007. The Members of the AHAW Scientific Panel were:

Bo Algers, Harry J. Blokhuis, Donald M. Broom, Patrizia Costa, Mariano Domingo, Mathias Greiner, Daniel Guemene, Jörg Hartung, Frank Koenen, Christine Muller-Graf, David B. Morton, Albert Osterhaus, Dirk U. Pfeiffer, Ron Roberts, Moez Sanaa, Mo Salman, J. Michael Sharp, Philippe Vannier, Martin Wierup, Marion Wooldridge.

SUMMARY

In September 2006, the Council of Europe adopted a recommendation on seal hunting inviting member and observer states to ban all cruel seal hunting methods and to prohibit the stunning of animals with instruments such as hakapiks, bludgeons and guns. A written declaration was then adopted by the European Parliament requesting the Commission to draft a regulation to ban the import, export and sale of all harp and hooded seal products, whilst ensuring that this measure would not have an impact on traditional hunting (e.g. Inuit). The Commission undertook to make an assessment of the animal welfare aspects of the killing and skinning of seals and asked EFSA to issue a Scientific Opinion on this matter as well as to assess the most appropriate killing methods which reduce unnecessary pain, distress and suffering.

EFSA's Scientific Opinion was adopted by the Scientific Panel on Animal Health and Welfare (AHAW) on 6 December 2007. The Opinion critically evaluated the available evidence but little robust information was found that could be considered scientifically valid, robust and objective, and that had not been obtained without some form of bias, or there was a lack of independent verification. Nevertheless, it was possible to look objectively at the different methods used, their inherent advantages and disadvantages, their use in practice, and to draw some conclusions and recommendations. Ethical, social, cultural, economic and some relevant management aspects do not form part of this opinion (as they are outside EFSA's remit).

A stakeholders' consultation meeting was organised by EFSA on 4 October 2007 in Parma (Italy) to give an opportunity to interested parties to provide relevant scientific information and data. Twenty-five stakeholder organizations attended the meeting and the information provided was considered when drawing up the Scientific Opinion. In addition, following a general request for input to the EFSA Advisory Forum (AF Meeting, Berlin, 19 April 2007), the Norwegian Scientific Committee for Food Safety adopted a Scientific Opinion on the animal welfare aspects of the killing and skinning of seals in the Norwegian hunt, which was taken into consideration in EFSA's Scientific Opinion.

Seal hunting (killing and skinning) is commonly carried out around the Arctic, and in southern Africa. Around 750,000 seals of at least fifteen species are killed and skinned by humans for commercial purposes each year with Canada, Greenland and Namibia accounting for approximately 60% of all seals killed in 2006. The degree to which seal hunts are regulated by law and monitored by observers varies in different countries and range states. Moreover, reference to welfare aspects of killing of seals is not included in all current regulations. The killing of seals can be compared with the killing of wild, domesticated and captive animals; and the criteria used to assess whether or not the killing methods are humane could be similar. However, no equivalent data to that obtained in the abattoir are available for seals (e.g. time to loss of consciousness, monitoring points for unconsciousness that can be applied in the field). In practice, and in terms of welfare, the effectiveness of the killing methods used for seals vary according to the methods used, the skill of the operators, and the environmental conditions.

The Scientific Opinion concluded that seals are sentient mammals that can experience pain, distress, fear and other forms of suffering. It is pointed out that there are only a very limited number of studies published in peer-reviewed journals that can be used to evaluate, with a high degree of certainty, the efficacy of the various killing methods employed in different seal hunts around the world. Other studies (e.g. by NGOs, industry linked groups) that highlight serious deficiencies and concerns in the hunts, may contain potentially unproven serious biases (see Chapter 4). In relation to the killing methods, it was concluded that many seals can be, and are, killed rapidly and effectively without causing avoidable pain, distress, fear and other forms of suffering, using a variety of methods that aim to destroy sensory brain functions. However, there is strong evidence that, in practice, effective killing does not always occur but the degree to which it does not happen has been difficult to assess, partly because of a lack of objective

data and partly because of the genuine differences in interpretation of the available data. When seals are hit or shot, but are not dead, they may have to be hit or shot again or may they be moved or skinned whilst conscious, resulting in avoidable pain, distress, fear and other forms of suffering. In addition, seals may be struck and lost with injuries that may cause suffering and affect their survival in the wild. If seals are dead, or have been bled-out after adequate stunning from which they do not recover consciousness, then skinning is not a welfare problem. In terms of monitoring each seal to ensure death or unconsciousness before bleeding-out it was concluded that it is not always carried out effectively, and that this will lead to seals feeling the skinning cuts before loss of consciousness and death due to bleeding-out. It was also concluded that bleeding-out stunned seals to ensure death is frequently not carried out in some hunts. Some methods of killing seals are inhumane e.g. trapping seals underwater until they die, and should not be used. Seal hunts that involve herding before slaughter can cause fear and other forms of suffering in addition to any avoidable pain at the time of killing. Seals that are herded but are not targeted to be killed may suffer fear and, if the suckling young are separated from their nursing dams, they may also experience hunger until they are reconnected.

Seals should be protected from acts that cause them avoidable pain, distress, fear and other forms of suffering. Death or irreversible unconsciousness should be rapidly ensured after an attempt at killing or stunning by effective monitoring, and before bleeding-out and skinning are started. Observing the extent of brain injury, the presence or absence of responses such as the corneal (blink) reflexes, body movements, as well as palpation of the skull could be used for assessing and monitoring effective destruction of the brain. However, the presence of an intact skull would not necessarily mean that the animal had not been rendered unconscious or was dead and, conversely, a partial fracture could be compatible with consciousness and sensibility. Furthermore, some body movements may be voluntary or involuntary and can occur in dead or unconscious as well as conscious animals. Therefore, the establishment of reliable, practical and enforceable criteria to ensure that the degree of brain damage is such that an animal is irreversibly insensible or dead need to be found. In some countries training of sealers is mandatory and only hunters who pass a shooting proficiency test are allowed to kill seals. However, little information recorded by independent observers exists on the effectiveness of the training programmes, as well as on ways in which hunts can be monitored using criteria that define avoidable pain, distress and fear. As a way to help ensure the humane killing of seals, the “three-step” method of effective hitting/shooting, effective monitoring, and effective bleeding-out, as well as a fourth step of effective implementation should be recommended.

Key words: seal welfare, stunning, killing, bleeding, skinning, seal hunting, consciousness, unconsciousness.

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BACKGROUND AS PROVIDED BY THE COMMISSION

In the EU, Community measures are in place **related to conservation and trade.** All seal species benefit from protection under EU legislation, which includes the **"Habitats" Directive.**[2]

With reference to international trade, the EU has put the **EU Wildlife Trade Regulations** in place to implement the provisions of the Convention on International Trade in Endangered Species **(CITES)** in the EU.[3] The Convention's objective is to ensure that trade only takes place if it does not threaten the survival of species of wild fauna and flora.

In the 1970s, various studies had raised doubts about the effects of commercial hunting on the conservation of harp and hooded seals. Moreover, widespread concerns were expressed by the European Parliament and various stakeholders.

As a reaction to these concerns, **Council Directive 83/129/EEC (amended by Council Directive 89/370/EEC)**[4] prohibits the importation into the Member States of skins of whitecoat pups of harp seals and of pups of hooded seals (blue-backs) and products derived therefrom. This Directive does not apply to products resulting from traditional hunting by the Inuit people.

In response to more recent public concerns relating to animal welfare aspects of the killing of seals, several EU Member States are considering, or are in the process of introducing, national legislative measures banning the use and importation of seal skins and seal products.

On 17 September 2006, the Council of Europe adopted a recommendation[5] on seal hunting inviting member and observer states practising seal hunting, amongst other issues, to ban all cruel hunting methods, which do not guarantee the instantaneous death, without suffering, of the animals, and to prohibit the stunning of animals with instruments such as hakapiks, bludgeons and guns.

During its session from 25 to 28 September 2006, the European Parliament adopted a written declaration[6] requesting the Commission to immediately draft a regulation to ban the import, export and sale of all harp and hooded seal products, while ensuring that this measure would not have an impact on traditional Inuit seal hunting which only accounts for 3% of the current hunt. This Declaration reflects the main issues of public concern, i.e. concerns about the application of humane killing methods and sustainability of the hunting quotas.

A reply from the Commission was sent to the European Parliament on 16 January 2007, which can be summarised as follows:

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[2] Council Directive 92/43/EEC of 21 May 1992, OJ L 206 , 22/07/1992, on the conservation of natural habitats and of wild fauna and flora.

[3] EU Wildlife Trade Regulations implementing the provision of the Convention on International Trade in Endangered Species (CITES) in the EU: Council Regulation (EC) No 338/97 of 9 December 1996, OJ L 61, Volume 40, 03/03/1997 and Commission Regulation (EC) No 865/2006 of 4 May 2006, OJ L 166, 19.06.2006.

[4] Council Directive 83/129/EEC of 28 March 1983 - OJ No L 091, 09/04/1983, as amended by Council Directive 89/370/EEC of 8 June 1989-OJ No L 163, 14/06/1989 concerning the importation into the Member States of skins of certain seal pups and products derived therefrom.

[5] Council of Europe, Parliamentary Assembly, Recommendation 1776 of 2006 on seal hunting <http://assembly.coe.int/Main.asp?link=/Documents/AdoptedText/ta06/EREC1776.htm >.

[6] European Parliament, Written declaration adopted during its session of September 25th to 28th 2006: <http://www.europarl.europa.eu/sides/getDoc.do?reference=P6_TA(2006)0369&language=EN>.

- Council Directive 83/129/EC, together with CITES legislation, provides an adequate response to the conservation concerns related to seals species.[7]
- With respect to the animal welfare aspects, there are suggestions that inhumane killing and skinning practices are used in some places. The Commission, recognizing the significant level of public concern, and in line with its commitment to high animal welfare standards, has undertaken to make a full and objective assessment of the animal welfare aspects of the methods used for the killing and skinning of seals.

On 15 March 2007, Commissioner Dimas made a statement on seal hunting to the Plenary of the European Parliament. He announced that part of the assessment would be conducted by the European Food Safety Authority.

In doing so, EFSA's Scientific Opinion should, *inter alia*, take account of available studies, including those conducted in range states (Burdon et al., 2001; Daoust et al., 2002; Smith et al., 2005) ("range states" are to be understood as all territories where seals are present and are (or could be) hunted, including EU Member States and Overseas Territories). In this context, the Commission has received scientific information from several range states which will be provided to EFSA.

TERMS OF REFERENCE AS PROVIDED BY THE COMMISSION

In view of the above developments, the Commission asks the European Food Safety Authority to issue a Scientific Opinion on:

1. the animal welfare aspects of the methods currently being used, particularly non-traditional methods, for killing and skinning seals in respective range states; and
2. in addition, to assess, on the basis of current scientific knowledge including other available information on different killing and skinning practices, the most appropriate/suitable killing methods for seals which reduce as much as possible unnecessary pain, distress and suffering.

CLARIFICATION OF THE MANDATE

The "Background" provided to EFSA refers to the statement made by the European Parliament in its written declaration that "…Inuit seal hunting…only accounts for 3% of the current hunt." Some members of the Working Group (and later, some stakeholders) noted that the figure requires some clarification. The Working Group has now confirmed that the quoted figure actually comes from an attempt a few years ago to calculate the proportion of harp seals (Pagophilus groenlandicus) killed by aboriginal peoples in Labrador and the eastern Canadian Arctic, in relation to the total number of harp seals landed in Canada in one year. It is possible to calculate several different figures and it is important that they are explained and presented in context. For example, it can be calculated that the catch of Northwest Atlantic harp seals by Inuit in the eastern Canadian Arctic in recent years has been far less than 1% of the total Canadian catch of harp seals. If the Greenland summer hunt for the same population is included, then the current Inuit catch of Northwest Atlantic harp seals is nearer 25% of the total. And, if ringed seals (Pusa hispida) are included, then the Inuit share of the total catch of harp and ringed seals by Canada and Greenland becomes even higher.

[7] For Seals species currently listed under CITES, please refer to< http://www.unep-wcmc.org/eu/Taxonomy>.

Animal welfare aspects of sealing are independent of the methods used (i.e. whether "traditional" or "non-traditional") and from a scientific point of view all methods currently in use need to be considered in the EFSA assessment.

ACKNOWLEDGEMENTS

The European Food Safety Authority on behalf the Scientific Panel on Animal Health and Welfare wishes to thank the Working Group for preparing the Scientific Report, which has been used as a basis of this Scientific Opinion. The working group was chaired by the AHAW Panel Member Prof David B. Morton. Members of the Working Group were:

Morton, D.B. (Chairman); Ersbøll, A.K., Nunes Pina, T. (Risk Assessors); Algers, B.; Boyd I.; Daoust, P-Y; Hartung, J.; Kirkman, S.P., Lambooij, B.; Lavigne, D. M.; Raj, M.; Stenson, G.B..

Prof. Egil Ole Øen and Prof. Tore Haug are gratefully acknowledged for their valuable comments and contributions. Prof. Temple Grandin is also acknowledged for her comments and valuable remarks.

The AHAW Panel also would like to thank the stakeholders organisations for the valuable comments and suggestions provided on the draft Scientific Opinion and for the enormous amount of information provided (including video material) which was evaluated by the WG Members and when considered pertinent included in the Scientific Opinion.

The AHAW Panel acknowledges the Norwegian Scientific Committee for Food Safety, that, following a general request for input by the EFSA Advisory Forum, adopted a Scientific Opinion on animal welfare aspects of the killing and skinning of seals in the Norwegian hunt, which was taken into consideration in this Scientific Opinion.

The scientific coordination for this Scientific Opinion has been undertaken by the EFSA AHAW Panel Scientific Officers E. Aiassa, S. Barbieri and O. Ribó.

APPROACH

This Scientific Opinion is in response to the terms of reference of the Commission's mandate and evaluates the animal welfare aspects of the methods currently used for the killing and skinning of seals. It also assesses the most suitable methods of killing seals based on the available scientific data. To address these questions a working group of experts with relevant experience in this field was set up.

The opinion has been divided in different chapters, including a brief description of the biology of the various species of seals and the seals hunts; a description of the different killing and skinning methods and how they should be used in theory; a description of the use of the killing methods in practice; the neurophysiological aspects of the determination of death; and the education, training and competence of the sealers. From the data presented in each chapter conclusions and recommendations have been drawn which can be found at the end the document.

In line with the terms of reference for EFSA, the working group carried out a Risk Assessment, but, due to the limited amount of data, only a qualitative Risk Assessment could be done, based mainly on non-peer reviewed opinions as well as the working group experts' opinion. Therefore, no conclusions have been drawn from the Risk Assessment but the outcomes have been used to rank problems and to identify areas of concern.

In order to obtain as much as relevant and recent scientific information as possible, a stakeholders' consultation meeting was organised by EFSA on 4 October 2007 in Parma (Italy) to give the opportunity to the interested parties to comment on the draft opinion as well as to provide all possible scientific information and data. Twenty-five stakeholders organisations attended the meeting and the information provided was taken into consideration when producing the Scientific Opinion.

In addition, following a general request for input to the EFSA Advisory Forum (AF Meeting, Berlin, 19 April 2007), the Norwegian Scientific Committee for Food Safety adopted a Scientific Opinion on animal welfare aspects of the killing and skinning for the Norwegian seal hunt, which was also considered in the Scientific Opinion.

The mandate indicates that EFSA is to look at the animal welfare aspects of the methods currently being used for killing and skinning seals, particularly non-traditional methods, but as the methods used to kill seals may be the same or very similar, the findings of this opinion will apply to all types of hunts. In drafting this Scientific Opinion, the panel did not take into consideration any ethical, socio-economic, human safety, cultural or religious or management issues, the emphasis has been to look at the scientific evidence and to interpret that in the light of the terms of reference. Nevertheless, it is acknowledged that such aspects can have an important impact on animal welfare.

1. Seal species, their distribution and the hunts

Seals are killed for three main reasons:

1. for commercial gain (i.e. for the sale of products such as skins, blubber (or oil), meat, and male genitalia;
2. for subsistence and cultural purposes, particularly by aboriginal peoples;
3. because seals are perceived as pests or competitors with humans and their activities (e.g. direct or indirect impacts on fishing, aquaculture, or as vectors of fish parasites) or as threats to other species of concern (e.g. predation upon endangered species). In cases

where individual animals (*vs.* a population cull) are the focus, the animals are often referred to as "nuisance seals".

The rationale for a particular hunt may include one or more of these general categories. Also, the use of the terms may vary and this can create confusion. For example, the term "subsistence hunt" is often used to describe a hunt where the seal is killed by an aboriginal for personal consumption. However, in many areas, all or part of the seal may be sold to purchase food or other supplies and seals may also be killed for personal consumption by non-aboriginals. Seals may also be killed unintentionally, e.g. they may be drowned as a result of incidental catches in fishing gear (by-catch) or killed as a result of other activities. An examination of these issues in detail is outside of EFSA's mandate, but where the killing methods used are the same, the findings could be used to assess welfare.

Generally, hunts considered as "subsistence" have few, if any, regulations and are poorly monitored. Similarly, the killing of nuisance seals may or may not be regulated (with respect to numbers and methods used) in different areas. Therefore, this opinion focuses primarily upon the methods used in commercial hunts although information on killing methods used in other types of hunts is included where possible.

This opinion has been limited by the existing information as the vast majority of available data is from commercial hunts.

1.1. Seal species killed and skinned in range states

There are thirty-three extant species of pinnipeds (fur seals, sea lions, walrus, and true seals). A thirty-fourth, the Caribbean monk seal, *Monachus tropicalis*, is now considered extinct.

Pinnipeds occur mainly along the coasts of polar, sub-polar and temperate regions (Davies, 1958; Lavigne and Kovacs, 1988; see Appendix 1). At least fifteen species are killed and skinned by humans for commercial purposes, or to satisfy subsistence and cultural needs. The countries where the seal hunts take place, the species killed and the available reported numbers and/or quotas are summarized in Table 1.

The degree to which such seal hunts are regulated by law and routinely monitored by observers varies in different countries and range states (Appendices 3 and 4).

In addition to being killed and skinned for commercial, subsistence and/or cultural purposes, seals may be killed in regions where their distribution overlaps that of commercial fisheries (Lavigne, 2003). Examples include grey seals (*Halichoerus grypus*) and common seals (*Phoca vitulina*), off the coasts of Scotland and Ireland, highly endangered monk seals (*Monachus monachus*) in the Mediterranean, and Australian and New Zealand fur seals (*Arctocephalus pusillus doriferus* and *A. forsteri*) in Australia and New Zealand, respectively. The seal hunts that once occurred in several South American range states seem to have ended, although fishers still reportedly cull southern fur seals and sea lions in some countries, including Chile, Peru, and Uruguay. However, no figures about the number of seals culled are available. In the past, grey seals were also caught in their birthing caves on the Faroe Islands and the animals were killed by a blow to the head, but today only rifles are permitted for killing seals. As few Faroese have a rifle licence and there is no tradition of using fur and blubber, seal hunting there has "virtually ceased", although fish farmers may occasionally still shoot seals (NAMMCO, 2004).

Table 1. Species and populations of seals that are killed and skinned. Compiled by S. Fink and D. M. Lavigne, July 2007, with subsequent contributions from G. Stenson and T. Haug (September 2007).

Country / Range State	Species	# reported killed or quota / allowable catch	Region	Seasonality	References
Åland (Finland)	*Halichoerus grypus*	450 (2007 quota)	Baltic coast between Sweden and Finland in the coastal waters of the autonomous region of Åland	15 April 2007 to 31 January 2008	Jaktlagen för landskapet Åland (ÅFS 31/1985); Anonymus, 2007.
Canada	*Odobenus rosmarus rosmarus*	4 (*average annual kill, 1997-2001)	South and East Hudson Bay		Fisheries and Oceans Canada, 2000 (does not include struck and lost).
		48 *	Hudon Bay / Davis St.		Fisheries and Oceans Canada, 2000 (does not include struck and lost).
		180 *	Foxe Basin		Fisheries and Oceans Canada, 2000 (does not include struck and lost).
		9 *	Baffin Bay		Fisheries and Oceans Canada, 2000 (does not include struck and lost).
	Phoca vitulina	200-300 (Nunavut)			NAMMCO, 2004.
	Pusa hispida	50,000 - 65,000 (not including struck and lost)			NAMMCO, undated a.
	Halichoerus grypus	9,000 (TAC 2007); 887 (reported catch 2007); 1804 (reported catch 2006)	Not Sable Island	February	Fisheries and Oceans Canada 2007b.
	Erignathus barbatus	1000-2000 (Nunavut)			NAMMCO, 2004.
	Pagophilus groenlandicus	270,000 (TAC 2007); 224,745 (reported catch 2007); 335,000 (TAC 2006); 354,344 (reported catch 2006)		November - June (most killed April-May)	Fisheries and Oceans Canada, 2007a; Fisheries and Oceans Canada, 2007b; Stenson, 2005.
	Cystophora cristata	8,200 (TAC, 2007);17	No hunting in the Gulf of St.	November - June	Fisheries and Oceans Canada,

Country / Range State	Species	# reported killed or quota / allowable catch	Region	Seasonality	References
		(reported catch 2007); 40 (reported catch 2006)	Lawrence	(most killed March - June)	2007b; MMR, 1993.
Finland	*Pusa hispida*	considered a game spp, but no licences granted		16 April - 31 May; 1 Sept. - 15 October	NAMMCO, 2004.
	Halichoerus grypus	685 (2007 quota) 312 (2005/2006 reported catch)	Three so called "Stamförvaltnings-regioner" (regions of population management) are set up one in the Gulf of Bothnia, one in the south west (bordering to the Islands of Åland) and one in the Gulf of Finland, which together cover most of the Baltic coast from the Swedish boarder in the North West to the Russian Boarder in the South East. No hunting licenses will be given outside of these Stamförvaltnings-regioner.	Year round with the exception of a closed season between Jan 1 and April 15.	Jaktlagen (615/1993) and Jaktförordningen (869/27.11.1998); Föreskrift 21.6.2007 1309/720/2007; also see memo: JORD- OCH SKOGSBRUKSMINISTERIET: FORESKRIFT. Management Plan for the Finnish Seal Populations in the Baltic Sea, (Ministry of Agriculture and Forestry, 2007).
Greenland	*Odobenus rosmarus rosmarus*	219 (2001 landed catch)	Davis Strait		NAMMCO undated b; also see Stewart, 2002.
	Pusa hispida	83,437 (1999 reported catch) / "between 70,000 and 90,000 with no obvious trend" (NAMMCO, undated a); "~ 70,000" NAMMCO, 2006; 89.773 (reported catch 2005)		Hunted year-round	NAMMCO, undated a; NAMMCO, 2006; DFHA, 2006.
	Erignathus barbatus	1000		Year round	Unconfirmed.
	Pagophilus groenlandicus	90,580 (reported catch 2005); 90.351 (reported catch 2005)		Year round	A. Rosing-Asvid, Greenland Institute of Natural Resources, Nuuk, pers. comm.; DFHA, 2006.
	Cystophora cristata	6,307 (reported catch		Year round	A. Rosing-Asvid, Greenland

Country / Range State	Species	# reported killed or quota / allowable catch	Region	Seasonality	References
		2003); 4.096 (reported catch 2005)			Institute of Natural Resources, Nuuk, pers. comm.; DFHA, 2006.
Iceland	*Phoca vitulina*	200-400		Spring	NAMMCO, 2004.
	Halichoerus grypus	Less than 200-400		Fall	NAMMCO, 2004.
Namibia	*Arctocephalus pusillus pusillus*	86,000 (2007 quota); 83,071 (reported catch 2006)		July - November	Nolen, 2007.
Norway	*Phoca vitulina* (coastal hunt)	949 (quota 2005); 614 (reported catch 2005); 660 (reported catch 2006)		2 January - 30 April and 1 August - 30 September (along entire coast)	Council of Europe, 2006b; Norwegian Directorate of Fisheries, undated a and b; T. Haug, pers. comm.
	Pusa hispida (coastal hunt)			2 January - 30 September; 1 August - 30 September	Norwegian Directorate of Fisheries, undated a and b.
	Halichoerus grypus (coastal hunt)	1184 (quota 2005); 379 (reported catch 2005); 329 (reported catch 2006)		1 Feb - 30 Sept (south of Stad).; 2 Jan - 15 Sept (north of Stad)	Norwegian Directorate of Fisheries, undated a and b; T. Haug, pers. comm.
	Erignathus barbatus	Not available			T. Haug, pers. comm.
	Pagophilus groenlandicus (commercial hunt)	31,200 1+ harp seals (West Ice TAC, 2007), 7,827 pups and 1+ animals, which is equivalent to 4,734 1+ animals (West Ice, reported catch, 2007); 15,000 (White Sea, TAC, 2007); 6,153 pups and 1+, White Sea reported catch, 2007); 3304 (reported catch, West Ice, 2006); 10,086			Council of Europe, 2006b; T. Haug pers. com.; ICES, 2006a; Ministry of Fisheries and Coastal Affairs (Norway), 2007.

Country / Range State	Species	# reported killed or quota / allowable catch	Region	Seasonality	References
		(reported catch, White Sea, 2006); 15000 (West Ice quota 2005), 5808 (reported catch 2005); 10,000 (White Sea quota 2005); 8,197 (reported catch, White Sea, 2005)			
	Cystophora cristata	5600 (2005 quota, West Ice); 3926 (reported catch, West Ice 2005); 4000 (2006 quota, West Ice); 3647 (reported catch 2006); 0 (no quota or catch, protected in 2007)			Council of Europe, 2006b; ICES, 2006b.; T. Haug, pers. com.
Russia	*Odobenus rosmarus divergens*	1212 (catch, uncorrected for struck and lost, 2000)			Total corrected annual mortality for Alaska + Chukotka estimated to be 5789 (Angliss and Outlaw, 2007).
	Phoca largha	15,000			Unconfirmed.
	Pusa sibirica	3,500			Unconfirmed.
	Pusa hispida	35200 (2005 quota)	(Bering / E. Kamchatka / Okhotsk = 31,400; Barents, Kara, White Seas = 3800)	Year round (NAMMCO 2004)	Russian government official decree #1428 from Nov.17-2004; Joint Russian - Norwegian commission/press release on harp seal quotas.
	Pusa caspica	9140 (2005 quota)	Caspian Sea zone		Russian government official decree #1428 from Nov.17-2004; Joint Russian - Norwegian commission/press release on harp seal quotas.

Country / Range State	Species	# reported killed or quota / allowable catch	Region	Seasonality	References
	Histriophoca fasciata	16,700 (2005 quota)	W. Bering, E. Kamchatka, Okhotsk		Russian government official decree #1428 from Nov. 17-2004; Joint Russian - Norwegian commission/press release on harp seal quotas.
	Erignathus barbatus	11,700 (2005 quota), additional 800 for Barents and White Sea.	W. Bering Sea, E. Kamchatka, Okhotsk Sea zones		Russian government official decree #1428 from Nov.17-2004; Joint Russian - Norwegian commission/press release on harp seal quotas.
	Pagophilus groenlandicus	45,100 (2005 quota, White Sea); 22,474 (2005 reported catch, White Sea); 7107 (2006 reported catch); 5,476 (reported catch 2007); no catches in Greenland Sea since 1994			Russian government official decree #1428 from Nov.17-2004; Joint Russian - Norwegian commission/press release on harp seal quotas; T. Haug pers. comm.; ICES 2006a, G.B. Stenson pers. comm.
	Cystophora cristata	not since 1994			
Sweden	*Halichoerus grypus*	200 (quota, 2007); 103 (reported catch 2006)	Baltic coast from Finnish border to the north to the island of Oland in the South (not the southernmost portion of Swedish coast)	16 April - 31 December	Swedish Environmental Protection Agency, 2007; NAMMCO 2004; G.B. Stenson, pers. comm.
United States (Alaska native hunt)	*Callorhinus ursinus*	1645-2000 (St. Paul) and 300-500 (St. George), estimated annual subsistence needs from 2005-2007	St. Paul and St. George Islands (Pribilof Islands)		Department of Commerce, 2006.
	Eumetopias jubatus	197 (mean 2000-2004 including struck and lost)	(aboriginal subsistence)		Angliss and Outlaw, 2007.
	Odobenus rosmarus divergens	2334 (catch, uncorrected for struck and lost 2000)			Angliss and Outlaw, 2007; (total corrected annual mortality for

Country / Range State	Species	# reported killed or quota / allowable catch	Region	Seasonality	References
					Alaska + Chukotka estimated to be 5,789).
	Phoca vitulina	2062 (mean 2000-2004, including struck and lost)			Angliss and Outlaw, 2007.
	Phoca largha	5265 (Best available estimate)			Angliss and Outlaw, 2007.
	Pusa hispida	9567 (Best available estimate)			Angliss and Outlaw, 2007.
	Histriophoca fasciata	193 (mean, 2000)			Angliss and Outlaw 2007.
	Erignathus barbatus	6788 (Best available estimate)			Angliss and Outlaw 2007.
United States (other)	*Zalophus californianus*	0-2 (Pacific Northwest treaty Indian tribes)			Caretta et al., 2007.
	Phoca vitulina richardii	5 to 15 (aboriginal subsistence) + 15 (shooting)			Caretta et al., 2007.
TOTAL*		**c.a. 900,000***			

The three largest seal hunts (Canada's commercial harp seal hunt - TAC = 270,000; West Greenland's harp seal hunt - unregulated, but currently landing c.a. 90,000 animals; and Namibia's Cape Fur seal hunt - TAC = 86,000) account for approximately 57% of the total number of seals allowed to be killed or reportedly killed annually (uncorrected for struck and loss).

*the number of seals of the hunted species is 15-16 million animals

1.2. Seal Biology

Although a variety of seal species are hunted, the majority of animals killed belong to five species: harp seals, ringed seals, grey seals, hooded seals and Cape Fur seals. In order to better understand the context in which the killing and skinning of seals occurs, some basic information on the biology of the major seal species hunted is provided below.

1.2.1. Harp seal (Pagophilus groenlandicus)

The harp seal is one of the most abundant and best known pinniped species in the North Atlantic. It is a highly gregarious and migratory species that lives in close association with pack ice during, at least, part of the year. The annual range (Figure 8) is essentially defined by the southern and northern limits of pack ice and is largely coincident with the sub-arctic region of the North Atlantic (Dunbar, 1968).

Three distinct populations of harp seals are usually recognized (Reijnders et al., 1993; Reeves et al., 1992), based primarily upon whelping (pupping) locations and small morphological, genetic, and behavioural differences (see Perry et al., 2000, for a review). Pups of the Barents Sea and White Sea populations are born (pupping) in the White Sea of Russia ("East Ice") but spend much of the year in the Barents Sea. A second population, referred to as the Greenland Sea population, whelp near the island of Jan Mayen off the east coast of Greenland ("West Ice") and summers in the northeast Atlantic and Barents Sea. The third population lives in the Northwest Atlantic off the east coast of Canada and breeds off the coast of Newfoundland and Labrador (referred to as the "Front"), and in the Gulf of St. Lawrence ("Gulf"). The majority of pupping in the Gulf occurs in the southern part but a small but variable number of seals are born in the northern Gulf each year (Figure 5). Northwest Atlantic harp seals summer in the waters of the eastern Canadian Arctic and west and/or South-east Greenland. The majority of seals migrate southward in the fall although some remain in the Arctic throughout the year.

Of the three harp seal populations, the Northwest Atlantic is the largest with an estimated 5.5 million seals in 2007 (95% CI = 3.8-7.1 million; DFO, 2007). A total of 742,000 (95% CI 497,000 -867,000) harp seals was estimated to be in the Greenland Sea in 2005 while in the Barents Sea/White Sea population, total abundance in 2005 was estimated to be 2.4 million (95% CI 1.8 - 2.75 million) seals (ICES, 2006a).

Harp seals in the northwest Atlantic are born from late February through mid March, depending upon location. In the White Sea, harp seals are born at the same time, while those in the Greenland Sea are born slightly later. Each female gives birth to a single pup. Pups are born with a white lanugo fur and are referred to as "whitecoats". The young quickly gain weight, more than doubling their weight to over 30 kg (Stewart and Lavigne, 1980) in less than two weeks, due to the high fat content of their mothers" milk. Harp seals are nursed for approximately 10 - 12 days (Kovacs and Lavigne, 1985) after which the female leaves to mate and feed. Adults undergo their annual moult after pupping and mating, before beginning their summer migration northward.

The weaned pups (2 to 6 weeks old) remain on the ice and undergo a post-weaning fast during which they survive on the thick layer of blubber accumulated during suckling. Shortly after weaning, they begin to moult their white coats, going through a series of distinct pelage stages including "grey coat" and "ragged jacket" until the white coat is completely lost to reveal a short-haired, black-spotted, silvery pelt known as a "beater." After their first year, harp seals are known as "bedlamers" until they shed their spotted pelage and attain the characteristic saddle (or harp) shaped pattern between 4-9 (males) or 4-12 (females) years of age (Roff and

Bowen, 1986). The average age of sexual maturity is approximately 5 years of age although males may not breed until they are older (Sergeant,1991; Sjare et al., 2004).

Adult harp seals are about 1.7 m in length with females being marginally smaller, on average, than males. Although adults may weigh about 130 kg early in the pupping season, they are approximately 25% lighter at the time of the moult in April, and their weight also varies considerably between years (Chabot and Stenson, 2002). Adults have a black, wish - bone marking reminiscent of the Celtic harp on their backs which gives them their common name. The faces of adults are also black whereas the remainder of the body appears silvery - grey when dry.

1.2.2. Ringed seal (*Pusa hispida*)

The ringed seal has a circumpolar Arctic distribution with no clear boundaries between separate stocks (Reeves, 1998). Adult seals are thought to be relatively sedentary although juveniles occasionally disperse over long distances. Ringed seals are capable of maintaining breathing holes in solid ice which allows them to venture further into the Arctic pack ice than other mammals. The total world population of ringed seals is not well known but is considered to be at least a few million (Reeves, 1998). Stirling and Calvert (1979) estimated an aggregate world population of 6-7 million.

Both male and female ringed seals usually mature at 5-7 years of age (Reeves, 1998), although females may mature earlier in some areas (Lydersen, 1998). Females give birth to a single white-coated pup in snow lairs that are built into drifts on shorefast or pack ice, usually in late March and April (Smith and Stirling, 1975), although there is some geographic variation in mean pupping dates (Smith et al., 1991). Lactation lasts 5-7 weeks (Hammill et al., 1991).

The ringed seal is one of the smallest seals. Newborn pups average only 4.5 kg and are weaned at approximately 22 kg (Hammill et al., 1991; Lydersen, 1998). Adult females reach a length of approximately 1.27 m while males are slightly longer at 1.32 m. Asymptotic weight is approximately 55-60 kg with females possibly being slightly larger than males (Lydersen and Gjertz, 1987). However, some ringed seals may grow to approximately 100 kg.

1.2.3. Grey seal (Halichoerus grypus)

The grey seal is found across the North Atlantic Ocean and in the Baltic Sea. There are substantial uncertainties around the estimates of grey seal population sizes but, overall, the global population is probably about 400,000 (Haug et al., 2007a). There are two centres of population in the North Atlantic; one in Canada centred on Nova Scotia and the Gulf of St Lawrence (although also extending now into the coast of Maine and southward to Cape Cod) and the other around the coast of the UK, especially in Scottish coastal waters. The largest population is in Canada which may contain about 50% of the world's grey seals; 30-40% occurs around the UK and the remainder are in the Baltic and along the coast of Norway. Small numbers also occur along the southern North Sea coast, in the Faeroe Islands and in Iceland. Populations in Canada, UK and the Baltic are increasing, although numbers are still relatively low in the Baltic where the population was drastically reduced by exploitation over many decades (Haug et al., 2007b).

Generally, grey seals come ashore on remote islands and coastlines to give birth to their pups. In the Baltic and Gulf of St Lawrence, grey seals also whelp on seasonal sea ice. In Europe pupping takes place in autumn (September through November), but in Canada and the Baltic it takes place in January and February. Moult takes place in spring. At other times of the year grey seals haul out and rest between foraging trips to sea for food on a broader range of coastal

regions than are used for breeding. Although grey seals show directed movements, they do not appear to undergo large scale migrations.

Female grey seals give birth to a single white-coated pup, which is nursed for about three weeks before being weaned and moulting into its adult coat. Parental care abruptly ends at weaning, after which pups forage independently. About 50% of pups probably die of natural causes in their first year. The locations of pupping tend to be very consistent between years and individual females will usually return to give birth at a similar location each year. Adult females give birth in most years and have a pregnancy rate as high as 90% in some populations. Mating takes place at the pupping sites once females enter oestrus at the end of lactation and takes place on land or on the ice. Males enter into a competitive system for access to oestrous females by maintaining a position within the pupping colony.

Adult male grey seals may weigh up to 350 kg and grow to over 2.3 m in length. Females are smaller, reaching a maximum of 250 kg and 2 m in length. After their first year, grey seals have a high probability of living for more than 20 years and some may live up to 50 years. Males begin to breed from about age 10 and females often begin to breed at about age 5. Size differences have been observed between the grey seals in the UK and in Canada but this may be a sampling artefact.

1.2.4. Hooded seal (Cystophora cristata)

Hooded seals are large true seals that are found in the North Atlantic. Although they cannot be genetically differentiated (Coltman et al., 2007), two putative populations have been identified for management purposes: the Greenland Sea and the Northwest Atlantic. In the Greenland Sea, hooded seals give birth on the pack ice near the island of Jan Mayen off the east coast of Greenland. In the northwest Atlantic, they give birth off the Canadian coast along southern Labrador and/or northeast Newfoundland (the "Front"), in the Davis Strait, and in the Gulf of St. Lawrence (the "Gulf"). It is not known how much interbreeding there is among Northwest Atlantic hooded seals whelping in these different areas, but seals from all three areas are known to mix during the non-breeding period. The Northwest Atlantic population was estimated to total 593,500 (SE=67,200; 95% C.I. = 465,600-728,300) seals in 2005 (Hammill and Stenson, 2006) while the Greenland population was recently estimated to be 88,300 (95% CI 48,600-108,500; ICES, 2006b).

Hooded seals are sexually dimorphic with males reaching approximately 2.5 m and averaging a little over 300 kg (maximum over 400 kg). Adult females are just over 2 m in length and weigh approximately 160 kg. Most females become sexually mature between 3-7 years of age (ICES, 2006b). Although males may mature at a similar age, they are unlikely to mate until much older. Pupping takes place in mid- to late March in both Northwest Atlantic and Greenland Sea. Unlike harp and grey seals that shed their natal fur near the time of weaning, hooded seals shed their lanugo *in utero* and are born with a pelage (blueback) that is kept until their first post-natal moult at approximately 16 months of age. Some hoods appear to retain this blueback pelage until their second moult at 28 months, after which they attain the adult pelage. The nursing period of hooded seals is the shortest known, averaging only 4 days, during which the young grow extremely fast, gaining 7 kg/day (Bowen et al., 1985). During this period, they approximately double in weight from around 20 kg to 45 kg. Following weaning, young hooded seals remain on the ice for a couple of weeks until they begin to disperse (G.B. Stenson, pers. comm.).

Hooded seals are seasonal migrants, spending most of the year in offshore waters (G. B. Stenson, pers. com). The northwest Atlantic population summers off south and west Greenland or in the eastern Canadian Arctic. They migrate to the whelping areas during the late autumn or

early winter. After weaning their single blueback pup in March, females mate and disperse to deep water slope edges to feed. Eventually they migrate to the Denmark Strait near southeast Greenland to moult in late June or July. Following the moult, the majority of adults appear to migrate around Cape Farwell and along west Greenland to Baffin Bay before returning to their whelping areas. Juvenile hooded seals appear to remain in northern waters. Following weaning, Greenland Sea hooded seals disperse across the northeast Atlantic ranging from the British Isles north to Svalbard to feed (Folkow et al., 1996).

1.2.5. Cape Fur seal (Arctocephalus pusillus pusillus)

The Cape Fur seal is distributed along the south and west coasts of southern Africa from the south of South Africa to southern Angola (Kirkman et al., 2007; Meÿer, 2007; Figure 5). Breeding sites are found on rocky beaches on small islands, and on rocky and sandy beaches on the mainland, where the largest colonies currently exist (David, 1989).

Like all fur seals, the Cape Fur seal is gregarious and has a polygynous mating system characterized by aggressive territoriality on the part of breeding males (Kirkman and Oosthuizen, in press). Sexual dimorphism in body size is extreme, with adult males reaching 2-2.3 m in length and 200-360 kg in weight, outweighing adult females (1.2-1.7 m in length) by 4-5 times when in breeding condition (Lavigne and Hannah, 2001; Rand, 1959). Each year, adult males begin to arrive at the breeding colonies in October and compete for territories, in which about 10-30 females will eventually give birth, each to a single pup (Wickens and York, 1997). Breeding is highly synchronous with the median birth date estimated to occur between 3-10 December (David, 1987; de Villiers and Roux, 1992) with approximately 90% of births occurring between 22 November and 17 December (David, 1987).

Females mate about 6 days after giving birth and then begin a cycle of off-shore foraging in alternation with on-shore attendance and nursing of their pups. This pattern continues until the pup is fully weaned. Foraging trips may last as long as a week, but the average is 3-4 days, while the average duration of the shore visits is about 2½ days (David and Rand, 1986; David 1987; Boyd et al., 1999). Weaning is a gradual process which commences in about July and is generally completed between August and the onset of the following breeding season (October to November) (Rand, 1959). However, lactation may last well into the second year should the mother lose her next pup (Rand, 1955). Until they are fully weaned, the pups do not hunt extensively but may supplement their milk diet with food caught in the vicinity of the colony (Rand 1959). According to Rand (1959), the effects of the pup hunt on the attendance patterns of mothers hastens the weaning process, which would otherwise be more protracted. At 8-12 months of age (approximately August to November) male pups range between about 0.93 and 1.21 m in length and between 19 and 37 kg in weight; females between about 0.92 and 1.11 m in length and between 15 and 28 kg in weight (Rand, 1955).

The size of the entire Cape Fur seal population in 1993 was estimated to be about 1.7 million (1.5-2.0 million) animals aged one year and older (Butterworth et al., 1995). The size of the population in 2004 is thought to have been similar (Kirkman et al., 2007). Since 1990, total pup production has been estimated to be in the region of 320,000 in some years (1993, 1998 and 2004) (Kirkman et al., 2007). Approximately 60% of these pups (*ca* 180,000) are born in Namibia, of which approximately 75% (ca 135,000) occur in the three colonies where hunting occurs (Kirkman et al., 2007). Since 1993, there have considerable fluctuations in pup counts, particularly in Namibia where in 3 of 6 censuses which took place between 1995 and 2004, the pup count was 50% or lower than the 1993 level (Kirkman et al., 2007).

1.3. Hunts distributed by country

Seal hunts have occurred in various parts of the world throughout history, and the different stunning and killing methods used have been documented in various ways. Very little robust information is available, however, on the efficacy of each of these methods and their respective advantages and disadvantages in relation to animal welfare. Moreover, there are logistical difficulties inherent in assessing objectively the processes involved when these hunts are conducted under very different, remote, uncontrolled and unverifiable conditions. Table 2 provides a list of the methods to hunt seals in various countries. The following sections provide details on the nature of hunting, relevant regulations and catch levels in a number of countries where seal hunting still takes place.

Table 2. Methods used to kill seals and their geographic location.

Methods	Instrument	Target area	Geographical location
Physical	Hakapik	Head	Canada Norway
	Club	Head	Canada Namibia US (Alaska)
	Slagkrok	Head	Norway
Firearms	Shotgun	Head	Canada
	Rifle	Head	Canada Greenland Norway Namibia Sweden United Kingdom Finland Iceland Ireland Russia (unconfirmed)
Netting	Seal net	Whole animal	Canada Greenland US (Alaska) Russia Iceland
Harpoon		Anywhere	Canada (Inuit) Greenland (unconfirmed)

1.3.1. Canada

1.3.1.1. Description of hunting methods and catches

Seals are hunted in the Canadian Arctic and Atlantic regions for subsistence and commercial purposes. Historically, harp, hooded, ringed and bearded seals have been targeted in these hunts. More recently, grey seals have also been taken. Today, the majority of animals killed and skinned are harp seals although ringed seals are the species most frequently killed species in the Arctic.

The commercial harp seal hunt in Atlantic Canada is the largest marine mammal hunt in the world. The hunt focuses almost exclusively on harp seals (Table 1), the vast majority (~ 95%) of whom are killed when they are between 1 and 3.5 months of age (i.e. “beaters”; Stenson, 2005). According to Canada’s Marine Mammal Regulations, the sealing season runs from 15

November to 15 May. Although some harp seals are shot between November and February, most of the hunt currently occurs from mid- or late March to mid-May. The closing date can be extended at the discretion of Canada's fisheries minister. Since the mid-1980s the commercial hunt has been carried out using longliners (vessels 3.7 m-19.8 m in length) or small boats (vessels under 3.7 m long). Where there is solid ice and seals are close to shore, sealers may hunt on foot or use snowmobiles. Depending on the ice conditions, mainly the size of the ice floes, hunters either shoot the seals from their boats or go down on the ice and strike the animals with a hakapik.

Hunting takes place in three main areas - the southern Gulf of St. Lawrence, the northern Gulf and off the coast of northeast Newfoundland or southern Labrador (referred to as the "Front"[8]; Figure 8). In 2006, approximately 14,000 commercial sealing licences were issued for Canada's commercial seal hunt (Bevan, 2006). DFO has stated that it does not know how many of these licences are active, i.e. how many sealers participate in the seal hunt each year, but estimates that there are about 5,000 active sealing licences (DFO, 2006).

Between 1,500 and 2,200 boats participate in the hunt annually. Although longliners may have up to 8-10 sealers aboard, there are usually only one or two designated marksmen, who shoot the seals from ranges mostly less than 40 m. Quotas are divided among the various areas and fleets with approximately two-thirds of the seals taken at the Front (see Chapter 4.2.1 for the calculation). Hunting in the Gulf is split between the southern and northern areas. Generally, the majority of hunting takes place in the southern Gulf, but in recent years the implementation of regional allocations and poor ice conditions in the southern Gulf have resulted in a shift of the hunt towards the northern Gulf. From ¼ to ⅓ of the seals are taken by small boats.

Although the majority of harp seals are taken under the age of 3-4 months, because of differences in when seals are killed in various areas, catches are usually separated into young of the year seals (i.e. less than 12 months old) and seals one year of age and older (1+).

The Total Allowable Catch (TAC) for Canada's 2007 commercial harp seal hunt was 270,000 although the reported catch was lower (216,000; see Table 7). Accounting for assumed levels of struck and lost animals, this increases the catch to 230,000 (Table 7). This is a decline over the previous 5 years when reported catches averaged 330,000 (Stenson, 2005; see Table 7).

In addition to harp seals, 1,000-2,000 grey seals have been taken in recent years (Table 1). Historically, large numbers of hooded seals were also taken during the commercial hunt, but since 1999 an average of only 125 seals were taken annually (Stenson, 2006). The majority of grey seals are taken as beaters while hooded seals cannot be killed before they moult their blueback pelage which occurs at 16 months of age at the earliest. The few hooded seals taken are generally 3 years of age or older (Stenson, 2006) and they are killed with high-powered rifles.

Since 1995, Canada has also allowed people living in traditional sealing areas to kill up to 6 seals for personal consumption. These seals cannot be sold. Before being issued with a licence, these hunters must be trained in the use of a firearm, obtain a firearms certificate and undergo a training course familiarizing them with seals and applicable hunting regulations. Approximately 1,000 seals are taken under these permits annually.

Harp, ringed and bearded seals are the primary species hunted by Inuit for subsistence purposes in the Canadian Arctic. Current estimates place the size of this hunt at fewer than 1,000 harps, 50,000-65,000 ringed and 1,000-2,000 bearded seals (Table 1). Small numbers of walrus and harbour seals are also taken. Harp seals are usually shot during the summer from open boats.

[8] The actual location of the hunt at the Front changes year on year

Ringed seals are also shot in open water or taken using nets or harpoons in or around breathing holes in the ice. Once shot, seals are retrieved using gaffs or similar instruments.

1.3.1.2. Regulations in Canada

Marine Mammal Regulations (MMR, 1993) under the Fisheries Act (Government of Canada, 2003) outline the regulations applied to the commercial seal hunt in Canada. Additional restrictions can be imposed as a "condition of Licence". The MMR describe the legal methods for killing seals during the commercial seal hunt (Appendix 3). The seals are to be hit on the head with a club or hakapik, or shot. In the former case, the sealer should manually check the skull or administer a blink reflex test to confirm that the animal is "dead"[9] before proceeding to strike another seal. In the latter case, when a firearm is used, the person who shoots the seal or retrieves it should administer a blink reflex test as soon as possible after it is shot to confirm that it is dead. Furthermore, no person shall start to skin or bleed a seal until it has been confirmed dead through the application of a blink reflex test or palpation of the skull.

Legally approved rifles, ammunition and clubs or hakapiks are described in the Marine Mammal Regulations within the Fisheries Act. The specific requirement of each is described in Chapter 3 of this Opinion. The use of nets is not allowed in the commercial hunt, although they are permitted north of 54^0N as a traditional method for subsistence purposes by aboriginal hunters. Riflemen in Canada are required to take a firearm safety course and to register their firearms (Firearm Act, Department of Justice Canada, 1995).

The MMR (1993, with associated Conditions of License) regulate other measures related to seal hunting in Canada. These include:

- Sealing seasons are established for harp, hood and grey seals.
- It is illegal to kill, trade or barter harp seals before they begin to moult their white lanugo fur.
- It is illegal to kill, trade or barter blueback hooded seals.
- Sealing is not allowed in breeding or whelping patches.
- Sealing cannot take place from vessel greater than 19.8 m in length.

Malouf (1986) briefly describes where and how nets were previously set to catch harp seals and, to a lesser extent, ringed seals, in Canada. Netting of seals south of 54^0N in Canadian waters has been prohibited since 1993, and in Canada the method is currently used exclusively by "traditional" hunters.

1.3.2. Norway

The Norwegian hunt is primarily focussed on harp and hooded seals. Norway also has a long history of hunting these species, although on a much smaller scale. Both Greenland Sea ("West Ice) and Barents Sea/White Sea (East Ice) harp seals are hunted by Norway, as are Greenland Sea hooded seals.

The Greenland Sea harp seal hunting season usually opens on April 10 and closes on June 30 while the Barents Sea harp seal hunt opens March 23 and closes on May 15. The ice conditions in the Norwegian hunt and the methods used are similar to those of the Canadian hunt, although a much smaller number of larger vessels (2-5 vessels ~ 60 m long) are used. The animals are shot from the bow, normally at a range of 30-70 m. In slack ice conditions, the

[9] While the word "dead" is used in Canada's Marine Mammal Regulations, it does not mean "death" as defined in various EFSA documents, viz. "a physiological state…where respiration and circulation have ceased" (e.g. EFSA 2004, 2005). See also Chapter 5. Seals clubbed in the prescribed manner should be irreversibly or terminally unconscious (or "brain dead") but the heart will continue to beat.

shooting might also be conducted from small boats or from the ice. Since the 1990s, use of rifles for the initial stunning of animals (first weapon) has increased at the expense of hakapiks (or slagkroks). This is because the weaned pups which are targeted tend to be more alert than un-weaned pups, and are more likely to escape into water when approached by humans. The percentage of young seals which are shot (as opposed to the hakapik being used as the primary killing method) may vary somewhat depending on the time of year and the conditions of the hunt (i.e. stability and thickness of ice). According to the information given by national inspectors, on some boats, in some seasons, rifles are used on almost 100% of the seals targeted (E.O. Øen, pers. comm.).

The seals are bled on the ice immediately after they have been shot and struck with the spike of the hakapik. Skinning of the seals may start within a few minutes (pups) to several hours (adults) after bleeding.

The Norwegian quota for harp seals in the Greenland Sea since 2001 has been set at 15,000 1+ animals, or an equivalent number of pups (where one 1+ animal = two pups). This quota for harp seals was changed to 31,200 1+ animals from 2006 as a result of assessments made by the ICES/NAFO Working Group on Harp and Hooded seals (ICES, 2006a). Catches in 2004 and 2005 were 9,895 (including 8,288 pups) and 5,808 (including 4,680 pups), respectively (ICES, 2006a). The quota for Greenland Sea hooded seals was set at 5,600 1+ animals (where one 1+ animal = 1.5 pups) for 2004 and 2005 and 4,000 in 2006. A total of 4,881 (including 4,217 bluebacks) were taken in 2004 and 3,826 (3,633 bluebacks) in 2005 (ICES, 2006b). All hunting of bluebacks was stopped in 2007.

The Norwegian quota for harp seals in the White Sea/Barents Sea population was set at 10,000 1+ animals (or an equivalent number of pups, where one 1+ animal = 2.5 pups) in 2004 and 2005. The reported Norwegian catch was 33 (all 1+) in 2004 and 8,197 (including 1,162 young of year) (ICES, 2006a).

Norway also allows the non-commercial (sport) hunting of coastal (grey and harbour) seals. This hunt is usually conducted from land and seals are usually shot while they are hauled out. The regulations for weapons and ammunition for this hunt are similar to the commercial hunt. If seals are shot in the water, this is done in areas of shallow water, so they can be retrieved if they sink. The shooting range is usually between 20 and 100 m.

1.3.2.1. Regulations in Norway

In the commercial hunt of seals in Norway, only registered ocean-going vessels found suitable and equipped for seal hunting can be used. The crew usually consists of 13-15 persons. The master of the vessel is required to attend an annual one-day training and information course held by the Directorate of Fisheries for seal hunters. Members of the crew are required to attend the same course every second year. According to the regulations relating to the hunt, vessels participating in the seal hunt shall keep a catch logbook and carry an inspector (usually a veterinarian) on board during the hunt. Vessels may also be required to carry international observers on board. The role of the international observer is to secure that the catch operations occur according to the rules and regulations relating to the hunt.

It is a requirement that animals which are shot and are lying still, are struck with the sharp end of the hakapik as soon as possible to ensure that they remain unconscious until bled out (the sharp end of the slagkrok may be used on pups instead of a hakapik, but use of the slagkrok on seals > 1 year old is banned). When hunting on the ice, each marksman is assigned one person whose task is to use the hakapik and to bleed the animals.

Only marksmen who have passed a separate shooting proficiency test may shoot seals during the hunt. A new test must be taken prior to every seal-hunting season. The test shall be taken

with the same weapon and the same type of ammunition that will be used during the hunt. Riflemen are required to take a firearm safety course and to register their firearms. They must also pass an annual shooting test with a rifle before they are issued with issued a licence (Øen, 2006).

Specific regulations (Article 7) include:

- Animals shall be killed in such a way that they do not suffer unnecessarily.
- Adult animals shall be shot. Pups shall be shot or struck with a hakapik or seal club (slagkrok).
- An animal that has been shot shall be struck with a hakapik as soon as possible. A pup may also be struck with a seal club or slagkrok.
- When a hakapik or seal club (slagkrok) is used, the seal shall be struck on the skull. It shall first be struck with the butt end or blunt projection of the tool, so that the skull is crushed. After that, the animal shall be struck with the spike of the tool, so that it penetrates deep into the brain. If an animal has been shot and is lying still, it is sufficient to use the spike of the tool only.
- Seals shall be bled on the ice immediately after they have been struck with a hakapik or seal club (slagkrok). During hunting of individual seals, seals may be bled on board if they are taken on board immediately and conditions otherwise so indicate.
- Seals shall be bled by making a cut from the underside of the jaw to the end of the breastbone, then cutting the blood vessels to the fore-flippers.

It is prohibited to:

a. hunt seal species other than harp seals (in 2007);
b. kill un-weaned pups;
c. hunt adult harp seals in whelping areas;
d. hunt seals that are in the water;
e. shoot seals if conditions are such that they cannot be struck with a hakapik and be bled on the ice;
f. hunt in artificial light;
g. use lines, nets or any form of trap;
h. use shotguns;
i. use a hakapik on adult animals that have not been shot first;
j. use a slagkrok on adult animals;
k. strike with a hakapik or slagkrok anywhere but on the skull.

1.3.2.2. Available data on animal welfare aspects of seal hunt

Norwegian regulations require that a sealing inspector (usually a veterinarian) is on board each sealing vessel. However, unlike some other hunts, e.g. Canada's commercial seal hunt, no independent (meaning independent of government and industry) observer opinions are available for Norwegian seal hunts.

1.3.3. Greenland

1.3.3.1. Description of hunting methods and catches

Ringed, harp, hooded, bearded and harbour seals are hunted in Greenland for subsistence purposes and as food for dogs. Pelts are also sold. Hunting occurs throughout the year although the majority of harp and hooded seals are killed during the summer or autumn. Hunters are classified as either full time or part-time based upon how much of their livelihood is obtained from hunting. The availability of seals and the methods and weaponry used in seal hunting vary regionally and seasonally (NAMMCO, 2004). The majority of seals are shot, although some

ringed seals (30-35%) are caught using nets set in breathing holes, under the ice through cracks or around icebergs (DFHA, 2007). Netting usually occurs during the winter months in northern areas but the majority of hunters use rifles of a .22 Magnum calibre or larger (NAMMCO, 2004).

Ringed and harp seals are the most important species in Greenland. Reported catches of harp seals in Greenland varied from just under 100,000 in 2000 to 68,000 in 2003 (DFHA, 2006). In 2005, reported catches were approximately 90,000 (A. Rosing-Asvid, Greenland Institute of Natural Resources, Nuuk, pers. comm.). Catches of ringed seals remained around 80,000 over the same period while an average catch of 5,800 hooded seals was reported annually. Reported catches of bearded seals range between 1,000 and 2,000 per year while 724 and 812 harbour seals were reported to have been killed in 2003 and 2004 respectively. Based upon samples collected from Greenland hunters, Stenson (2005) estimated that since 1984, approximately 14% of the harp seals killed were less than one year of age. In contrast, since 1985 almost 32% of the hooded seals killed were classified as young of the year (Stenson, 2006). However, data on the age structure of current catches is extremely limited.

1.3.3.2. Regulations in Greenland

Seals can be hunted by all Greenlandic residents, provided they have either a full time or a part time hunting permit. Hunters are required to submit an annual catch report. There are no specific guidelines regulating the types of rifles that can be used or when most seal species can be killed although communities may have local rules. It is illegal to kill harbour seals between October and May. The Animal Protection Law (25/2003) states that "any person who is about to kill an animal must ensure that the animal is killed as quickly and as painlessly as possible. Killing by strangulation or hanging is prohibited. Killing by drowning mammals other than marine mammals is also prohibited" (DFHA, 2007), and so it is permitted to net marine mammals.

1.3.4. Russia

1.3.4.1. Description of hunting methods and catches

Five species of seals are hunted along the Chukotkan, Arctic and Pacific coasts of Russia (NAMMCO, 2004): harp, ringed, ribbon (*Histriophoca fasciata*), bearded (*Erignathus barbartus*) and spotted (*Phoca largha*) seals. Seals are also hunted in the Caspian Sea – the Caspian seal (*Pusa caspica*) – and Lake Baikal – the Baikal seal (*Pusa sibirica*). The ringed seal is the most commonly hunted species and is taken on the ice or in open water throughout the year. The other species are taken seasonally depending upon availability.

Netting is a commonly used method for catching seals in the Chukotka. Different kinds of nets are used; long tangle nets are used in open water during the summer while shorter nets are often used in the winter across fractures in the ice. A small net is used below breathing holes to catch ringed seals. Seal traps (a partially submerged box) are used on some rivers (NAMMCO, 2004). The majority of seals are shot from boats, ice or the shore.

Ringed seals are caught using traditional nets or shot with rifles by Russian hunters in the White and Barents Seas (NAMMCO, 2004). Approximately 200-300 seals are taken in this area annually. In the Kara Sea, ringed seals are taken only by local native people using nets or rifles. There are no commercial hunts for bearded seals, however, they are taken by local native people in the White, Barents and Kara Seas using nets or rifles.

Historically, Russian sealers using large vessels were involved in the harp and hooded seal hunt in the Greenland Sea but this has not been pursued since 1994. In recent years, the extent of

commercial hunting in the White and Barents Seas has also varied. Harp seals are taken primarily on the whelping ice in the White Sea, and from February through early March (March 10); only whitecoats are hunted on the whelping patches. Seals are killed using hakapiks (similar to the Canadian hakapik) and the pelts are transported to land using helicopters. This type of sealing was last conducted in 2005. In the second half of the March moulting seals (i.e. ragged jackets) are live-captured and transported with helicopters to open sheds built along on the coast, where they are held until they complete their moult. After moulting (beater stage), the seals are killed (not known how). A small number of seals (~138) were taken this way in 2007, but this approach is likely to be discontinued in the future due to the high cost (A. Golikov, pers. comm.). Russian sealers had a quota of 45,100 1+ harp seals (or an equivalent number of pups, where one 1+ animal = 2.5 pups) in 2005 (Table 1). Reported catches in 2005 were 22,474 seals (including 14,258 young) (ICES, 2006a).

The nature of sealing in the White Sea appears to be changing. In 2006 and 2007, the majority of harp seals were taken from small boats (based upon either ships or on land) from the end of March until early May. This hunt focussed on harp seal beaters and all seals were shot with rifles. A small number (~200) of moulting adults (1+) were hunted.

1.3.4.2. Regulations in Russia

No information on the regulations controlling hunting was found.

1.3.5. Namibia

1.3.5.1. Description of hunting methods and catches

Historically, Cape Fur seals were hunted for commercial purposes in southern Africa (South Africa and present-day Namibia). The commercial hunt in South Africa ended in 1990 and a moratorium remains in place today (Kirkman, 2006). Cape Fur seals are currently hunted only in Namibia, at three large mainland colonies, namely Cape Cross, Wolf Bay and Atlas Bay, during the austral (southern hemisphere) winter and spring. Initially in the hunt, pups are taken; as the season of the hunt progresses, the focus shifts to adult males (defined as being at least three years of age). The pups are clubbed, usually with a wooden pick handle, while adult seals are shot, usually with silenced 0.22 rifles (Anonymous, 1997). Carcasses are not skinned on site at the colony, instead, when the killing is over for the day, they are loaded onto trucks to be taken to the factory for processing (IFAW, 1994).

Since 2000, the total allowable catch (TAC) for pups has been set at between 50,000 and 85,000 whereas the TAC for adult males has ranged from 5,000-7,000 (Table 10). Reported catches for adult males ranged between 3,500 in 2001 and 5,300 and 2006, and for pups, ranged between 29,600 in 2003 and 77,800 in 2006. Therefore, in 2006, the Namibian hunt was among the three largest seal hunts in the world (Table 10).

In addition to the commercial hunt (referred to in Namibia as a "harvest"), trophy hunting for Cape Fur seals is also allowed between 15 September and 15 November, e.g. see advertisement from Kataneno Hunt, operating out of Windhoek, Namibia.[10] Seals are also killed illegally by fishermen in both Namibia and South Africa and in both countries, some seals are locally culled to reduce perceived negative impacts of seals (predation or displacement) on threatened seabird populations (Kirkman, 2006).

[10] Available at <www.afrintrophyhunting.com/oryx--hunting.htm>. Accessed 6 September 2007.

1.3.5.2. Regulations in Namibia

Seal hunting in Namibia is conducted by private (hunting-) rights-holders, although it is under government control. The regulations prescribing the procedures for carrying out the Namibian hunt (Ministry of Fisheries and Marine Resources, 2001) are given in Appendix 4. In summary, the regulations specify that adult seals are to be shot in the head, using a rifle. Pups, on the other hand, are to be struck on the top of the head with a sealing club as they are released between rows of clubbers, after first having been rounded up and driven away from the water's edge. The regulations state that the inspector must be satisfied that the animals which have been shot or clubbed are dead, and that clubbed animals (but not shot animals) must be bled (the method is referred to as "stun and stick"). In the case of the pup hunt, there is a specified format and persons are designated as "clubbers", "stickers" and "herders" in the hunting party. In terms of the regulations, less structured methods of killing pups such as chasing them down and clubbing them, or surrounding and clubbing pups within a group, are outlawed.

In addition to the regulations, conditions are applied to hunting rights-holders in advance of each hunting season (Kirkman, 2006). Typically, these indicate that all personnel must receive training before and during the season. According to these conditions, only clubbers performing at an adequate level are allowed to use clubs, clubbers must have previously gained experience as herders and in the case of shooting, marksmen must undergo a weekly test to satisfy the inspectors of their accuracy. Since 2001, the hunting season has officially opened on 1 July each year (previously the starting date was August 1st); the official closing date is 15 November (Iyambo, 2001, cited in Kirkman, 2006).

1.3.6. Baltic (Finland and Sweden)

1.3.6.1. Description of hunting methods and catches

There are currently three species of seal in the Baltic Sea: the Baltic ringed seal (*Pusa hispida botnica*), the grey seal and the common (harbour) seal (*Phoca vitulina*). Ringed and grey seals occur in Finnish territorial waters, while the harbour seal occurs on the eastern coasts of Denmark and on the coasts of Skåne, Gotland and Öland in Sweden (Helle and Stenman, 1990a, b). Only grey and ringed seals are currently hunted in the Baltic. Although hunting occurred historically in the region, it was stopped in Sweden in 1975 and in Finland in 1982 due to low population levels. Hunting began again in 2001 and in 1997 in Sweden and Finland respectively (NAMMCO, 2004).

Seals are killed using two basic methods in both Finland and Sweden. Both entail the use firearms and targeting of the head area. During the spring seals are hunted on the ice (in Kvarken and north). During the open water season, hunting usually takes place around islands and skerries frequented by seals. Seals are shot by land-based hunters in shallow water areas. A second hunter retrieves the seal before it is lost. The struck and lost rate was estimated to be relatively high (42%) in the first year of the Swedish hunt but is now estimated at 5% (NAMMCO, 2004). In Finland, shooting is carried out using a calibre .222 or greater, while in Sweden the calibre is 6.5 mm or larger. Only ammunition with a soft point which rapidly expands causing damage to the skull contents should be used.

The quota for grey seals in Finnish waters was 603 in 2005/06 and 618 in 2006/07. Reported catches in 2005/06 were 312. Recent quotas for grey seals in Swedish waters were 170 (2003-2005), 180 (2006) and 200 (2007) seals. Approximately 80 seals were taken annually between 2002 and 2005 while a little over 100 were reported in 2006.

As reported in the Management Plan for the Finnish Seal Populations in the Baltic Sea (Ministry of Agriculture and Forestry, 2007), seals are mainly hunted along the coast on the newly frozen ice, and on long hunting trips to the iced-over sea. Harpoons were were used as

well as clubs, spears, traps and hooks, especially during the breeding season (Gottberg, 1925; Nyström, 2000; Ylimaunu, 2000). Different types of nets were used, including nets used as a passive trap, and nets used during active hunts which required the presence of the hunter. To protect fishing gear from seal attacks, special seal traps, trap nets and cages were developed (Nyström, 2000; Ylimaunu, 2000). There was also a small-scale attempt to eliminate seals by poisoning (Ylimaunu, 2000). Furthermore, seals were often trapped in fish traps, trap nets and nets as by-catch.

1.3.6.2. Regulations in Finland and Sweden

The Habitats Directive (Directive 92/43/EEC) protects 5 seal species regularly occurring within EU. Member States are obliged to designate special areas of conservation for all these sites (Natura, 2000). Grey seal, Baltic ringed seal and harbour seal are so called Annex V species which means that any exploitation may be subject to management measures. Member States have an obligation to monitor the conservation status of these species to ensure that they are maintained at a favourable conservation status. The Habitats Directive (Article 15) also lists the prohibited methods and means of capture and killing, and modes of transportation.

The Finnish hunt has been documented since 1956 and there is a Management Plan for the Finnish seal populations in the Baltic Sea (Ministry of Agriculture and Forestry, 2007). There is a management plan for grey seals in Sweden as well. Seal hunting is permitted under the Habitats Directive and the Finnish Hunting Act. Grey seals and Baltic ringed seals may be hunted under the act with a licence during their hunting season. Hunting licences for seals are granted by the game management district by virtue of regulations issued by the Ministry of Agriculture and Forestry. Seals must be hunted in an ecologically sustainable manner, without endangering their favourable conservation status.

Due to damage to the fisheries, grey seal hunting was opened again in mainland Finland in 1998 and in Åland in 1999. The hunting season for grey seals is from 16 April to 31 December. The open season for ringed seals is from 16 of April to 31 of May and from September 1 to October 15 (no hunting quotas have been issued from the Ministry of Agriculture and Forestry) (Hunting Decree, 479/2000 and its amendment, 1st Oct 2003) and no hunting licences have been issued since 1993 (Ministry of Agriculture and Forestry, 2000).

Further information about seal hunting and monitoring is provided in the Swedish and Finnish management plans (Ministry of Agriculture and Forestry, 2007).

1.3.7. Iceland

1.3.7.1. Description of hunting methods and catches

In Iceland, seal hunting is focused primarily upon harbour seals and grey seal pups. Seals are killed primarily for their fur but the meat, blubber and flippers are also used. Land owners have the right to kill seals on their land and therefore, almost all of the hunting is carried out by farmers on their own land or with the permission of the land owner. In recent years, approximately 200-400 harbour seals and somewhat fewer grey seals have been taken annually (NAMMCO, 2004).

The methods of hunting vary with area and circumstances. Netting is the most common method used for hunting harbour seal pups that are taken mainly in the spring. Rifles are not used in order to reduce any disturbance in the whelping areas. Nets are set close to small rocky islands or across creeks and channels. In the glacial rivers along the south coast, nets are pulled upstream between the riverbanks to catch pups, they are then landed and killed using a seal club or shot with a .22 calibre rifle (NAMMCO, 2004).

Grey seal pups are almost entirely killed in the whelping areas using either a seal club or .22 calibre rifle from a short distance. Adult grey seals are shot using higher calibre rifles (.222 - .243 calibre) (NAMMCO, 2004).

1.3.7.2. Regulations in Iceland

No information on the regulations controlling hunting was found.

1.3.8. United Kingdom

1.3.8.1. Description of hunting methods and catches

Grey seals are only intentionally killed in the UK as nuisance animals around fisheries and fish farms and most of these seals are killed in Scottish waters; there is no commercial hunt. The following details are given for clarification of the situation in the UK.

1.3.8.2. Regulations in United Kingdom

The Conservation of Seals Act (1970) provides the legislative basis for the regulation of killing and removing seals permanently from the wild in England, Wales and Scotland in addition to the Habitats Directive (92/43/EEC). There are annual closed seasons set for grey and common seals. These closed seasons cover the main breeding seasons of both species. Outside these closed seasons no licence is required to remove seals. Licences can be granted to remove seals during the closed season. These can be approved for scientific or educational purposes, collection for zoological gardens, protection to fisheries, reduction of populations and management purposes, and the use of seals as a resource. Protection of stock in fish farms is not a valid reason for granting a licence.

The use of rifle for killing seals is mandatory at all times of year. However, there are no calibre regulations except that minimum muzzle energy is set to 600 footpounds (83kgm/845joules) and with minimum weight of the bullet of 45 grains (3g). This corresponds mainly to relatively low powered centre-fire ammunition of calibre .22. There is no specification for bullet types, requirements for education of hunters or any marksmen's shooting proficiency tests in the UK regulations. Killing seals by netting is illegal in the UK.

The Conservation of Seals Act 1970 provides a legislative framework within which managers have considerable flexibility to change policy depending upon circumstances. It would be possible under this act to provide total year-round protection for seals, with a few specific exceptions. For example, Conservation Orders can be put in place and this can extend the licensing regime to provide year-round protection. Conservation Orders can also add conditions to licences including reporting conditions and stipulation about the type of training required of any individual holding a licence to shoot seals and the type of weapons or ammunition to be used. At present almost all of the North Sea coast of the UK and the Northern Isles (Orkney and Shetland) have some form of Conservation Order in place to limit the killing of seals to only nuisance animals and for research.

UK firearms legislation is very restrictive and very few people own firearms. In the UK, policy concerning the licensing of rifles is set regionally, but in most places the issuer of the licence, who is the Chief Constable (Chief of Police) for the region, will normally require that the rifle licence stipulates specifically what it can be used for. If seals are not included in the licence conditions, it cannot be used for shooting seals. In some regions (those where most shooting occurs), those who hold permits to shoot seals have to attend a training course. This is designed around a similar curriculum as deer.

Parts of the Conservation of Seals Act 1970 are currently undergoing a review in Scotland. It is likely that the Scottish Government will issue "guidance" in the very near future about some of

the definitions within the Act. Of particular concern is the so called "netsman's defence" which was included in the Act to mainly allow coastal salmon netsmen to defend their nets from seals within the "vicinity" of their nets without a licence, even during closed periods. However, not only has the coastal salmon net fishery almost disappeared, this clause within the Act has led to abuse. This abuse surrounds the definition of the word "vicinity" which has allegedly amounted on occasions to the shooting of seals hauled out several miles from nets or the intentional setting of a fishing gear in locations close to seals. The failure of a recent prosecution has led to the Scottish Government undertaking a review and it is likely that "vicinity" will be closely defined, possibly to less than 10 metres. The definition of what constitutes *bona fide* fishing gear will also be tightened.

1.3.9. United States

1.3.9.1. Description of hunting methods and catches

Seals have been historically hunted in the Pribilof Islands and in south-east Alaska. In the southeast, northern fur seals (*Callorhinus ursinus*), Steller sea lions (*Eumetopias jubatus*) and harbour seals are shot (NAMMCO, 2004). The most common practice is to shoot animals while they are on shore, or to herd them into shallow water before shooting in order to minimise struck and lost rates. Animals or carcasses that sink after shooting are retrieved using a grappling hook. A .222 calibre rifle with full metal jacket ammunition is most commonly used for seal hunting although larger calibre rifles are used occasionally. Wounded seals are killed by striking their heads with a club (NAMMCO, 2004).

The structure and conduct of the subsistence harvest for northern fur seals *(Callorhunus ursinus)* is essentially the same as the commercial harvest. The specific locations and frequency by which seals can be harvested are specified by the regulations which permit only the taking of sub-adult male seals from haul-out areas. The intentional taking of females or disturbance of the breeding rookeries (areas) is prohibited. Only experienced sealers can participate in the most important elements of the harvest which are carefully organized and managed by the harvest foremen.

Additionally, a certified veterinarian with extensive expertise regarding fur seals is contracted by the National Marine Fisheries Service (NMFS) to serve as the Humane Observer for the harvest. The Humane Observer is not specifically required by regulation, but has been mutually agreed by the Federal and Pribilof tribal Governments as an essential part of the hunt to ensure it is pursued and conducted in a humane manner. The Humane Observer works with the hunters to prevent animals from becoming overheated. Sealers round up a group of sub-adult (mostly 2 - 4 years old) males from the herd and drive them slowly to the harvest area. Females and any male seals over 4 years old are excluded from the drive as soon as possible. Pups are very rarely involved in the round-up and drive, due to the fact that they are seldom found on the haul-out areas during the season.

Once the drive ends at the harvest area, the animals are left to rest and cool down in a loose group. Once cooled, the seals are separated into small groups of harvestable seals with the remainder allowed to return to the haul-out areas. Once isolated, experienced "stunners" render the seal unconscious the seals using a hardwood club approximately 5 - 6 feet long to deliver a swift blow to the back of the animal's head. Once unconscious, sealers make a quick incision into the chest cavity to cut the diaphragm and incise the heart, thereby ensuring the animal will not regain consciousness and is killed. Seals are then skinned and butchered.

In addition to the fur seal hunt, natives in Alaska also hunt harbour, ringed, bearded, and ribbon seals, as well as Steller Sea Lions and walruses for subsistence purposes (Table 1).

1.3.9.2. Regulations in United States

To initiate the Pribilof Island harvest, NMFS must publish a proposed annual subsistence harvest estimate. The purpose of the notice is to provide an estimate for the annual subsistence need for St. Paul and St. George Islands.

The hunt opens on June 23 and closes when the subsistence needs of the Pribilof Aleuts have been met or August 8, whichever comes first. Only sub-adult male seals may be taken.

The regulations also require that the hunt be conducted and managed in a "non-wasteful manner" and at the end of each harvest season, the Humane Observer and tribal government representative must provide a final harvest report.

Since 1996, the Tribal Government of each island has determined the number of fur seals that would be needed by their communities each year for each 3 - year period. Generally, St. Paul Island has requested 1,645-2,000 seals while on St. George Island, the requests have ranged from 300-500 seals.

2. Practices for killing animals in abattoirs and in the wild

Seals are wild animals and so it is valid to compare the criteria used and the controls in how we kill other wild animals, as well as how domesticated animals are killed in abattoirs. This comparison is important, as there is a considerable body of literature for the killing of animals in abattoirs that minimises pain, distress, fear and other forms of animal suffering. This literature can be used as a benchmark reference for the technical procedures involved such as restraint, slaughtering, monitoring, and bleeding-out. This section deals with some of the controls and the criteria used to assess whether or not the killing methods are those which do not cause avoidable pain, distress and other forms of suffering.

Care should be taken when comparing the efficacy of these different methods of killing because of the great variation in environmental conditions involved. It is pertinent to ask whether any of the methods used in the wild or in abattoirs meet objective criteria of animal welfare in order to eliminate or reduce avoidable or unnecessary pain and distress? What is of prime importance is that if animals are going to be killed, then it they should be killed with no avoidable suffering regardless of human utility and circumstances.

2.1. Domesticated or captive animals in abattoirs

In the European Union the scope of Council Directive 93/119/EC on the protection of animals at the time of slaughter is given in Article 1:

> *"This Directive applies to the movement, lairaging, restraint, stunning, slaughter and killing of animals bred and kept for the production of meat, skin, fur or other products and to methods of killing animals for the purpose of disease control"*.

During the gathering, transport, driving and lairaging of animals there will be an inevitable element of distress occurring as well. Additional factors that have to be taken into consideration will include the species, breed, age and husbandry experience of the animals, the distance, duration and conditions of transport, the lairage time and unloading facilities.

In an abattoir the facilities are well controlled in many respects and so it is relatively easy to ensure good welfare by applying certain criteria for the buildings, associated resources (e.g. equipment) and harmonised procedures so as not to cause avoidable animal suffering at slaughter.

Large scale slaughter of food producing animals should only take place on licensed premises. People involved in pre-slaughter handling, stunning and slaughter are usually trained and certified and many of the slaughterhouses in EU have at least one person on duty designated as an animal "Welfare Officer" or "Welfare Operative" whose responsibility is to ensure the welfare of the animals on the premises, from the time of arrival to slaughter, i.e. during their period of sensibility. The Official Veterinarian has the overall responsibility for animal welfare, amongst others, and may have specialised training (additional to a veterinary qualification) (Directives 64/433/EEC and 93/119/EC).

Stunning (causing an animal to lose consciousness) before slaughter of animals is a statutory requirement in the EU (except for religious slaughter) as well as in many other countries including Canada and Norway. Stunning renders an animal insensible so that shackling, hoisting (hanging upside down), and slaughter (bleeding by severing the major blood vessels in the neck or thorax) can be performed without causing the animals avoidable pain and suffering (Directive 93/119/EEC; EFSA, 2004). A specific requirement for stunning is that it must not be carried out unless it is possible to bleed the animals immediately afterwards. When free bullets are used, the shooting is subject to authorization by the competent authority, which must ensure in particular that firearms are used by qualified staff in compliance with the general provisions of Article 3 of this Directive 93/119/EC. In accordance with this Directive, stunning methods should induce momentary loss of consciousness and sensibility whereas stunning and killing methods should induce death before the animal can recover consciousness (e.g. bleed out is started within 15 seconds of stunning). Physical stunning methods should ideally induce immediate (for example, less than one second, EFSA, 2004) and unequivocal loss of consciousness and sensibility, or when loss of consciousness is not immediate (e.g. gas methods), the induction of unconsciousness should be least aversive and should not cause avoidable pain and suffering.

In the abattoir, the number of mis-stuns has been estimated to be 4 to 6.6% for captive bolt shooting (EFSA, 2004). During a field study in the United States the percentages of cattle stunned effectively with 1 shot from a penetrating captive bolt stunner were: 100% in 12% of processing plants; 99% in 24%; 95-98% in 54% of the plants; and < 95% in 10% of the plants. All cattle where the first shot missed were immediately re-stunned (Grandin, 2000).

2.2. Wild animals

Wild animals are killed throughout the world for a variety of reasons including meat and other products, subsistence, sport, trophy gathering, fur, control of "pest" animals, research and for disease control purposes. The methods used to kill these animals vary considerably, including: poison, shooting with firearms of different types with different bullets/shot and different calibres, bow and arrow, harpoons, leg-hold and other forms of traps, and submersion systems. The efficacy of these methods, in terms of the intensity and duration of poor welfare that they potentially inflict, also vary according to the species of animals, methods used and the skills of the person using them. In some countries training in killing methods, normally with firearms, is offered and in other countries it is mandatory.

Animal welfare requirements for stunning and slaughter of animals in slaughterhouses also apply to on-farm killing of animals for disease control purposes. The Office International des épizooties (OIE) has published guidelines on stunning and slaughter for human consumption, and killing for disease control purposes (OIE, 2007) including the use of firearms. These guidelines emphasise the importance of animal welfare and the aim of ensuring good welfare when animals are killed. They also apply, in principle, to animals killed "outside slaughterhouses". The OIE (2007) criteria for the killing using a free bullet and "*Requirements for effective use"* include:

a. "The marksman should take account of human safety in the area in which he/she is operating […].

b. The marksman should ensure that the animal is not moving and in the correct position to enable accurate targeting and the range should be as short as possible (5 - 50 cm for a shotgun) but the barrel should not be in contact with the head of the animal.

c. The correct cartridge, calibre and type of bullet for the different species, age and size of animals should be used. Ideally, the ammunition should expand upon impact and dissipate its energy within the cranium.

d. Shot animals should be checked to ensure the absence of brain stem reflexes."

However, only some of these criteria would apply to the shooting of wild animals e.g. they will often involve movement and a shooting range of 5-50 cm for a shotgun is unrealistic for seals.

Under the Agreement on International Humane Trapping Standards, the currently designated time to loss of corneal reflexes with the use of killing traps varies from 45-300 seconds depending on the target species, for both North American and European fur-bearing animals (including species such as muskrats that are killed as pest animals in some European countries), "with a view to lowering the threshold requirements agreed upon" through further research (AIHTS, 1997). There are ongoing discussions on trapping and killing wild animals between the EU and other countries.

In hunting, the number of missed kills and wounded animals is difficult to estimate, but some studies have suggested figures of 10% or more for North American white-tailed deer (*Odocoileus virginianus*) (Nixon et al., 2001) and 16-44% for North American waterfowl (although many of these injured birds recover from their wounds) (Hicklin and Barrow, 2004). There are some recent data on struck and loss rates in seals given in Chapter 4.

3. Description of the killing methods

This section deals with the details of each of the main methods used to kill seals, particularly from the viewpoint of the animal and its welfare, regardless of where the animal is killed. It is assumed that the best practice for that method will be followed e.g. the person will be competent, the equipment will be well maintained, and that killing will be conducted under conditions conducive to humane killing. In addition, the terrain, the type of seal, its age, the weather at the time, and other factors may well affect the efficiency and effectiveness of killing on occasions. Where any of these factors produce inherent advantages or disadvantages of the method, this will be pointed out.

3.1. Hakapik

3.1.1. Description

The hakapik is a hunting weapon originally designed by Norwegians and a modified version is used in the Canadian commercial harp seal hunt. The Canadian hakapik (as described in the MMR of the Fisheries Act of Canada, 1993) consists of a metal ferrule that weighs at least 340 g with a slightly bent spike not more than 14 cm in length on one side of the ferrule and a blunt projection not more than 1.3 cm in length on the opposite side of the ferrule and that is attached to a wooden handle that measures not less than 105 cm and not more than 153 cm in length and not less than 3 cm and not more than 5.1 cm in diameter.

By comparison with the Canadian version the Norwegian hakapik has a metal ferrule that weighs at least 400 g with a blunt projection (hammer) not more than 4 cm long. Opposite the hammer, the ferrule has a slightly bent, sharp spike between 12 and 18 cm in length. This metal ferrule is attached to a 110 to 150 cm long wooden shaft. In Norway, the hakapik is used as a primary method early in the hunting season for pups and as a secondary method to ensure death in all animals whether shot, or killed with a hakapik.

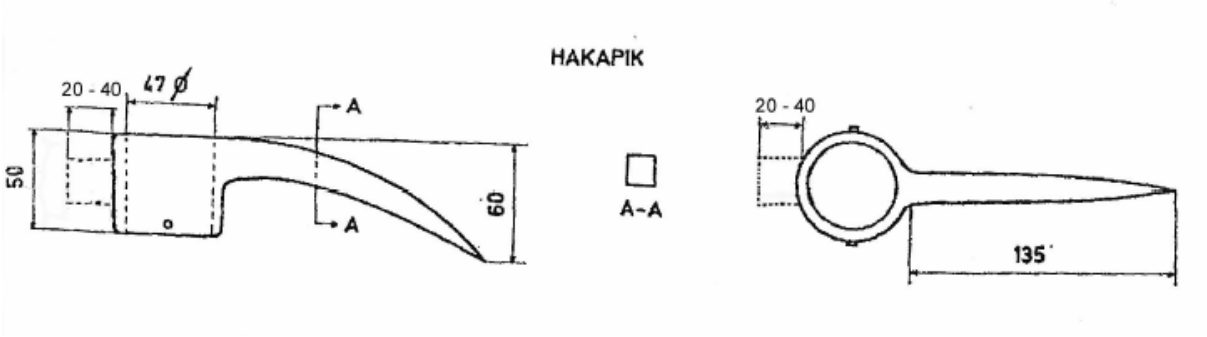


Figure 1. Schematic drawing of Norwegian Hakapik (VKM, 2007).

A modified version of the Norwegian hakapik, the slagkrok, is a 50 cm long, club with a sharp spike at the blunt end. It weighs a minimum of 1 kg, at least 250 g of which should be accounted for in the blunt end next to the spike. Both, hakapik and slagkrok were considered to be effective by the VKM (2007). As slagkroks are now rarely used, it will only be referred to when its use is different from the hakapik.

Up to now, the hakapik used in Russia has been similar to the Canadian hakapik, but the Norwegian hakapik may be used in the future (E.O. Øen, pers. comm.).

3.1.2. Basic effect

The proper use of the hakapik consists in striking the bones covering the cerebral hemispheres (i.e. the parietal, frontal and occipital bones, collectively known as the calvarium) behind the eyes of the seal with the intention of causing multiple fractures and collapse (crushing) of the skull and destroying the brain. The proper use of a hakapik is likely to either kill or stun seals (to cause reversible or irreversible unconsciousness) (Blix and Øritsland, 1970; expert opinion of the WG based on post-mortem evidence). The thickness of the skull bones of young harp seals ("beaters", 3 weeks to 3 months, which represent more than 90% of the commercial hunt in Canada and Norway), is thin. In a limited survey the bones were found to be between 0.5 and 2 mm thick depending on the location on the cranium. As the fontanelles are not yet fused and the skull can, in theory, be fractured extensively by a single blow (VKM, 2007). However, the actual structure of the bone and its physical properties have also to be taken into account as they may make the skull bones more or less resistant to damage.

Although a single well placed blow to the head should be sufficient to stun or kill a young seal, sealers are often seen to strike the animals on the head two or three times in rapid succession, as previously required by Canadian legislation,[11] in order for the sealer to ensure that the animal is indeed stunned or killed, not necessarily because the extra blows are needed.

[11] Earlier publications (late 1970s) produced by the Canadian Government on humane killing of seals (mainly whitecoats at that time) recommended at least three blows to the seal's skull (Malouf, 1986) but current regulations require that the sealer strike sufficient blows to ensure the skull has been crushed (MMR, 1993).

For several reasons including skull thickness (in a 1+ animal the thickness is between 0.8 and 3.6 mm, n=2, VKM, 2007), a hakapik is not considered to be an effective weapon for stunning adult harp seals (Anonymous, 1990 and inferred in the Norwegian Regulations). By crushing the calvarium, the intended effect of a blow or blows from a hakapik with the blunt end is the destruction of the underlying brain, primarily both cerebral hemispheres and possibly the brainstem as well. With the longer blunt projection of its ferrule, the Norwegian hakapik may have the added advantage of penetrating more deeply into the brain tissue compared with the Canadian hakapiks when administered in the right direction. Moreover, Norwegian regulations require that, following a blow to the skull, the sealer strikes the animal's brain with the spike of the ferrule in order to destroy it further, and that second blow is intended to reach the brain stem (Øen, 2006).

3.1.3. Time to loss of consciousness

Destruction of the brain will lead to immediate loss of consciousness. Data on stunning of seals with the hakapik that is used in the Norwegian hunt is limited. Only one research paper seems to be available on the stunning and killing ability of a slagkrok under controlled (laboratory) conditions (Blix and Øritsland, 1970). This study showed that effectively delivered single blows to the heads of 3 conscious three week old hooded seals with the blunt part produced immediate and irreversible disappearance of brain activity, as recorded by an electroencephalogram (EEG). They also showed that respiration continued for between 15 and 27 minutes in two of the pups that were not bled out following stunning, while cardiac activity persisted for 30-56 min in all three animals. The maintenance of respiration probably reflected the fact that the brainstem (in which the neural circuits that control respiration are located) remained intact after stunning with a single blow. Since cardiac activity continued and the animals were not bled-out, these neural structures continued to receive a blood supply and maintained functional integrity for some time after death. An equivalent situation has been described when stunning cattle with the captive bolt pistol (Gregory, 1991). Blix and Øritsland (1970) concluded from their trial that a strike with a slagkrok constituted an effective method of killing young seals, and that the animals were not conscious after the blow.

3.1.4. Advantages

The hakapik is currently used as a means of killing young harp seals (normally less than 3 - 4 months old) and is considered to be effective when sufficient care is taken to apply the blows effectively on the head and to verify their results (Smith et al., 2005). The hakapik is easy to use on younger seals which generally do not react much to human intrusion, but as the animals become older they may react moving their heads, showing a defence posture, or move away. The multiple blows that sealers sometimes deliver to the head should ensure that the calvarium is crushed and that the underlying brain is destroyed before the sealer proceeds to verify that the animal has been stunned or killed. Because of this and because the sealer is immediately next to the seal, the chances of striking and losing an animal into the water are considerably reduced. Also a blow can be repeated very rapidly (within a few seconds) if the hunter is uncertain about the effect of the previously delivered blow(s). Consequently, the whole killing process can be performed very rapidly as the monitoring and bleeding-out can be carried out immediately after the blow(s).

3.1.5. Disadvantages

The first blow from the hakapik may not stun the animal immediately if it does not hit the calvarium but hits, for example, the jaw or snout or other part of the body. This will then cause pain in conscious animals. Furthermore, in cases where the blow hits only one side of the skull

(estimated to be 14% by Daoust et al., 2002) and destroys only one side of the brain, the rest of the brain may continue to function enabling the animal to feel pain. This may also affect the detection of corneal (blink) and other reflexes used to determine loss of consciousness. This emphasises the value of giving more than one blow in quick succession in order to end any possible suffering.

The hunter has to be close to a seal, and if it moves its head or moves away, the accuracy of the strike may be compromised. This depends very much on the species and the hunt (see Chapters 2 and 5).

3.1.6. Requirement for effective operation

For effective use the following apply:

- The strike should hit the skull over the brain with sufficient force and accuracy to destroy both cerebral hemispheres.
- The hunter should withhold striking a blow if it is unlikely to be of sufficient force or accuracy e.g. if he is off-balance or if the animal is in a position to escape into the water.
- The hunter should know where to hit and why the hakapik needs to be used with good precision.
- The operator should be sufficiently strong and trained in the use of the hakapik.
- The hakapik should be strong and not break or fracture, and kept in good shape.

3.1.7. Monitoring points

The common signs of brain death include one or more of the following:

- No rhythmic breathing.
- Relaxed carcase.
- Collapsed calvarium and crushed skull confirmed by palpation.
- Loss of a bilateral corneal reflex.
- Dilated pupils on both sides.

3.1.8. Conclusions from other Reports

The Panel on Euthanasia of the American Veterinary Medical Association (AVMA, 2007) stated that: “Euthanasia by a blow to the head must be evaluated in terms of the anatomical features of the species on which it is to be performed. A blow to the head can be a humane method of euthanasia for neonatal animals with thin craniums, such as young pigs, if a single sharp blow delivered to the central skull bones with sufficient force can produce immediate depression of the central nervous system and destruction of brain tissue. When properly performed, loss of consciousness is rapid.” And “Personnel performing euthanasia by use of a blow to the head must be properly trained and monitored for proficiency with this method of euthanasia, and they must be aware of its aesthetic implications”.

One of the conclusions reached by Malouf (1986) in relation to the Canadian hunt of harp seal whitecoats, was that: “Judged by the criteria of rapidity of unconsciousness and particularly the absence of pre-slaughter stress, the clubbing of seal pups is, when properly performed, at least as humane as, and often more humane than, the killing methods used in commercial slaughterhouses, which are accepted by a majority of the public”. In addition, according to a 1993 report from the Parliamentary Assembly of the Council of Europe, clubbing in the context of the Norwegian harp seal hunt, if correctly carried out, is as good as the usual methods of slaughter, causing the animal to die in the course of a few seconds.

3.2. Clubs (no spike)

The club is intended to perform in a similar way to the hakapik and slagkrok, but there are few data on the club *per se*. Consequently, only differences anticipated by the WG will be described in this section. Because of the considerable operational differences between the hunt for Cape Fur seal pups in Namibia and hunts for true seals in the other range states, distinctions are made in the sub-sections below where applicable.

3.2.1. Description

Clubs were used in the Canadian commercial harp seal hunt when whitecoats were the primary target, but are used less often now that beaters are mainly hunted. The dimensions of the club are clearly described in the Canadian MMR (1993): a Canadian regulation club must be round, made of hardwood, and measure between 0.6 m and 1 m in length; for at least half its length, beginning at one end, it must measure between 5 cm and 7.6 cm in diameter. Clubs used in other countries may vary according to the hunt. For instance, in Namibia, the wooden shaft of a pick (pick-handle), which matches the minimum dimensions for a sealing club in the Namibian Sealing Regulations (0.9 m in length, 1 kg in weight; see Appendix 4) is commonly used for the pup hunt (Anonymous, 1997).

As there are differences in length, weight and weight distribution, the force of impact will likely be different from that of the hakapik for the same momentum applied. Moreover, the club does not have a projection which can penetrate the skull. Rowsell, observing the whitecoat hunt at the Front in 1972 (reported by Malouf, 1986), found that the club was not as effective as the hakapik for killing the larger harp seal pups or the hooded seal pups.

3.2.2. Basic effect

The intended effect is to cause the collapse of the calvarium and the destruction of the brain leading to unconsciousness and death.

3.2.3. Advantages

3.2.3.1. Namibia

Sealing clubs are used during the hunt for Cape Fur seal pups, which are aged between about 7 and 10 months at the time of the hunt. At this age, all the important sutures of the skull are still open (Rand, 1956). Generally, pups are running towards, past or away from the clubbers when they are struck. An accurate, forceful strike with a club can, nevertheless, render a pup unconscious immediately. In the case of an ineffective strike, it is possible for the clubber (or another clubber) to follow up with repeated blows, provided the hunting operation follows the stipulated procedure (see Regulations in Appendix 4).

3.2.3.2. All other range states

Similar to the hakapik.

3.2.4. Disadvantages

3.2.4.1. Namibia

The accuracy of blows is compromised by the fact that the targets are nearly always in motion. The extra momentum required to inflict effective blows with the relatively light pick-handle may further compromise accuracy, but without the extra momentum, the forcefulness of the

blows would be compromised. Clubs, particularly pick-handles, are likely to be less effective in the case of older animals which have thicker skulls, and which may be mistaken for pups.

Otherwise, the disadvantages mentioned for the hakapik in Chapter 3.1.5 also apply in general.

3.2.4.2. All other range states

Similar to the hakapiks and including the points made in 3.2.4.1.

3.2.5. Time to unconsciousness

Immediate when performed correctly.

3.2.6. Requirements for optimal operation

Similar to those outlined for the hakapik. Considering the potentially greater failure rate compared with hakapiks (see 3.1.6), the need for effective monitoring, follow up blows and rapid bleeding-out is emphasised.

3.2.7. Monitoring points

Similar to those outlined for the hakapik.

3.3. Firearms

3.3.1. Description

The specifications of firearms and ballistics used to kill seals vary according to the hunt and the size or age of seal targeted. Details for three of the range states, Canada, Norway and Namibia, are given below.

In **Canada**, according to the MMR (1993), firearms that can be used to hunt seals fall into two categories: (1) a rifle and bullets which are not full metal-jacketed (i.e. expanding ammunition) and which produce a muzzle velocity of not less than 1,800 feet (550 m) per second and a muzzle energy of not less than 1,100 foot-pounds (1,490 joules); or (2) a shotgun of not less than 20 gauge and rifled bullets. The rifle, especially of .222, .223 and .243 calibres, is the preferred weapon to hunt beaters. In every instance, the hunter aims for the head or upper neck just behind the head in order to ensure a quick kill and also to preserve the integrity of the main part of the pelt.

In **Norway**, adult (>1 year) seals are shot with rifles using expanding bullets with a minimum impact energy of 2,700 joules (275 kg/m) for 9 gram bullets and 2,200 joules (225 kg/m) for 10 gram bullets at a range of 100 metres (calibre 6.5 mm, .308 and higher).[12] The requirement of ammunition for pups is expanding bullets with impact energy of at least 981 joules (100 kg/m) (calibre .222 and higher). Seals which show coordinated movement after being hit are usually immediately re-shot. Rifles must be inspected and approved by a gunsmith before departure for the hunt, and sighted-in with the ammunition to be used during the hunt.

In **Namibia**, the Sealing Regulations (see Appendix 4) state that adult seals (described as seals 3 years of age and older) must be shot in the head while on land, using a rifle. In the Regulations, "rifle" is defined as "a rifle which is used with ammunition capable of killing an adult seal instantaneously by penetrating the brain case and destroying the brain without exiting

[12] These are the same requirements that are prescribed for ammunition used for hunting of large terrestrial animals like moose, red deer, etc. in Norway.

on the opposite side of the brain case". The ammunition in use is 0.22 LR subsonic cartridges fired from a rifle fitted with a silencer (Anonymous, 1997).

3.3.2. Basic effect

The accurate use of an appropriate firearm and ammunition to kill seals will involve hitting the head (or high neck just behind the head) at some point. Soft-pointed expanding bullets that mushroom on impact with the head should destroy the brain, even if they are off-target to some degree, providing there is sufficient impact and they do not just hit soft tissue (Fackler, 1988; MacPherson, 1994; Daoust and Cattet, 2004). Fragmenting bullets, on the other hand, are designed to break apart instantly on impact, and all the kinetic energy from the bullet is transferred into the target in a very short space of time often resulting in the head of the seal being blown apart upon impact. As well as a bullet being able to expand or fragment, the degree of damage to a target from a bullet (terminal ballistics) is influenced by several factors such as the speed of the bullet, and the extent to which the target tissue can stretch in order to absorb some of the cavitation produced by the rapidly moving bullet. The brain is a semi-fluid tissue constrained within a rigid cavity and therefore cannot stretch, but is instead crushed. At the high pressure typically caused by high-velocity bullets, the brain may be blown away or pressed through natural openings such as the sinuses or foramen magnum. In addition, the cranium itself will often crack so that secondary damage is inflicted by bone splinters. The brain stem is particularly sensitive to increased intracranial pressure. Consequently, a powerful enough projectile does not even have to hit the brain directly to cause a devastating injury (Øen, 1995; Daoust and Cattet, 2004; Øen and Knudsen, 2007). For instance, shock waves created from an impact site close to the upper cervical spine, may be sufficient to cause bleeding and tissue disruption higher up in vital areas of the central nervous system. Similarly, shots through the upper part of the neck will usually completely destroy or transect the spine and cause instantaneous unconsciousness or very rapid death by causing major damage to the spinal cord and brainstem and by severing blood vessels to the brain (pithing or spiking with a punctila to sever the spinal cord would result in paralysis and is prohibited by law). Daoust et al. (2002) observed in two harp seal beaters that a shot through the soft tissues of the neck appeared to cause rapid death without fracturing the vertebral column. It is conceivable that even ammunition of a lower power than authorized might still be sufficiently powerful to kill seals in a humane manner when they are hit directly in the neurocranium (brain case). However, because of the less severe wound that such ammunition would cause, there is a higher chance that the animal would only be injured rather than irreversibly stunned or killed if hit elsewhere with such bullets (Malouf, 1986; Daoust and Cattet, 2004).

Besides the power of the rifle and ammunition used, a rifle is only as effective in its ability to stun/kill an animal as the marksmanship of the hunter and the conditions under which the hunt is conducted. In the cases of the Norwegian and Canadian hunts, the effectiveness of shooting may be compromised by the relative motion of the boat and of the ice floe on which the seal rests, movements of the animal itself, and the small size of the target (head and upper neck). For these reasons, sealers, who normally shoot from the upper deck of the vessel (roughly 3-4 m above water level), claim that they rarely shoot from distances exceeding 40 m (Daoust and Cattet, 2004; VKM, 2007).

3.3.3. Advantages

A shot to the head or upper neck of a young seal with ammunition of appropriate power should cause immediate death because of its impact power and the large ensuing wound (Daoust and Cattet, 2004; Øen, 2006; Mörner, 2007). Another advantage is that because the seal is shot

from a distance, there would also be little or no stress associated with human intrusion immediately prior to the shot.

Modern rifles with optical sights, possibly combined with rangefinder are very accurate weapons at shooting distances relevant for seal hunting, and shots fired at the brain will usually be grossly destructive with severe bleeding and tissue damage. In the case of the dense Cape Fur seal colonies in the Namibian hunt, the use of the low calibre, low velocity 0.22 LR cartridges reduces the risk of other animals being killed or wounded by a bullet that passes through the skull of a target animal. Furthermore, the use of such firearms, particularly with a silencer, may result in less disturbance to the colony than when large calibre cartridges which cannot be silenced as effectively are used (Anonymous, 1997).

3.3.4. Disadvantages

The main disadvantage with firearms is the risk of the targeted animal being hit with insufficient force and/or accuracy to cause instantaneous death or unconsciousness, and possibly escaping wounded. This may be caused by one or more of the following: poor marksmanship, excessive distance (e.g. shots fired over ranges > 50 m), unstable platforms (e.g. a boat or ice floe in rough weather conditions), unanticipated movement by the animal (e.g. a sudden movement of the head just before the hit) or inadequate firearms / ammunition. In any seal hunt, it is likely that a certain proportion of the animals will be only wounded, regardless of the power of the ammunition. Wounded seals may escape before they are re-shot, as there is no guarantee that the rifleman will be able to inflict a successful repeat shot immediately. This is especially true for animals which are shot while in water, and also for animals which occur dense colonies (e.g. the Cape Fur seal), where a wounded seal which has moved position may be obscured by other animals (S.P. Kirkman, pers. comm.).

The distance between hunter and seal implies a necessary delay in verifying the results of the shot, unless the behaviour of the animal, such as vocalization or erratic movements of its head, clearly demonstrates visually to the hunter that an animal is only wounded. Moreover, in the case of seals shot on ice floes, the need for the vessel to perform difficult manoeuvres among ice floes may prolong the time between the shot and someone reaching the animal to monitor its condition.

In the case of the Cape Fur seal hunt in Namibia, due to the low inertia of the ammunition in use, there is a high risk of animals not being killed outright with a single shot (Anonymous 1997), particularly in the case of large males with thick skulls. Also, the Regulations do not require that animals are bled following shooting, and it is common for several animals to be shot before any are approached at close quarters to monitor and bleed. Shot animals which have lost consciousness but not irreversibly, may therefore subsequently regain consciousness and escape before they are approached.

If animals are shot in the extremities of the head e.g. nostrils, or on the skin surface, there may not be enough impact resistance for the bullet to fragment or mushroom, but the seal may still sustain life-threatening injuries.

3.3.5. Time to unconsciousness

Immediate when performed correctly.

3.3.6. Requirements for effective operation

Requirements for effective operation may be summarized as follows:

- The operator must be a trained marksman and know which areas to target. These include the brain or upper neck area in the case of most species. In the case of adult Cape Fur seals, which have extremely muscular necks covered with thick fur, only the brain should be targeted.
- The operator must be sufficiently trained with the rifle used in the hunt and must have competence incorporating an ethical approach, and the discipline to judge under which conditions to withhold shooting, taking into account factors such distance of the target and the body position of the seal in relation to the marksman and, in the case of the Cape Fur seal, in relation to other seals).
- Shooting should be not carried out when conditions are poor (e.g. in terms of dim light, high wave action, and instability of the platform and target).
- The rifle, sightings and ammunition must be well maintained and kept unsoiled by e.g. dirt, snow and ice.
- Appropriate ammunition and adequate power.
- The time between shooting and monitoring of the state of the shot animal should be as short as possible.

3.3.7. Monitoring points

- Presence of a head
- Absence of rhythmic breathing.
- A relaxed carcass.
- Collapsed calvarium and crushed skull by palpation or observation.
- Loss of a bilateral corneal reflex.
- Dilated pupil on both sides.

3.3.8. Additional information from other reports

Daoust and Cattet (2004) compared the damage to the skulls of harp seal beaters caused by .22-magnum rimfire cartridges (of lesser power than is currently allowed by the Canadian MMR, 1993) versus 22-250 centrefire cartridges. When hitting the brain case directly, the .22-magnum cartridge caused multiples fractures of the skull, but the bone fragments showed little displacement. In contrast, the 22-250 cartridges were powerful enough to completely destroy the head of the animals, and thus mere visual inspection would be sufficient to verify the animal's death. Other types of authorized ammunition, however, might require manual palpation of the skull to ensure that it is destroyed. The current Canadian MMR (1993) require that, if a firearm is used to stun/kill a seal, the person who shoots that seal or retrieves it administer a corneal reflex test as soon as possible after it is shot to confirm that it is unconscious or dead.

For several years, the rifle appears to have been the most commonly used weapon in the five main harp seal hunts (Canada's commercial hunt, Canada's Arctic summer hunt, the West Greenland summer hunt, the West Ice hunt, and the White Sea hunt). Its use is likely to continue to dominate and even to increase if the poor ice conditions in winter and spring, which have characterized recent years and which limit the ability of sealers using hakapiks to reach live seals, persist. It is an effective weapon from a humane perspective when used by a good marksman with the right ammunition and firearm. Poor weather conditions may increase the proportion of animals that are not killed instantly, compared with other types of hunt, although no specific information is available on this.

3.4. Netting and trapping underwater

In the context of this assessment, nets are assumed to be a form of underwater trap. Although capture of seals in nets is the normal method of entrapment, other methods of submerged trapping may also be used where the seal is held underwater.

3.4.1. Description

Netting is commonly used to hunt ringed seals during winter in Greenland and Russia, and for young harbour seals in Iceland (NAMMCO, 2004). Several types of seal nets are used. The "summer net" is 15 to 20 m in length and is used in open water. The "winter net" is 5-6 m in length and is set across fractures in the ice. A special type of net, which is a square of about 2.5 m, is set beneath seal holes in the ice, so that it hangs below the hole like a sack. Seal traps are used on rivers in Russia. The trap is a partially submerged mesh box with a trap door at the top which remains at the surface. When a seal hauls out onto the box, it falls through the trap door into the trap.

3.4.2. Basic effect

The basic purpose of netting is to restrain the seal in a submerged position long enough for it to exhaust its oxygen supply and to die from asphyxiation. Malouf (1986) describes the use of meshed pen traps within which caught seals were swimming and shot and, although no longer used in Canada, this process is still being used in Finland. Ronald (1982) carried out a study which involved underwater observations of how harp seals became trapped in nets and died; these observations were not supplemented by records of physiological parameters such as electrocardiograms or electroencephalograms. Because of seals' diving adaptations, Ronald (1982) supposed that seals did not realize their danger immediately upon becoming trapped, but it was observed that the trapped seals eventually struggled violently. Through their diving adaptation, seals can tolerate higher levels of lactic acid than terrestrial mammals (Zapol, 1987), and the sensitivity of their respiratory centres to carbon dioxide is reduced (Rial et al., 2000). Therefore, they do not undergo quick narcosis and loss of consciousness. They are presumably conscious until the onset of death, remaining in a diving reflex with a reduced heart rate without attempting to breathe and therefore not aspirating any water.[13] The recovery time after dives increases in relation to dive duration, which suggests that seals continue to accumulate lactic acid and carbon dioxide during dives and that these need to be metabolized or vented when the animal surfaces. It is likely that any physiological or chemical buffering of the carbon dioxide load in the body will soon be overcome in circumstances where dive durations are extended beyond the normal limits.

It is possible to view the killing of seals by netting from both a physiological and a behavioural point of view. Because of the diving adaptations of seals, the process leading to death will last tens of minutes, perhaps even more than an hour in extreme cases, depending upon species. Although we have a poor understanding as to how some diving adaptations to diving (especially those relating to the ability of seals to extend dives using anaerobic metabolism), may lead to stress, pain or suffering, we can conclude that these adaptations tend to extend the time from entrapment until death and therefore potentially also the time over which stress, pain or suffering could be experienced.

We can examine the likely responses of seals to entrapment under water based on our current knowledge of diving physiology and behaviour.

[13] For a different reason, this form of "dry drowning" is seen in a small proportion of humans who have drowned, when laryngeal spasms prevent aspiration of water into their lungs.

(i) Many diving studies have demonstrated that seals make quite sophisticated behavioural choices regarding when during a dive to return to the surface. Such choices appear to be based upon a combination of oxygen reserve levels (or possibly carbon dioxide levels), foraging success and the environment encountered during the dive.

(ii) Some seal species return to the surface long before their oxygen reserves are exhausted so that, during normal behaviour, these choices are made well before asphyxiation becomes an imminent risk. Other species that are long and/or deep diving, such as the Australian fur seal (*Neophoca cinerea*) and the New Zealand sea lion (*Phocarctos hookeri*), are thought to routinely exceed their so-called aerobic dive limit (Costa and Sinervo, 2004).

(iii) All current information and evolutionary theory suggest that seals will have strong feedback between tissue oxygen (and/or carbon dioxide concentrations) and their behavioural response to these levels throughout dives. It is likely that the denial of normal behavioural choices during diving will cause stress. In the face of declining tissue oxygen concentrations (or increasing carbon dioxide concentrations) and approaching asphyxiation (and/or drowning), initial stress is likely to lead to distress and suffering.

(iv) There will be some variation in the time to death of trapped seals according to whether they were trapped at the beginning or end of a dive.

Most netting of seals involves the use of tangle nets. It is common experience that some seals respond to entanglement by spinning rapidly along their cranio-caudal axis. This is likely a natural response to escape predation or natural entanglement in seaweed or other natural marine debris.

(i) Entangled seals will likely experience stress as a result of the entanglement because they are being denied their normal behavioural and physiological choices;

(ii) Entangled seals will usually incur a high energy cost as a result of struggling to escape the net and this will increase the rate of oxygen use. This may reduce the time to onset of asphyxia/drowning but we can be reasonably sure that entanglement will cause protracted distress and suffering extending over many minutes and, possibly, tens of minutes (Elsner, 1965; Davies et al., 2004).

3.4.3. Advantages

It would appear that this mode of death holds no advantages for diving animals such as seals, from an animal welfare perspective.

3.4.4. Disadvantages

Death by suffocation of seals trapped in nets underwater is clearly protracted, and suffering is likely to be prolonged, although the exact period of stress will vary but has not been specifically studied.

3.4.5. Time to unconsciousness

Because of their remarkable diving adaptations, normal underwater foraging trips by seal species targeted using nets or traps may last from several minutes to over 25 minutes (ringed seals, Burns et al., 2004) and even over 52 minutes (hooded seals, Folkow et al., 1999; Stenson et al., unpublished data). However, when seals are trapped they may have prepared themselves for a long dive or they may be coming up to take a breath. This may account for the fact that seals die more quickly in some situations than in others.

As they struggle violently during the later stage of entrapment, some seals may be able to escape from the net or perhaps break the net if they are large enough. However, no information is available on the escape rates of seals from nets set specifically set to catch them.

3.4.6. Requirements for effective operation

In view of the conclusions, these points do not need to be considered.

3.4.7. Monitoring points

In view of the conclusions, these points do not need to be considered.

3.4.8. Additional information from other reports

Because of the time taken for seals to die underwater, and because the seals are conscious throughout this period, Malouf (1986) endorsed Ronald (1982) and concluded that: "Netting is a very inhumane way of taking seals". Yet, the WG heard from stakeholders at the Stakeholder meeting that netting is, for Greenlanders anyway, the only way to hunt seals (primarily ringed seals) in winter for subsistence. Moreover, they are under the impression that the seal just lies still and dies.

3.5. Other methods

A number of other methods e.g. poisoning, decapitation, pneumatic devices, electrocution and others (Williams et al., 1973) have been suggested and tried unsuccessfully, but two potential methods that have been mentioned for further development are the pistol and captive bolt.

3.5.1. Pistol

The only research that has been carried out on pistols is in a series of experiments done by Hughes in the early 1980s (Malouf, 1986). A proposal was made to use a .38-shot pistol as an alternative to the club or hakapik for killing harp seal whitecoats but it was unsuccessful from an animal welfare perspective, and the research was abandoned. Moreover, proper maintenance of such weapons under cold and wet conditions on the ice floes would be difficult.

3.5.2. Captive bolt

The captive bolt has been suggested as an alternative to the hakapik as both methods have certain functional similarities i.e. to render an animal insensible by inducing brain concussion and destruction (Daly, 1987). One reason why captive bolts may not be appropriate is that they may not function properly in harsh weather conditions. Even if an effective captive bolt were to be designed the feasibility of achieving effective stunning in unrestrained animals on the ice would pose additional limitations.

3.5.3. Poisoning and overdose of anaesthetic drugs

Ylimaunu (2000) reported that a small scale attempt to eliminate seals by poisoning was carried out though no information is available on when, where and how it was done. Cyanide was also used in Canada in the late 1940s. Overdoses of anaesthetics have also been tried but none of these methods was found to be practical or were inhumane.

3.6. Bleeding-out, hauling, and skinning

3.6.1. Bleeding-out animals

Animals should be bled-out as quickly as possible after they have been stunned by a blow or a shot. This is a very important component of an efficient and humane killing process, as it ensures death by terminating blood flow to the brainstem. Furthermore, according to pelt processors, prompt bleeding of the animal is beneficial for pelt quality. Although irrelevant from an animal welfare perspective, this should provide a strong incentive for the sealers to adhere to this practice. Little is known, compared with farm animals, regarding how much time it takes for seals to bleed to death, nor regarding the efficacy of different blood vessels for the bleeding process. Relative to body mass, the total blood volume of diving mammals is 2-3 times greater than in non-diving mammals (Berta and Sumich, 1999). However, according to Norwegian experience, transecting the brachial arteries (those which are normally cut using the recommended bleeding technique) results in a rapid drop of blood pressure, as indicated by cessation of pulsatile flow within 10-15 seconds (VKM, 2007). Notwithstanding which major blood vessels must be cut in order to ensure rapid bleeding, the cuts through skin and blubber need to be large and deep in order to reach these vessels, and would undoubtedly cause severe pain if they were carried out on a conscious animal. Therefore, the importance of first ensuring without any doubt that an animal has been properly stunned and is unconscious or dead cannot be emphasized enough.

3.6.2. Relevant regulations and guidance

It is not always the case that animals will be dead or irreversibly unconscious after a blow or shot and so bleeding out to ensure death is essential. In Norway, at least one person is assigned to each marksman to club and bleed animals which are shot. Young seals are normally bled on the ice, but may be bled on the boat if they are taken on board immediately. Once the seal has been turned onto its back, an incision is made from the underside of the jaw to the breastbone, followed by incisions into the armpits to cut the brachial artery on both sides. Simultaneously, other large vessels in this area are also cut, contributing to the blood loss. This is probably the quickest means of exsanguination which can be applied. According to the Norwegian regulations, a seal is not considered dead until it has been bled, and therefore seals may not be skinned until they have been bled.

By comparison, the current Canadian MMR (2003) have no specific requirement for bleeding. They simply indicate that "no person shall start to skin or bleed a seal until a blinking reflex test has been administered, and it confirms that the seal is dead". In 2005, an international group of veterinarians, brought together by WWF, reviewed the current practices of the Canadian harp seal hunt and recommended that "*Bleeding to achieve or ensure death, following stunning, should be accepted but that the Mammal Regulations (2003) should be amended to remove the requirement for death to occur before bleeding, and replace it with a requirement for an animal to be unconscious before bleeding*" (Smith et al., 2005).

Considering the safety issues associated with the difficult working conditions often encountered during certain seal hunts (e. g. the small size of some of the ice floes on which seals may be stunned), and that animals may be shot from a distance, a regulation requiring the animal to be bled immediately after stunning may not always be practicable, depending on the hunt. This emphasizes the need for effective stunning and re-stunning if it is in doubt whether the animal is irreversibly unconscious before the animal is transported (e.g. hooked and dragged onto the main deck of the sealing vessel), bled or skinned.

In the Namibian hunt for the Cape Fur seal, the regulations (see Appendix 4) prescribe that the hearts of pups which have been clubbed must be pierced with a knife. However, the regulations do not require, for animals which have been shot (adult males), to be bled-out. Bleeding must be carried out as soon as possible and, preferably immediately, after the effectiveness of the stunning process has been verified (which in turn should be as soon as possible after stunning).

3.6.3. Skinning animals

If animals are dead or irreversibly unconscious, skinning will not pose a welfare problem. In Namibia, carcasses are first transported by truck from the colony to the factory before skinning commences Therefore skinning usually occurs several hours after killing (Anonymous, 2000a). In Norway, skinning of the seals may start from a few minutes after the bleeding (pups) to several hours later (adults). However, if an animal is still conscious when skinning commences, or regains consciousness during the process, then there is a serious welfare problem. It is highly likely that animals skinned alive will quickly die as a result of blood loss during skinning as it involves severing major blood vessels.

In order to maintain the integrity of the pelt to maximise financial return, an animal must be skinned in a very specific manner by someone well experienced in the process. The whole skinning process when performed by a skilled worker takes less than a minute. The process commences with a straight incision being made along the ventral midline from the mandibular symphysis to the perineum. If an animal is to be bled-out prior to being skinned, the ventral midline incision is initially confined to the thoracic portion. Further incisions may also be made into the axillary regions in order to cut the brachial arteries for bleeding, depending on the hunt (this does not apply to the Namibian hunt where seals are bled out by chest sticking).

3.6.4. Hauling of carcasses

In Norway, fastening of lines to animals on the ice or hooking is prohibited before the seal has been struck with the hakapik and bled. Exceptions has been made for hunting of individual seals from the ship while it is moving forward in the ice but only in the case of animals which are obviously brain dead (see Chapter 1.3.2.1).

In the Namibian hunt, large males which have been shot may be gaffed and hauled before they are loaded onto a truck. Smaller animals are carried or dragged (by their flippers) being thrown onto the truck (S.P. Kirkman, pers. com).

4. Evaluation of the killing methods used in practice

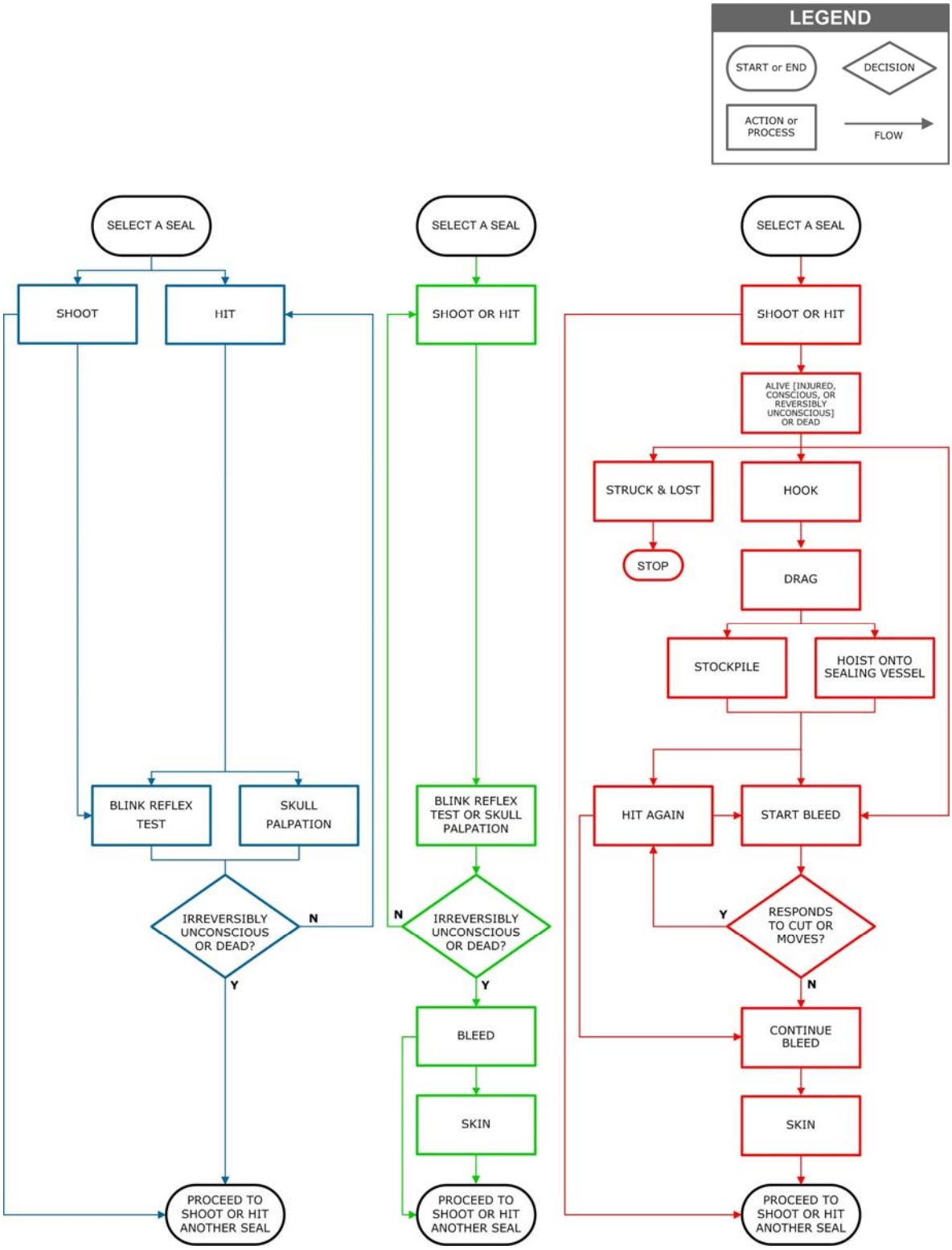
Limited information is available that evaluates killing methods employed in various seal hunts around the world (summarized in Table 1). Since independent observer reports are only available for Canada's commercial seal hunt and Namibia's hunt for Cape Fur seals, the evaluation of the methods used for killing seals focuses on these two hunts. However, the Norwegian hunt has also been independently evaluated to some degree.

4.1. A note about the importance of "continuity of evidence"

In order to evaluate whether humane killing has been achieved in any seal hunt, it is necessary to have "continuity" in the evidence examined. In other words, it is necessary to observe, in sequence, an animal being hit or shot, the application of a reflex test for consciousness (e.g. blink test), skull palpation, or some other confirmation of irreversible unconsciousness or

death, followed - ideally, and as recommended by Burdon et al. (2001) and reiterated by Smith et al. (2005) - by bleeding out to ensure rapid death (see Figure 2, green arrows). The number of animals dealt with in this way in an observed sample provides the only reliable measure of the number (or percentage) of animals killed in a manner consistent with not causing animals avoidable pain and distress. Moreover, such numbers can only be extrapolated to the entire hunt if there is adequate sampling that is representative of the entire hunt with respect to sample size and sampling design. If a blink test, skull palpation, or other test, is performed, and the animal is bled-out immediately, it will ensure that the animal was rendered immediately unconscious and slaughtered humanely, although there are other situations where there is clear evidence that an animal has been killed humanely (e.g. massive destruction of the head by a bullet). However, in the absence of these steps, the amount of pain and suffering by an individual animal cannot be determined and could thus range from none to severe.

Figure 2. Prescribed (blue arrows), recommended (green arrows) and other observed procedures (red arrows) for the killing and skinning of Northwest Atlantic harp seals in Canada's commercial seal hunt (Lavigne, Fink, Wallace and Stenson, unpublished).



There are a number of situations where a lack in continuity of evidence can lead to misinterpretations of the evidence. One such situation involves the examination of skulls of seals that have been killed and skinned. In most instances, observers examining skulls post mortem did not see the seals hit or struck, did not observe sealers checking for a blink reflex or

palpating the skull, and did not witness the animal being bled, or skinned. Furthermore, there is no way of knowing how many times the seals were hit or shot, and at what time intervals, before the skulls were crushed. In fact, it cannot be determined whether the skulls were crushed before or after skinning (e.g. Scott, 1971) without witnessing the whole killing and skinning process. In these situations, lacking continuity of evidence means that it cannot be confirmed whether animals with crushed skulls were, in fact, rendered immediately unconscious (as confirmed by a blink reflex text, skull palpation, or other such test) and bled immediately thereafter to ensure humane slaughter. Without continuity of evidence, it also cannot be determined post-mortem whether an animal with only a partially crushed skull was actually conscious before being skinned. Finally, without continuity of evidence, it cannot also be established that animals that do not have a fractured skull were not rendered unconscious, irreversibly unconscious or dead (see Chapter 4.2.2.2.).

Specific examples where a lack of continuity in the evidence plays a role in the interpretation (and possible misinterpretation) of data are discussed below.

4.2. Evaluation of the methods used for killing and skinning in Canada's commercial seal hunt

4.2.1. Available data on animal welfare aspects of Canada's commercial seal hunt

There are four recent reports by veterinarians that examine animal welfare aspects of Canada's commercial seal hunt. The first is a report of an international veterinary panel assembled by the International Fund for Animal Welfare (IFAW). This report was based on observations of the 2001 seal hunt, and a review of video footage of sealing activities recorded by IFAW from 1998-2000 (Burdon et al., 2001).

The second report is a peer-reviewed study prepared by five Canadian veterinarians, based on observations of the 1999 and 2001 seal hunt, and a review of IFAW's video footage from the 2001 hunt (Daoust et al., 2002).

The third report was prepared by an international group of veterinarians assembled by World Wildlife Fund, who reviewed the available information and made several recommendations regarding animal welfare (Smith et al., 2005). This group included at least one participant from each of the two previous veterinary panels.

A fourth report (Butterworth et al., 2007) was submitted to EFSA in October 2007. This report provided data from post-mortem examination of 17 harp seal pups killed in 2007 and from videos supplied by IFAW and the Humane Society of the United States (HSUS) of 169 seals killed by over 20 different sealing vessels during Canada's commercial seal hunt from 2003 to 2007, inclusive.

In addition to the four veterinary reports, IFAW submitted video evidence to EFSA, covering the years 1998, 1999, 2000, and 2001, as well as from the 2004, 2005 and 2007 seal hunts. Additional video footage and analyses were provided by HSUS and from other observers and stakeholders. Both IFAW (2007) and HSUS (2007) also submitted compilation tapes referred to elsewhere in this opinion.

The four veterinary reports (Burdon et al., 2001; Daoust et al., 2002; Smith et al., 2005; Butterworth et al. 2007) and video footage (e.g. IFAW 2007; HSUS, 2007) indicate that methods other than those prescribed in Canada's Marine Mammal Regulations are used in the stunning, killing and skinning of harp seals during Canada's commercial seal hunt (Fink, 2007b). As a consequence it is important to distinguish between the prescribed methods for

stunning and killing seals, described in Canada's Marine Mammal Regulations (see Appendix 3), and the methods that are actually employed during Canada's commercial seal hunt.

The authors of this opinion tried to capture the diversity of approaches currently involved in the stunning, killing and skinning of harp seals during Canada's commercial seal hunt in Figure 2. The blue arrows indicate the prescribed methodology outlined in Canada's Marine Mammal Regulations.

The quantitative observations, which are contained in three of the four reports mentioned above (Burdon et al., 2001; Daoust et al., 2002; Butterworth et al., 2007), are summarized below. In the opinion of the experts, the observations were derived from what amounts to opportunistic, as opposed to scientifically randomized or systematic sampling by different groups of observers, and they must be interpreted accordingly. For example, a small number of samples collected in the Gulf of St. Lawrence over a short period of time cannot be extrapolated to the entire hunt, 66% of which, on average (2000-2007; range 36-90%), takes place at the Front off Newfoundland (calculated from data in Fisheries and Oceans Canada, 2005; 2006; 2007a and b) over a longer time frame.

Because of the difficulties in evaluating whether or not a seal has been rendered unconscious by a blow to the head or by a bullet at a distance or on videotape (Burdon et al., 2001) or after the animal has been skinned, varying interpretations among experts examining the same evidence are to be expected. Different studies may also produce quite different results for a variety of other reasons. These reasons include: the location and time (both date and time of day) of the hunt being observed; differing sample sizes; the age of animals being targeted; between-observer variation; individual differences in sealer behaviour and competence, which may also vary with the physical fitness of the sealer and how long he has been sealing that day; as well as with ice and weather conditions; and whether seals are being struck or shot on solid ice, loose pack ice, or in water. In the latter two cases, sea state may also influence the results.

Results may also be influenced by whether or not sealers are aware that their hunting practices are being observed and recorded (Daoust et al., 2002; S. Harris, 2007, pers. comm. letter to EFSA, 6th October 2007), or anticipate that observers may later conduct post-mortem examinations of skulls remaining on the ice after they have moved out of the vicinity. Other potential biases, summarized by S. Harris (2007, pers comm.), include those associated with the selection of sealing vessels to observe; biases arising from data being collected under optimal conditions (observers cannot usually collect data during adverse flying conditions); and possible biases due to small sample sizes. Accordingly, some of the observations will likely represent "best practices" (e.g. where sealers are aware of being observed and the weather conditions are optimal) whereas others (e.g. a chance encounter with a boat with poor sealing practices) may be biased in the opposite direction. Such realities may account for the wide variation seen in some of the observations reported below.

4.2.2. Observations on killing methods

Burdon et al. (2001) provided some data on the various killing methods they observed in videos of the 1998-2000 hunts in the Gulf of St. Lawrence. Of the 179 seals they observed, 96 were shot, 56 were shot and then struck on the head, 19 were struck on the head, and 8 were killed by unknown means.

Daoust et al. (2002) examined carcasses of 225 beaters killed, mainly with a hakapik, in the Gulf during 1999. They also provide data on 47 shot seals taken at the Front the same year and on 167 seals shot or killed by hakapik "in roughly equal proportions' in the Gulf in 2001.

Butterworth et al. (2007) carried out post-mortem examinations on 17 clubbed seals collected in 2007 (location unspecified). They also examined videos collected between 2003 and 2007 in

the Gulf and on the Front showing 169 cases of seals being killed. Of these 37% were shot first, while the remainder were clubbed (using a hakapik in 93% of cases, a club in 4%, and illegal implements such as gaffs in the remaining 3%).

According to figures provided to EFSA by the Canadian Department of Fisheries and Oceans (DFO, 2007b), of a total of 2155 harp seal beaters killed by 21 vessels in 2006, 6.45% were killed with a hakapik in the Gulf and 9.93% on the Front. In 2007, of a total of 1738 animals killed by 19 vessels, 6.35% were killed with a hakapik in the Gulf and 1.26% on the Front.

Observed deviations from the prescribed methods have included the improper use of legal killing instruments (Fink, 2007a) and the use of a variety of instruments that are not listed in the Marine Mammal Regulations for striking seals on the head (Fink, 2007b). Such instruments include gaffs (Burdon et al., 2001)[14] and boat hooks (Fink, 2007b; also see HSUS, 2007; IFAW, 2007). The extent to which such documented deviations occur has not been adequately quantified.

4.2.2.1. Shooting

Of 47 carcasses of harp seals shot on the Front in 1999 and examined by Daoust et al. (2002), 35 (75%) had been shot in the head: the skull and brain were "completely destroyed" in 28 cases, the mandible and base of the cranial cavity destroyed in 5 cases, and the snout and frontal region of the cranial cavity destroyed in 2 cases. Six (13%) of the 47 animals had been shot in the neck, with complete transection of the cervical portion of the vertebral column; three (6%) had been shot in the ventral region of the neck with destruction of soft tissues, including major blood vessels. The remaining three seals (6%) had been shot in the thorax or abdomen, one of which was "*found alive by itself on an ice floe and was immediately killed with a hakapik by a DFO officer*".

In 2001 in the Gulf, in most (estimated 85%) of 43 cases where the animals had been shot, the interval between the shot and first contact by a sealer (resulting primarily from the time required for the vessel to get close enough to the ice floe for one of the sealers to land) was 1 min (Daoust et al., 2002). Some of these animals (3 of 8, in one instance where exact records were kept) were still alive during this interval. Retrospectively, the authors thought that ammunition of lower caliber than allowed by the Canadian Marine Mammal Regulation may have been used that year.

In the 169 cases examined on video by Butterworth et al. (2007), of which 37% were shot, the authors were able to establish the start sequences for 88% of the seals. Of the seals shot, 78% were shot once. Of 51 shots where the point of impact could be established, 41% were in the head region, 55% were in other parts of the body, and 4% missed the animal entirely. The mean time interval from the first shot to contact by a sealer was 48.8±9.4 seconds. Sixty-six percent of the shot animals received subsequent blows from a hakapik and a further 16%, which were not clubbed, responded to stimuli after being shot. According to the authors, "[r]*esponses to stimuli were those that required a coordinated response, e.g. biting the gaff, resisting whilst being dragged or other coordinated movements, as opposed to uncoordinated movements which could be construed as a post-mortem swimming reflex*". However, the authors subsequently mentioned that "*…it was not possible to differentiate unequivocally between conscious responses and unconscious reflex activity*". Butterworth et al. (2007) concluded that a minimum of 82% of shot seals were not killed by the first shot. This was based on 66% of the shot seals having subsequently been clubbed (as mentioned above) plus 16% that "*responded to stimuli*" after having been shot but were not clubbed. However, Daoust et al. (2002)

[14] Note that the use of gaffs for stunning seals was originally banned by Canada's former Seal Protection Regulations as early as 1967 (Fisheries Act, Seal Protection Regulations, amended 1967).

observed that, 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. Therefore, the proportion of seals that were not killed by the first shot in the study of Butterworth et al. (2007) remains unclear.

4.2.2.2. Clubbing

Both Burdon et al. (2001) and Daoust et al. (2002) conducted post-mortem examinations of skulls collected from seals that were killed in the hunt. Burdon et al. (2001) collected their samples from harp seals killed in the Gulf of St. Lawrence during the 2001 hunt, after sealers had vacated the area. Carcasses were chosen "at random". Skulls were visually examined and palpated. Burdon et al. (2001) reported that in 13 (17%) of 76 skulls examined, there were no detectable lesions of the skull and said that "*it would be of significant question if any alteration of consciousness occurred in these cases*". An additional 19 (25%) exhibited minimal to moderate skull fractures. In these cases the authors said that "[m]*inimal fractures including hairline and non-displaced fractures could be associated with a decreased level of consciousness but highly unprobably* [sic] *unconsciousness…*[and that m]*oderate fractures would be more likely to be associated with a more significant decrease in consciousness than minimal, but would still not have a high level of probability to be associated with unconsciousness*". The remaining 58% of the skulls exhibited extensive fractures. "*Extensive fractures,*" they noted, "*would undoubtedly be associated with a level of unconsciousness and severe fractures would be highly probable to be associated with a level of unconsciousness*".

These observations and interpretations by Burdon et al. (2001) have been claimed by some to indicate that 42% (i.e. 17+25 = 42) of all harp seals are likely conscious when skinned. Such an interpretation does not represent what Burdon et al. (2001) actually wrote. It is incorrect to conclude that 42% of the seals in the sample were skinned alive. Further it is not appropriate to extrapolate from a small sample of 76 skulls collected in the Gulf of St. Lawrence over two days to all the animals killed during the entire hunt, which is conducted over several weeks, both in the Gulf and on the Front off Newfoundland and Labrador.

Because of a lack of continuity in the evidence, it is not possible to determine through post mortem examination of a partially crushed skull, whether or not an animal was actually conscious or unconscious at the time of skinning. Based on the available data, it can be concluded that 42% of the skulls examined were not completely crushed and that some of those animals may have experienced pain and suffering. However, as Daoust et al. (2002) indicated, it does not mean that all of these animals experienced pain (see Chapter 4.1). Conversely, it does not automatically follow that the remaining 58% of the animals in this sample were humanely killed. Some of these animals were likely killed humanely while others may not have been.

In another post-mortem examination of skulls, Daoust et al. (2002) reported that, during the 1999 hunt in the Gulf, two veterinarians examined a minimum of 225 beater carcasses, at least 220 of which had been killed by sealers prior to the observers' arrival (under circumstances similar to those of Burdon et al., 2001). Of these, 4 (1.8%) did not have multiple fractures. Three of these four seals had fractures of the maxillary bones while the fourth had a sub-dural haematoma. The authors concluded that these 4 seals may have been rendered unconscious by concussion after the blow(s) but could not rule out the possibility that these four animals would have retained or regained consciousness before being bled. In 2002, Daoust et al. (2002) also recorded three animals (out of a sample of 167 seals observed, i.e. 1.8%) still alive and conscious on the deck of a sealing vessel.

The above findings led Daoust et al. (2002) to conclude that "at best 98%" of animals were killed in an acceptably humane manner. These observations and interpretations by Daoust et al.

(2002) have been claimed by some to indicate that 98% of all harp seals are killed in an acceptably humane manner. Such an interpretation does not represent what Daoust et al. (2002) actually wrote. It is scientifically incorrect to conclude that 98% of the seals in either sample was killed humanely. Further it is not appropriate to extrapolate from two samples collected in the Gulf of St. Lawrence in two different years to all the animals killed during one entire hunt, which is conducted over several weeks, both in the Gulf and on the Front off Newfoundland and Labrador. Because of a lack of continuity in the evidence, it is not possible to determine, either through post-mortem examination of skulls or from observations of seal carcasses on the deck of a sealing vessel, whether or not an animal was humanely killed or rendered irreversibly unconscious. Based on the available data, it can only be concluded that, in these two cases, a minimum of 2% of the animals may have experienced avoidable pain and suffering. It does not automatically follow, however, that the remaining 98% of the animals in these samples were humanely killed. Again, some of these animals were likely to have been killed humanely, while others may not have been.

Daoust et al. (2002) also recorded that 86% of 100 skulls examined in 2001 had been completely crushed by strikes with hakapiks, 9% had only one half of the calvarium crushed, and 5% had only non-displaced fracture(s) of the calvarium or multiple fractures involving only the frontal portion. (the number and timing of the strikes were not provided). In this sample, the 14 seals (out of 100) with incompletely crushed skulls were considered likely to be irreversibly unconscious or dead (no blink reflex, no breathing) when examined on the deck of the sealing vessel by the veterinarian.

Of the 17 carcasses examined by Butterworth et al. (2007), all had been clubbed, one of which was also shot. Of these, 15 (88%) had “mild/moderate” (5) or “extensive” (10) skull damage; the remaining two had no evidence of skull damage. The authors also report that 82% of the seals exhibited ocular damage which is consistent with damage to the calvarium. Of these 17 carcasses, 44% also had damage to the face or neck. Based on this evidence, however, it was not possible to determine what may have been the state of consciousness of these animals following the blow(s).

According to figures provided to EFSA by the Canadian Department of Fisheries and Oceans (DFO, 2007b), officers examined the skulls of 190 harp seal beaters killed with a hakapik in 2006 and concluded that the damage was either “complete” or “high” in 179 (94.2%), “moderate” in 11, and “slight” in none. In 2007, officers examined the skulls of 38 animals also killed with a hakapik and concluded that the damage was either “complete” or “high” in 25 (65.8%), “moderate” in 13, and “slight” in none. Details of the circumstances surrounding the examination of these skulls were not provided for either year.

Malouf (1986) reviewed several earlier reports, mainly on harp seal whitecoats. As these animals are no longer hunted and killed, the relevance of these data may no longer apply to some of the current issues. Nevertheless, the Malouf data are interesting as they show something about the effectiveness of this physical method and perhaps also the varied attitude, skills and training of the sealers and their working conditions. Malouf (1986) described five reports by veterinarians, animal-welfare officers or biologists, based on their observations of the seal hunt in the Gulf of St. Lawrence between 1967 and 1978. The reports included specific quantitative information pertaining to clubbing as a stunning and killing method for whitecoats. These reports did not distinguish between the use of the hakapik versus that of the club, nor between ages of whitecoats. Bodyweight and behaviour change significantly with age, and older whitecoats are less mobile and have more blubber than beaters, which comprise the bulk of the animals killed in today’s commercial seal hunt. The proportion of skulls that had no or limited fractures in each of these studies was: 36.4% (1967; 154 skulls), 4.1% (1967; 512 skulls), 6.4% (1968; 695 skulls), 0% (1977; 400+ skulls), and 53.8% (1978; 13 skulls). Malouf

(1986) further commented that veterinarians who examined uncrushed skulls could state that some, but not all, of the seals from which these skulls derived were likely to be unconscious as a result of brain haemorrhages when they were killed.

There are at least two explanations for the observed differences in the studies mentioned above: 1) some sealers do a better job of crushing skulls than others, or 2) sealers do a better job of crushing skulls when they are aware that observers are (Daoust et al., 2002), or will be, in the vicinity, than when they do not anticipate that the skulls will later be examined.

4.2.2.3. Monitoring for crushed skulls and a blink reflex

Burdon et al. (2001) noted that, in 79% of 179 cases observed on videos, sealers did not check for a blink reflex. Similarly, Daoust et al. (2002) reported that, in 87% of 116 cases observed, sealers failed to palpate the skull or check the blinking reflex before proceeding to hook or bleed the seal or go to another seal. (In 2001 and 2002, checking for a blink reflex was not a legal requirement in the Canadian hunt. This step was reintroduced as a requirement in 2003 - Government of Canada, 2003-).

Butterworth et al. (2007) reported that, in 149 (88%) of 169 animals for which they could establish a start sequence for the killing process, sealers did not perform a blinking reflex test or skull palpation in 67% of the cases. These authors also noted that they never observed the three-step process of stunning, checking (palpation of the skull) and bleeding carried out in rapid sequence, as was recommended by Burdon et al. (2001) and by Smith et al. (2005).

4.2.2.4. Struck and lost animals

Canadian government scientists currently assume that 5% of young seals struck with a club, hakapik or bullet are not recovered by sealers, and their fate is unknown. They could survive or die (Sjare and Stenson 2002; Stenson, 2005). In recent years, some 98% of the seals landed in Canada's commercial seal hunt have been young, about 3 weeks to 3.5 months of age (Table 7). For older harp seals hunted in open water (not currently a significant part of Canada's current commercial hunt), it is assumed that one seal is struck and lost for every animal landed, i.e. a struck and lost rate of 50% (Stenson, 2005). In both cases, the struck and lost figures currently used by Canadian government scientists are based on a review of available data from earlier hunts for harp seals under a variety of conditions (Lavigne, 1999; see Sjare and Stenson, 2002, for more recent data; also see Johnston et al., 2000). The earlier studies confirmed that the number of animals struck and lost varies with the instrument used for killing, the age of the seals, the substrate upon which they are hunted (solid ice versus loose pack ice versus water), and the time of year (which influences the fat content of the seals and, thus, their buoyancy; Lavigne, 1999). Undoubtedly, struck and lost rates will also vary with the skill of the hunter and other variables, such as weather conditions. Burdon et al. (2001) observed that a small number of harp seals were struck and lost on the video footage they reviewed from the 1998-2000 seal hunts. Consistent with the Canadian government's figure, Daoust et al. (2002) reported that, in a sample of 167 harp seals struck with a hakapik or shot during the 2001 hunt, 5.4% (9) were lost.

4.2.2.5. Other relevant observations

In addition to the prescribed methods mentioned at the outset, there are a number of sealing activities reported by seal hunt observers and veterinarians that have been used to evaluate the humaneness of Canada's commercial seal hunt (see Figure 2, red arrows; HSUS, 2007; IFAW, 2007). Other scenarios that have been observed on the ice and in the videotaped evidence and analysed in the veterinary reports are summarized briefly below (as noted elsewhere in this Opinion, it must be remembered that different observers may come to different conclusions after examining the same evidence).

- Sealers hit/shoot one animal and proceed directly to hit/shoot other seals before checking for unconsciousness or death (Burdon et al., 2001; HSUS, 2007; IFAW 2007).
- Sealers repeatedly club a seal, sometimes in quick succession (series of blows), sometimes after other seals have been struck on the head or shot with considerable delay between successive strikes (Burdon et al., 2001). A series of blows can be used as a method of killing and does not necessarily imply that the first blow was ineffective. Repeated clubbing may occur when the sealer thinks the animal remains conscious or, possibly, when he simply wants to ensure that the animal is dead; in some such cases, the sealer may incorrectly assume that swimming reflexes mean that the animal is still alive. In the opinion of the Working Group repeated clubbing would not be necessary, on occasions, if sealers checked for a bilateral blink reflex or palpated the skull to ensure that the brain was crushed.
- Butterworth et al. (2007) reported that, of 94 seals observed on videos that were clubbed (63% of 149 animals for which the start of the sequence for the killing process could be determined), 39% received two separate series of blows; the mean time between series was 23.9±3.2 seconds. Twenty-five percent of seals – 12% receiving one series of blows, 13% receiving more than one series of blows – "responded to stimuli" (see Chapter 4.2.2.1 for a description) after having been clubbed.
- Although not required by Canada's Marine Mammal Regulations, harp seals are occasionally bled-out immediately after being struck (Burdon et al., 2001).
- Cases of seals being bled or skinned alive have been reported (Burdon et al., 2001; Butterworth et al. 2007). This is, however, an issue that is often difficult to resolve on video. Daoust et al. (2002) provide an example where a group of observers, examining video sequences different from those viewed by Burdon et al. (2001), came to different conclusions about animals being skinned alive.
- Sealers have been observed simply hooking a struck animal, some of which appear to have been alive (Burdon et al., 2001; Daoust et al., 2002; Butterworth et al., 2007) and dragging it across the ice to a central place where animals are being stockpiled (HSUS, 2007; IFAW, 2007), or directly to a sealing vessel (HSUS, 2007).
- Stockpiled animals have been observed breathing and conscious on the ice (HSUS, 2007; IFAW, 2007).
- Butterworth et al. (2007) observed blood in the stomach of 10 (59%) of 17 seals that had been clubbed, "indicating that they were alive and swallowing blood after the first insult".

4.2.3. Conclusions from the four veterinary reports

1. Burdon et al. (2001) concluded that Canada's commercial seal hunt results "in considerable and unacceptable suffering". This conclusion was based in part on post-mortem examination of 76 skulls (for a discussion of these particular data, and how they have been interpreted, see Chapter 4.2.2.2.).
2. Conversely, Daoust et al. (2002) concluded that "the large majority of seals taken during this hunt (at best, 98% in the work reported here) are killed in an acceptably humane manner" (for a discussion of these particular data, and how they have been interpreted, see Chapter 4.2.2.2).
3. Butterworth et al. (2007) expressed "considerable animal welfare concerns about how the hunt is conducted". They concluded that different animal welfare issues assumed greater prominence in particular years, but they found no evidence that poorer welfare is associated with poor ice conditions or other factors that make the hunt harder to conduct.
4. Butterworth et al. (2007) also suggested that commercial and practical considerations make clubbing seals inherently inhumane (Richardson, 2007). They concluded that it is not

possible to improve standards such that this method of killing would reach internationally acceptable standards.

5. According to Smith et al. (2005), Canada's commercial seal hunt has the potential to be a humane hunt. That working group also concluded that it can be undertaken in a humane manner, if done by skilled professionals using the guidelines they provided.
6. According to Smith et al. (2005), the competitive nature of the hunt creates an environment in which speed is the rule, and hunters may be encouraged to take shortcuts. Smith et al. (2005) thus recommended that competition and haste in the hunt be reduced.
7. Burdon et al. (2001) concluded that there is a lack of consistency in the treatment of each seal and the existing regulations are neither respected nor enforced.
8. Butterworth et al. (2007) concluded that there was widespread disregard for the Marine Mammal Regulations by sealers, and a failure by the Canadian Department of Fisheries and Oceans to monitor the hunt effectively and enforce the Marine Mammal Regulations.
9. According to Burdon et al. (2001), Canada's commercial seal hunt does not comply with basic Canadian animal production regulations. (NB Canada's animal production regulations were not designed to cover Canada's commercial seal hunt).
10. Smith et al. (2005) concluded that Canada's commercial seal "should be judged with reference to accepted practices for euthanasia, and in comparison with killing done in abattoirs".
11. Any method for killing a seal which does not allow for the three-step process of stunning, checking (by application of the blink reflex or skull palpation that the animal is irreversibly unconscious or dead) and bleeding-out to be performed, has the potential to create suffering (Burdon et al., 2001).
12. Burdon et al. (2001) concluded that any method of taking a seal that requires the seal to be recovered by gaffing or hooking before unconsciousness or death can be confirmed using the three-step process described in 11) above can be followed, can never be humane. However, as noted elsewhere in this Opinion, some of these animals may be killed humanely while others may not be. Such uncertainty will always remain in the absence of a test to verify irreversible unconsciousness or death.
13. As the three-step process described in 11) above cannot be followed in open water, Burdon et al. (2001) concluded that shooting seals in open water can never be humane (also see: Smith et al., 2005).
14. Training and enforcement should aim to produce a standard of competence whereby seals can be rendered unconscious can be achieved rapidly (Burdon et al., 2001).
15. Daoust et al. (2002) concluded that the proportion of animals that are not killed efficiently justifies the continued attention to the industry's activities, preferably by members of the veterinary profession.
16. 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 (Daoust et al., 2002).

4.2.4. Recommendations drawn from the four veterinary reports

1. Burdon et al. (2001) recommended that that seals must be recognized as Marine Mammals, not fish (as is currently the case in Canadian law).
2. The adoption of a more reliable and consistent procedure for the killing of seals (Burdon et al., 2001; Smith et al., 2005). Burdon et al. recommended a process of rapid stunning (resulting in a rapid loss of consciousness), followed immediately by a bilateral corneal reflex check to assess loss of consciousness, followed immediately by bleeding out to ensure death occurs. Smith's recommendations were similar, except that skull palpation to ensure the skull is crushed, was recommended over the blink reflex test.

3. The Marine Mammal Regulations should be amended to replace the requirement for death to occur before bleeding, with a requirement for unconsciousness before bleeding (Smith et al., 2005).
4. The process of rendering the seal unconscious, assessing the corneal reflex (or skull palpation; Smith et al., 2005), taking further action where necessary to ensure loss of consciousness and effective exsanguination, must all be performed before the hunter moves on to the next seal (Burdon et al., 2001).
5. Exsanguination should be performed by completely severing the brachial arteries and veins on both sides or by directly entering the heart and major vessels via the thoracic inlet (Burdon et al. 2001).
6. Because of the high struck and lost rates for harp seals shot in water, both Burdon et al. (2001) and Smith et al. (2005) recommended an end to the shooting of seals in the water during Canada's commercial seal hunt. Although this recommendation has been discussed during DFO's on-going regulatory review process (D.M. Lavigne, pers. comm.), it has not been implemented.
7. Smith et al. (2005) also recommended that a seal should not be shot in any other circumstance when it is possible that the carcass cannot be recovered.
8. Burdon et al. (2001) recommended that the sealing season be condensed to prevent the hunting of adult females (usually in water) during the third trimester of pregnancy.
9. Licensing and training should be mandatory for all sealers (Burdon et al., 2001; Smith et al., 2005).
10. In addition, it was recommended that the Canadian Department of Fisheries and Oceans should take steps to improve supervision, monitoring and enforcement, including the training of enforcement officers (Smith et al. 2005).
11. Observation effort should be increased on the Front (off the coast of Newfoundland and Labrador) (Smith et al., 2005).
12. Burdon et al. also recommended that the shooting seals should only be done by certified marksmen using legally required ammunition and weapons. The seals should be on the ice, at a distance and under conditions that will enable an accurate shot to be taken, whereby the projectile will enter the brain causing sufficient damage to render the animal either unconscious or dead. If there is any doubt regarding the effectiveness of the first shot, then subsequent shots must be fired to achieve the goal. The sealer should then approach the shot seal, assess the corneal reflex (or palpate the skull; Smith et al., 2005), and then immediately perform exsanguination.
13. Competition and haste in the hunt should be reduced to encourage the improved application of humane hunting methods (less suffering), improved supervision, monitoring and enforcement, and a safer working environment for sealers (Smith et al., 2005).
14. Smith et al. (2005) also recommended further research on possible refinement of the hakapik, bleed-out time, the swimming reflex, and assessment of gunner accuracy.

The following sections outline some of the animal welfare concerns associated with the prescribed hunting methods in Namibia's Cape Fur seal hunt, and concerns arising from the failure to implement the prescribed approach. However, it should be noted that it is based on limited data, that has not been peer reviewed and forms part of a NGO report.

4.3. Evaluation of the methods used for killing and skinning Cape Fur seals in the Namibian hunt

The following sections outline some of the animal welfare concerns associated with the prescribed hunting methods in Namibia's Cape Fur seal hunt, and concerns arising from the failure to implement the prescribed approach. However, it should be noted that it is based on limited data, that has not been peer reviewed and forms part of a NGO report.

4.3.1. The stunning and sticking of pups

The method used for the killing of pups in Namibia, namely the "stun and stick" method (see Chapter 1.3.5.2), has been the subject of much controversy because it is regarded by many as "inhumane" (David, 1989). Unlike adult males, to hunt the pups with rifles is impractical because of the relatively small size of the head and their tendency to congregate in groups. Other alternative killing methods which have been investigated have been found by scientists and veterinarians to be neither adaptable to fur seal hunts, nor more humane than stunning and sticking (Keyes, 1980).

Best (1990a) emphasized that hunting of pups by stunning and sticking them is only humane provided unconsciousness is instantaneous and bleeding-out ensures a rapid death. However, it is important to note that welfare concerns regarding the hunt for Cape Fur seal pups are not restricted to the effectiveness of stunning and sticking, but to several other aspects. These include distress and possible injury which may be inflicted upon the targeted animals before they are killed as well as to the animals which escape the hunt, and effects of repeated hunting disturbance on the welfare of animals, particularly suckling pups. Such concerns are discussed below.

In the opinion of Best (1973), a single blow with a sealing club usually shatters the cranium of Cape Fur seal pups and is sufficient to kill them instantly during the hunt. However, in 1974, veterinarian representatives of the USA Department of Commerce who were tasked with observing the Cape Fur seal hunt in South Africa and present day Namibia, pronounced the standards of hunting to be unacceptable, mainly because stunning was often ineffective (in which case unconsciousness was not instantaneous) and bleeding-out was frequently carried out incorrectly (so that rapid death was not ensured) (Wass, 1974; McDonald, 1974). More specifically, they observed that in many cases, several blows were landed before an animal was rendered unconscious, or animals were stunned so lightly that consciousness was partially regained before bleeding-out (25% of skulls they examined after the hunt did not have significant fractures). Furthermore, they noted that frequently, the major vessels of the heart were not cut during sticking. IFAW (1994) showed, in video footage taken of the pup hunt at the Cape Cross seal colony, clubbers applying several strikes to render animals unconscious, as well as some pups which appeared to be conscious at the time of sticking. The same video shows pups being laid out in rows following sticking and prior to being loaded onto trucks, in which some animals are still breathing and making movements. More recent observations of the hunt in Namibia are consistent with the above findings. Kirkman (2006) observed the hunt in 2001 and found that although many of the clubbers were effective, some of them were not, and frequently had to strike animals several times before causing unconsciousness.

Such movements of seals after clubbing may represent reflexive tremors or convulsions which many animals often undergo shortly after being killed by acute trauma to the brain. Alternatively, such movements may indicate that the animal is conscious. Of 30 animals to which a blink reflex test was administered while awaiting removal to the factory in 2001, 17% (5) exhibited a blink reflex (Kirkman, 2006). These animals were therefore neither rendered irreversibly unconscious when stunned, nor properly bled-out after stunning. Indeed, Kirkman (2006) noted that sticking was often performed carelessly, in that the chest and major blood vessels of pups were not cut.

Kirkman (2006) also observed that it was normal for there to be long delays between stunning and sticking and that invariably, some pups would regain consciousness before sticking occurred. The current hunting regulations do not specify a time limit between stunning and sticking, only that sticking take place "after clubbing". Kirkman (2006) estimated the time interval between the two events for individual pups at a Namibian colony in 2001 to be approximately 5 minutes, on average, but occasionally lasting as long as 15 minutes. In

comparison, the corresponding time interval at the same colony in 1977 was reported to be approximately 17 seconds, rarely exceeding half a minute (Anonymous, 1978). Kirkman (2006) attributed the failure to stick pups soon after they were struck to there being too few designated stickers in relation to the number of clubbers, to keep pace with the large numbers of pups being stunned almost continuously. In his opinion, the hunting-rights-holders placed far more emphasis on maximising the rate at which pups were immobilised, than on ensuring rapid death through immediate sticking. In fact, it is the preference of the rights-holders to not stick the animals (Anonymous, 1997), and Kirkman (2006) was informed by control officers overseeing the Cape Cross hunt that bleeding only took place when he (Kirkman) was present at the hunt (S.P. Kirkman, pers. comm.). The officers apparently had insufficient knowledge or understanding of the regulations to insist that bleeding be conducted after stunning. Therefore, it suggests that bleeding-out, while required by the regulations (see Chapter 1.3.5.2), was not routinely carried out.

4.3.2. The rounding up and herding of animals

Although the stunning and sticking of Cape Fur seal pups has been likened by some to the slaughter of livestock in abattoirs (Shaughnessy, 1976; Best, 1990a), in practice, the pups are unrestrained and are nearly always moving. Attempting to stun mobile animals in rapid succession, often on uneven terrain, has clear implications for the accuracy of the strike and the ability of sealers to ensure that each animal is properly stunned and remains unconscious prior to sticking (WSPA, 2007; Kirkman, 2006). Therefore, regulations stipulating that the hunt must follow a particular structure (see Chapter 1.3.5.2) are aimed at facilitating the effectiveness of the stun and stick procedure (Best, 1990a). For example, by separating small groups of pups from a larger group, the potential for clubbers to single out targets, and for bleeding to rapidly follow stunning, are increased, compared with less structured approaches (see Chapter 1.3.5.2). However, secretly filmed footage of the hunt at Cape Cross in 2000 (Network for Animals, 2007), which has previously been broadcast on South African television (Anonymous, 2000b) suggests that this procedure is not routinely adhered to. The footage showed animals being stunned while still in groups, and in which they moved about in a agitated manner so that the ability of the hunters to single out targets was adversely affected. There was also no evidence of sticking taking place.

The regulations for the Namibian hunt (see Chapter 1.3.5.2) do not place any upper limit on the size of groups that are held before stunning commences. Kirkman (2006) estimated that such groups frequently contain well in excess of 100 pups, as well as some adults, including mothers, which are eventually released by the herders. While held in groups, the pups are tightly bunched together and frequently attempt to clamber over each other. It is common for some of those seals to be held in these large groups for more than 30 minutes before they are stunned, during which time they may succumb to overheating or suffocation, or vomit milk (Kirkman, 2006; see also Best, 1990a). This is likely to be a distressing experience for all the animals concerned.

4.3.3. The shooting of adult seals

In the case of the hunt for adult males, the targets are small (the side of the head is aimed for), mobile and usually situated at close quarters with other seals. Considerable marksmanship, ammunition of appropriate calibre, and a good knowledge of seal anatomy, behaviour and biology are required if the shooting is to be done effectively and efficiently (Best, 1990a). While Kirkman (2006) observed that the standard of marksmanship during the 2001 hunt was generally high he, nevertheless, estimated that struck and lost rates of around 5% were the norm, with wounded animals escaping to sea. This is equivalent to about 250 wounded animals

assuming a typical quota of 5,000 adult males is achieved in one season. Kirkman (2006) attributed the ineffective shooting of animals mainly to the low killing power of the 0.22 calibre ammunition used in the hunt. However, in some cases poor marksmanship was also a factor. Control officers at the Cape Cross harvest estimated that the struck and lost rates of one assistant marksman who operated on some days during 2001, were in the vicinity of 15-20% (Kirkman (2006). However, it is not known how many seals were shot by this person.
Unless wounded animals escape, they are dispatched with one or more repeated shots, as the bleeding of animals following shooting is not required by the regulations in Namibia (see Chapter 1.3.5.2). Because several animals are usually shot before any one of them is approached closely, wounded animals which are initially rendered unconscious may only be dispatched some time after the first shot, unless they regain consciousness and manage to escape (S.P. Kirkman, pers. comm.).

4.3.4. The killing of suckling pups

In 1974, the USA veterinarian observers reported that many pups were observed to vomit milk during the hunt (McDonald, 1974; Wass, 1974). This had implications for the marketing of their pelts in the USA, on account of legislation prohibiting the import of marine mammals or their products if they were suckling at the time of taking (MMPA, 1972). Vomiting of milk was also observed by Kirkman (2006) and is evident in the IFAW (1994) video footage.

4.3.5. Effects of hunting disturbance

Kirkman (2006) states that the hunting operation for pups causes high stress and exertion levels among animals (IFAW, 1994; Network for Animals, 2007), including those which are eventually killed and those which escape. Whether or not the hunting regulations are adhered to, most seals in the vicinity of the operation (excepting those which are killed) flee into the sea, causing nursing mothers to become separated from their pups (Kirkman, 2006). During the hunting season, this disturbance is repeated during most days of the week at the three colonies where hunting occurs, which affects the attendance of mothers and may cause the nursing of those pups which escape the hunt to be prematurely terminated (Rand, 1959). It is unknown what proportion of pups are capable of surviving independently of their mothers when forcibly weaned at this stage. Since 2001, however, the hunt has commenced a month earlier than it did previously (1 July instead of 1 August), therefore the proportion surviving is likely to have correspondingly decreased (Kirkman, 2006).

In the 1980s, the shooting of adult seals at colonies in South Africa and present day Namibia was allowed to continue well into the pupping and mating seasons (Wickens et al., 1991). This produced disturbance in the breeding colonies which, according to Best (1990b) led to unnecessary cruelty, additional pup mortality and emigration of adult females. Currently, the hunt in Namibia ends on 15 November (Kirkman, 2006), before the period when most of the pups are born each year. However, a percentage of births do occur during late October and the first half of November each year (see Chapter 1.3.5.1), so that the hunt for adult males is likely to cause some degree of disturbance to breeding mothers and new born pups.

WSPA (2007) included an additional potential animal welfare concern: pups and other seals are subjected to witnessing the killing of conspecifics, which may cause additional stress in animals that have already been traumatized by being driven up the beach and confined prior to stunning. There are, however, little data to support this hypothesis from other species such as pigs (Grandin, 1997) and rodents, and none is available for seals.

4.3.6. Enforcement of the regulations

Kirkman (2006) reports that each hunting operation is attended by one or two government control officers, but there are no independent observers present. Although it is the task of control officers to ensure that the regulations, conditions and quota levels are adhered to, Kirkman (2006) observed that some officers apparently thought that counting the carcasses at the end of each hunt was their sole responsibility. Many officers were unfamiliar with the regulations and the conditions, and did not carry copies of these with them. One officer even admitted to never having read the regulations and the conditions of licence.

4.3.7. Additional conclusions of animal welfare observers

Kirkman (2006) summarized his conclusions regarding the humaneness of Namibia's seal hunt as follows:

- All the emphasis at the Namibian hunt is placed on maximizing returns-for-effort, at the expense of correct humane sealing practices.
- Due to the general carelessness regarding humane standards, unnecessary cruelty and suffering are inflicted. This state of affairs has persisted probably as a result of the inaccessible nature of the hunted colonies to the public: Cape Cross is in a reserve, and Wolf Bay and Atlas Bay are in restricted diamond mining areas, so in effect, the hunt is conducted behind closed doors.

In its submission to the Working Group, WSPA (2007) compared the regulations governing the Namibian seal hunt with the OIE Guidelines for the Slaughter of Animals. From its analysis, WSPA concluded:

- The degree of pain, distress and suffering experienced by suckling pups targeted in Namibia's seal hunt is likely to be severe.
- The clear contrast between methods used to kill seals in Namibia and criteria set for humane slaughter by the OIE are indicative of the inherent difficulties in attaining an acceptably humane slaughter in large-scale seal hunting.

Due to the target animals (suckling pups stressed by herding and separation); hunting environment (herding stressors, slaughter in view of conspecifics, targeting moving animals) and the rapid time frame within which animals are slaughtered (several hundred pups killed within a 1-2 hour period by 10-15 hunters leading to unacceptable delays between stunning and bleeding), the animals concerned are likely to suffer fear and pain and hence have very poor welfare.

4.4. Evaluation of the methods used for killing and skinning in other commercial seal hunts

4.4.1. Norway

In 1990, a detailed assessment was made of Norwegian sealing operations in the Greenland and Barents Seas in the period 1982-1988. The resulting report (Anonymous, 1990), which addressed general aspects of sealing as well as specific incidents that had been reported by inspectors accompanying sealing vessels, led to some important revisions of the regulations for the Norwegian hunt. These included:

a) When a seal is struck on the skull with a hakapik it shall first be struck with the butt end or blunt projection of the tool - after that, the animal shall be struck with the spike of the tool;

b) When seals are shot from the ice or from a catcher boat, all the animals shall be struck with a hakapik and bled as soon as the ongoing hunt makes this possible – during this type of hunting, at least one person shall at times be assigned to each marksman to club and bleed animals that are shot; and

c) It is prohibited to fasten a line to an animal on the ice before it has been struck with a hakapik or seal club and bled.

In 1995, Øen (in VKM, 2007) carried out a study on 349 weaned harp seal pups shot with rifles with calibres .222 and .223 at an average shooting range of 30 m. The number of rounds fired was 418 of which 384 hit the seals. Most of the extra shots were fired at seals previously hit outside the neck and head regions. Although some of these animals might have been unconscious, they were obviously not dead after the first hit. The results showed that 302 pups (86.5%) had been hit in the head or upper neck. Six of these 302 seals had been hit outside the brain; 2 of them were judged to be still alive at the field inspection and were killed with a hakapik. Thirty-four (9.7%) were hit in the neck and were all dead at inspection. Thirteen (3.7%) were hit in the thoracic region, of which 4 were still alive at inspection and were killed with a hakapik. Based on the seals' reactions and gross examination on the ice, which included inspection of the carcasses and palpation of the skulls, 343 (98.3%) of the seals were considered to have been rendered instantly and irreversibly unconscious or dead. "Reflex swimming movements" were registered in 21 (6%) of the seals that had been declared dead by a veterinarian. Laboratory examination of one of these seals showed that most of the cranium had been shot away with little residual brain tissue. Close inspection of 35 skulls showed that when the bullets hit the brain or in close vicinity to the brain, the bones of the calvarium and of the base of the cranial cavity were severely damaged and, in many cases, completely fragmented. Massive haemorrhages were seen at the base of the brain and in the meninges with hits in the skull, the neck and even the vertebrae of the thoracic region. No significant difference was demonstrated between the two calibres of rifle.

The Norwegian Scientific Committee for Food Safety, Panel on Animal Health and Welfare, consisting of 5 national experts, acknowledged that data on the efficiency of the Norwegian hakapik is limited. Based on experience, the experts concluded that the hakapik is highly effective in causing instantaneous unconsciousness and death of harp and hooded seal pups (<4 months old) and that the closeness of the hunter to the animal additionally contributes to a rapid kill (VKM, 2007).

There are no official statistics of the numbers or percentages of seals struck and lost alive or dead after being shot in the Norwegian hunt. In the field study in Norway mentioned above and involving 349 harp seal pups, no seal escaped wounded (Øen, 2006).

4.4.2. Greenland

The Greenland Ministry of Fisheries recently conducted a questionnaire survey of seal hunters in Greenland (Ugarte and Jakobsen, 2006). According to that survey, part-time hunters reported a mean struck and lost rate of 26% (n=37) whereas full-time hunters reported a mean rate of 21% (n=94) (p. 33). Reported struck and lost rates were higher (40-50%) in spring and early summer (May-July) than in late summer and fall (August-October). Most Greenlandic hunters surveyed and the Greenland hunters who participated in the NAMMCO workshop (NAMMCO, 2006) were of the opinion that the proportion of harp seals struck and lost was less that the 50% value used in management models. It is unknown what proportion of these lost animals were dead or wounded.

4.4.3. Sweden

There are some recent data on the shooting of grey seals in Sweden, where the struck and lost rate varied between 43% and 4% between 2001 and 2006 (Table 3).

Table 3. Reported figures for Total Allowable Catch quota, number killed and struck and lost between 2001-2006 (Swedish Environmental Protection Agency, 2007).

	Halichoerus grypus regional decree			*Halichoerus grypus* individual approvals			*Phoca vitulin* individual approvals		
Year	Quota	Reported[1]	Lost	Quota	Reported[1]	Lost	Quota	Reported[1]	Lost
2001	150	44	19	n/a	n/a	n/a	n/a	n/a	n/a
2002	150	79	7	n/a	n/a	n/a	n/a	n/a	n/a
2003	170	79	1	20	6	n/a	12	5	n/a
2004	170	81	8	13	4	n/a	12	4	n/a
2005	170	83	3	16	9	3	18	13	0
2006	170	107	4	20	10	3	16	8	1

[1] Reported implies shot, including lost; n/a: no information available.

5. Neurophysiological aspects

5.1. Introduction

This section deals with the neurophysiological aspects of killing, stunning, destruction of the brain and bleeding out, and the measures that can be taken to monitor loss of consciousness (the point at which an animal does experience adverse states such as pain) and to determine death.

While no specific scientific studies on nociception, pain and distress appear to have been carried out on seals, there are clear indications that seals are able to experience such adverse states like other sentient mammals based on their anatomical, physiological, behavioural similarities as well as from observations. According to the Panel on Euthanasia of the American Veterinary Medical Association (AVMA, 2007), "*Pain is that sensation (perception) that results from nerve impulses reaching the cerebral cortex via ascending neural pathways*". If both cerebral cortices are destroyed then the feeling of pain and other adverse feelings cannot be experienced. More specifically, a loss of consciousness requires disturbance to both cerebral cortices, the thalamus and the mesencephalic reticular formation (Lopes da Silva, 1983). A destruction of the brain stem and cerebral cortices will result in unconsciousness, insensibility and death. In humans, brain death, compared with loss of consciousness, is defined as a complete irreversible loss of brain stem function including cessation of cardio-respiratory functions (Wijdicks, 2001).

With respect to farmed animals slaughtered for human consumption, the moment of causing death in unconscious animals is less important (provided unconsciousness lasts until death, normally through bleeding-out) than the time taken to induce unconsciousness and insensibility, i.e. when an animal no longer responds to painful stimuli and ceases to be aware of adverse states such as fear and distress.

The killing of farmed animals usually consists of a two-step process: stunning, which is intended to cause an immediate loss of consciousness lasting until death; and secondly, bleeding which kills the animals by removing the blood supply to the brain and heart (EFSA, 2004). In seal killing, it is always the intention to destroy the brain with firearms or with physical methods (e.g. hakapik or club). The process of bleeding out is to ensure that death is an inevitable outcome in an animal that has not been killed outright but only stunned.

If it is certain that a seal has been killed outright then the recognition of consciousness, unconsciousness or irreversible unconsciousness becomes less important from an animal welfare point of view, but it is important for animals that are not dead. Even the recognition of death is uncertain in the short term i.e. soon after an animal has been "killed", however, a seal that has not shown any corneal reflex or breathing movement and has been in a completely relaxed state for less than an hour is almost certainly dead. Nevertheless, EFSA's (2004) Scientific Report on slaughter of farmed animals states that death is "a physiological state of an animal, where respiration and blood circulation have ceased as the respiratory and circulatory centres in the medulla oblongata are irreversibly inactive. Due to the permanent absence of nutrients and oxygen in the brain, consciousness is irreversibly lost. In the context of application of stunning and stun-kill methods, the main clinical signs seen are absence of respiration (and no gagging), absence of pulse and absence of corneal and palpebral reflexes, and pupillary dilatation". In conjunction with other signs, absence of respiration remains a sign compatible with death in seals.

5.1.1. Destruction of the brain

The aim of physical methods and firearms is to destroy the brain, i.e. the cerebral cortices on both sides of the brain, the thalamus and the brain stem. When this level of destruction occurs, an animal can be considered dead. If both cortices are destroyed, then an animal would be insensible and could be bled-out with no welfare problems. It should be noted that brain destruction is not the intention with other methods of killing seals such as nets and harpoons where the welfare of animals may be negatively affected before becoming unconscious.

5.1.2. Bleeding-out

Death of slaughtered animals has been defined as an "irreversible insensibility due to cerebral anoxia, usually due to severance of both common carotid arteries and the vessels from which they arise" (Blackmore and Delany, 1988). However, owing to the perfusion of the brain via the vertebral artery in some species, it is important to cut the blood vessels near the heart. Thus chest "sticking" in cattle and severing the brachiocephalic trunk leads to a drop in blood pressure to near zero within 8 seconds compared with 120 seconds or more when the carotids and jugulars are cut in the mid-neck region (Anil et al., 1995, in EFSA, 2004).

In seals, the brachial arteries and veins that supply the front flippers are cut at the beginning of the skinning process after an animal has been monitored for unconsciousness. However, if an animal has been misdiagnosed as unconscious, it will feel the cuts at the start of the skinning process before losing enough blood to become insensible. There are no data on how quickly bleeding leads to brain death, or heart failure. Reports indicate that cutting these vessels leads to severe haemorrhage, and that pulsatile blood loss ceases within 10-15 seconds (VKM, 2007).

5.2. Physiological differences between seals and other mammals

Seals have several unique features compared with terrestrial species that facilitate diving for long periods (Hempleman and Lockwood, 1978; Kooyman et al., 1981; Hochachka, 1981; Blix

et al., 1984; Behrisch and Elsner, 1984; Butler and Jones, 1997; Butler, 2004). These features include:

a. a relatively large total oxygen storing capacity;
b. a parsimonious use of blood oxygen by reducing metabolic rate and thus lowering the energy requirements of various organs;
c. blood circulation readjustments to ensure the oxygen stores are managed judiciously;
d. although metabolic activities of heart lung and brain during diving and recovery are consistent with a high potential for anaerobic glycogenolysis or glycolysis (by the heart), it may rarely be utilized. During diving, both cardiac output and coronary blood flow decrease by about 85%, thus, heart work during diving in the seal remains supported by an oxidative metabolism (Murphy et al., 1980).

5.3. Mechanical methods

The common physical methods used to kill seals are with a firearm or with some form of club or hakapik. These aspects are dealt with below and compared with other animals. It is likely that the severity of brain damage will be different according to the instrument; for example, striking seals with the metal projection (hammer or a ferrule) of a hakapik will induce more severe brain damage than strikes delivered using wooden clubs without projections. With firearms, the penetration of a missile e.g. bullet, into the brain can cause injury in the following three ways, depending on its velocity and shape.

a. By laceration and crushing at a relatively low velocity (< 100 m/s).
b. By shock waves at a high velocity (about 100 to 300 m/s).
c. By temporary cavitation at a very high velocity (> 300 m/s) (Hopkinson and Marshall, 1967; MacPherson, 1994).

Commonly used missiles for stunning and killing farmed animals are bullets and penetrating captive bolts. Immediately after stunning, animals go into a tonic spasm for approximately 10 s prior to relaxation (Lambooij and Spanjaard, 1981), and that can be followed by convulsive activity and enhancement of some spinal reflexes thought to be due to a removal of inhibitory influences from higher centres of the brain before the spinal cord becomes anoxic (EFSA, 2004). Directly after shooting, major changes are seen on the electroencephalogram (EEG) with delta and theta waves tending to an isoelectric line. At this point it is assumed that the animal is unconscious by analogy with similar EEG changes in humans (Lambooij and Spanjaard, 1981).

5.3.1. Captive bolt in farmed animals

Captive bolt stunning is widely used for red meat farmed animals (e.g. cattle, sheep, goat and deer). A cartridge with gunpowder, compressed air or a spring under tension is used to drive bolts (missiles) against or through the skull. In captive bolt stunning methods, the most important factor is to cause tissue damage by transmitting the energy from the missile to the brain and causing haemorrhage. The velocity of a bolt of a captive bolt pistol is about 100 m/s in air. At this low velocity and with its shape, the bolt should crush the cortex and deeper parts of the brain either from the bolt itself or by forward shock waves created by the impact (Lambooij, 1982). The ideal shooting position is frontally on the head (Lambooij and Spanjaard, 1981) at right angles to the frontal bones. When fired at an angle deviating from perpendicular, bolts tended to skid or slide along the skull surface and, as a consequence, may fail to stun animals (e.g. in poultry, Raj and O'Callaghan, 2001).

With non-penetrating bolts, it is generally agreed that they cause a traumatically induced derangement of the nervous system, resulting in an instantaneous diminution or loss of consciousness without gross anatomical changes in the brain (EFSA, 2004; Nilsson and Nordstrom, 1977). It should be also noted that many investigators consider blood flow impairment as being primarily responsible for the electrical changes in the brain, although the immediate changes in the brain cannot be explained by this theory.

5.3.2. Hakapiks and clubs in seals

Clubs and hakapiks aim to crush the skull and destroy the brain but it is possible for just one side of the brain cortex to be destroyed leaving the thalamus and the other side of the cortex intact. In such cases an animal may still be conscious. The thickness and structure of the skull bones will vary according to the species of seal being hunted and its age and may well influence the effectiveness of the strike in destroying the brain. Evidence has been presented that shows that some seals are struck and the skin and skull bones are still intact, and that others are hit on one side only and assumed to remain conscious (Chapter 4). When the pointed end of the hakapik is used in the direction of the vertebral column, then more of the brain, including the thalamus and brain stem, is likely to be destroyed. The angle of striking the skull of a seal with a rounded club or hakapik may influence the impact energy delivered to skull, the direction of travel for the spike of the hakapik and, as a consequence, the efficacy of the strike.

5.4. Monitoring points for insensibility and death

5.4.1. Introduction

Stunning and stun-kill methods are developed to induce, when applied correctly, pathological brain states that are incompatible with the persistence of consciousness and sensibility. The magnitude of deviation from the normal brain electrical activity can be determined using electroencephalogram (EEG) or electrocorticogram (ECoG). For example, effective captive bolt stunning induces highly synchronised electrical activity in the brain that leads on to a quiescent EEG. Effective slaughter methods for farmed animals ensure that captive bolt stunned animals do not regain consciousness or sensibility.

Most investigations concerning the mechanism of concussion have been performed using laboratory animals and only one (3 animals only) investigation appears to have been carried out with seals (Blix and Øritsland, 1970). Nevertheless, it may be possible to extrapolate between species, e.g. in humans, successive severe blows result in a prolonged loss of reflex activity and cause almost complete disappearance of all wave frequencies (isoelectric EEG) (Nilsson and Nordstrom, 1977).

It is evident from laboratory investigations in farmed animals that concussion does not always causes an immediate loss of consciousness and that after stunning, animals may not die immediately depending on the degree of injury to the brain. Therefore, it is recommended to kill farmed animals by pithing to damage the deeper parts of the brain and to prevent convulsions. Furthermore, when concussion from a blow to the head is incorrectly performed, an animal may be injured and not be stunned, or may not be stunned for a long enough time before being bled-out. Stunning and slaughter regulations require that the duration of unconsciousness induced by a method should last longer than the sum of time between stunning and bleeding-out time to death. For example, if a stun-to-bleed interval is 15 seconds and bleeding-out takes 35 seconds to induce death, then the duration of unconsciousness induced by the stunning method should last for at least 50 seconds.

5.4.2. Monitoring muscle tone and body movements

In farmed animals, the occurrence of tonic (rigid) seizures followed by clonic seizures (un-coordinated kicking or paddling leg movements) are considered to be signs of successful mechanical stunning (EFSA, 2004). According to Blackmore and Delany (1988), convulsions can be regarded as a reliable indication that an animal has been properly stunned, and these authors add that pedal reflexes may be intensified if an animal is handled. In her assessment of slaughter practices in cattle, Grandin (2002) considered that loss of sensibility should imply, among other signs, a loss of the righting reflex and, after being hoisted onto the bleed rail (i.e. after a few minutes), the animal should have a straight back and be limp with a flaccid head and neck. However, momentary (myoclonic) flopping of a limp head, or the odd kicking or limb movements, and reactions to tactile stimuli on limbs, should be ignored. These observations have not been supported by detailed neurophysiological data.

When stunned or killed by acute trauma to the brain, harp seals, like other animals, may undergo a period of tonic and clonic seizures. These consist of tonic contraction and lateral movements which can be very strong in some animals, and tended to be accompanied by contralateral movements of the cranial portion of the body. Despite these strong movements the animal moves non-directionally, as opposed to the directional flight response of a threatened animal. These reactions have been described as the "swimming reflex" and may be the equivalent of the "paddling reflex" in a proportion of livestock killed at slaughter. They can, therefore, be viewed as the movements of a successfully stunned animal. These "swimming" reflex movements can last for a considerable period of time and such seals have been verified as dead by veterinarians (Daoust et al., 2002; VKM, 2007). Nevertheless, there is a concern, in the absence of other indicators such as skull palpation, that some seals showing a swimming reflex may not be unconscious. Whether such animals are unconscious and the movements involuntary, or whether they are conscious and the movements voluntary can be substantiated with e.g. detailed neurophysiological studies.

As such evidence has been used to criticise the hunts when animals are observed from a distance, it is difficult to know whether it is a swimming reflex or voluntary activity that is being observed. This has led to different conclusions by different observers, even for the same video sequences.

When complete relaxation of the body is seen, it is likely to be associated with complete destruction of the brain and brain stem, and with no breathing. On the other hand if an animal is immobile with some muscle tone (head raised off the ice, flippers load bearing) or it exhibits a state of a fear-induced paralysis,[15] and remains immobile, with its head retracted and its front flippers flat against its body, it may still be conscious. If body movements are seen in response to a potentially noxious stimulus such as gaffing or dragging, then they are more likely to be a conscious response and such conscious responses may show some laterality, in accordance with the stimulus. Finally, if an animal is conscious and is turned on its back or side, it may right itself again (the righting reflex). Some of these conscious responses may resemble swimming reflexes, and it is not always be easy to distinguish between conscious and unconscious reactions from a distance and, particularly, when it is not possible to examine the animal clinically.

There is a potential paradox between a successful stun being evidenced by seizures and also by relaxation. This is possibly due to the extent of brain damage as well as the time after brain

[15] A behaviour known as "fear-induced paralysis" (the equivalent of tonic immobility or freezing behaviour shown in poultry and rabbits) and characterized by tonic contraction of the whole body, has been described in a young harp seals and is shown by some animals that feel threatened (Lydersen and Kovacs, 1995). Such immobile seals might be interpreted as dead but would still be conscious (Malouf, 1986; Daoust et al., 2002).

damage that has occurred and the type of stimuli that are applied. It seems that tonic seizures are followed by clonic ones that eventually disappear and are replaced by muscle relaxation. Consequently, these signs have to be considered alongside other criteria for monitoring consciousness and sensibility. In this regard, well-controlled laboratory studies are needed.

5.4.3. Monitoring eye reflexes

Dysfunction of the V and VII cranial nerves will lead to a loss of the corneal reflex in mammals (Sachs et al., 2007). The absence of a corneal reflex is used as a criterion for ascertaining brain death in humans (Eelco and Wijdicks, 2001) and the depth of anaesthesia in many vertebrates. Absence of such eye reflexes may be also used as an indicator of brain damage or brain failure. Visual cues and reflexes that are used in farmed animals to assess the success of a mechanical stunning procedure (Council of Europe, 2004) could also apply to marine mammals like seals, such as the loss of corneal reflexes, pupillary dilatation, and protrusion of the eyes. In severe cases of traumatic brain damage there may even be prolapse of one or both eyes. These signs imply, at the very least, a depression of brainstem activity but do not necessarily indicate irreversible unconsciousness or insensibility. For example, seals struck on the face or behind the eyes could have suffered damage to V and VII cranial nerves without impairment of consciousness.

In Canada's Marine Mammal Regulations (MMR, 1993) seals clubbed in the prescribed manner should be irreversibly or terminally unconscious (or "brain dead"), as evidenced by a loss of the corneal (blink) reflex. While the word "dead" is used in the MMR, it does not correlate with "death" as defined in various EFSA documents, viz. "*a physiological state…where respiration and circulation have ceased*" (EFSA, 2004; 2005) i.e. an absence of a blink reflex would not necessarily mean that an animal is "dead" in the EFSA sense, because death is expected to be achieved *via* slaughter and bleeding-out. In the case of seals, Burdon et al. (2001) suggested that a lack of a bilateral corneal reflex could be used as an indicator for loss of consciousness, resulting from profound brain damage or failure. Daoust et al. (2002) noted, however, that in some large mammals, "loss of the corneal reflex is not a definite sign of irreversible unconsciousness".

5.4.4. Monitoring physical damage e. g. palpation of the skull

Palpation of the skull can be used for assessing and monitoring the severity and extent of damage to skull bones and therefore, brain damage. The blubber is thin enough over a seal's skull for a clear contrast to be felt between a calvarium that is only partially intact and one that has been completely destroyed. However, certain criteria would have to be established before any particular degree or extent of damage felt during palpation could be reliably interpreted for field use. For example, the presence of an intact skull would not necessarily mean that the animal had not been rendered unconscious due to brain concussion and haemorrhaging that may occur around the brain or, indeed, if it had received a fatal neck wound. Conversely, if the skull was fractured in the front or the back of the skull it still could be compatible with consciousness. On the other hand, an animal that had had its skull blown off, e.g. after a bullet shot or where the brain had completely disappeared, would be dead.

5.4.5. A comparison with Traumatic Brain Injury in humans

The clinical outcome of stunning or killing of seals with a bullet or some form of hakapik could be similar to Traumatic Brain Injury (TBI), in humans as well as penetrating captive bolt stunning in farm animals. The effects of TBI depend on such factors as location and severity of the injury. Some of the clinical signs of TBI that are expected to occur include:

- immediate loss of consciousness as evidenced by a lack of response to external stimuli;
- respiratory failure;
- coma as evidenced by deep un-arousable unconscious state;
- paralysis and immobility as evidenced by loss of motor function and movement;
- dilated pupils or unequal size of pupils.

It may be possible to use such clinical signs as respiratory failure, paralysis, immobility and dilated pupils to determine unconsciousness in seals. The return of rhythmic breathing could indicate that the animal may still be conscious or recovering consciousness. On the other hand, an absence of breathing is more difficult to interpret as it may indicate that an animal is dead or that it has just stopped breathing (apnoea) mimicking diving reflex or even fear-induced paralysis. It has been reported that respiration was observed in unconscious and un-bled seals with "heart activity", 15 minutes after being struck by a slagkrok, and that it lasted for up to 27 minutes (Blix and Øritsland, 1970), presumably because the brain stem had not been completely destroyed. However, the pattern of respiration was not detailed.

5.5. Monitoring points

5.5.1. Introduction

In the context of stunning and slaughter or killing of seals, death can be described for practical purposes as (a) cessation of circulation, i.e. end of bleeding-out (e.g. slaughter); (b) cessation of cardiac and respiratory activity due to brain inactivity; or (c) destruction of the brain leading to cessation of cardiac and respiratory activity (e.g. pithing after captive bolt stunning in food animals or hitting animals with the pointed end of the hakapik that reaches the brain stem.

5.5.2. Signs of an effective stun in seals

- Absence of a head or brain or skull or palpation of the skull showing severe and extensive bilateral damage.
- Immediate collapse with immobility, apnoea (absence of breathing) and body relaxation.
- Immediate onset of tonic spasm followed by clonic spasms.
- No sign of recovery of consciousness during bleeding (e.g. rhythmic breathing).
- Loss of corneal reflex and pupillary dilatation.
- Gradual pupillary dilatation.
- Bilateral prolapse of the eyes with severe skull damage.

5.5.3. Signs of an ineffective stun in seals

- Absence of tonic spasms.
- Rhythmic breathing.
- Head held off the ice and coordinated voluntary flipper or body movements in response to a painful stimulus.
- Palpation of the skull that shows little if any damage, or the damage is only partial.
- Presence of physical reflexes and behaviour e.g. righting reflex when a seal is turned over onto its back, a positive corneal reflex or pupil constricted in one or both eyes.
- Purposeful flipper or body movements.
- Spontaneous blinking.

6. Education, training and competence of sealers and inspectors

The goal of education in animal welfare, especially during stunning or killing, is to promote changes in attitude that enhance respect for animals. It may be difficult to promote such changes simply through self-learning (e.g. training manuals, videos), where people do not have the opportunity to share their own views and appreciate the values and benefits of good animal welfare practices. "Collaborative learning", which can be delivered in traditional sessions or through internet-based interactive programs, may represent a more effective tool to achieve the desired goal (Zooprophylactic Institute of Abruzzo and Molise, Teramo, Italy, pers comm.). Any such program that would set out to explain the anatomical and physiological foundations of some of the recommendations on humane sealing practices, such as pain perception, the concept of death, the purpose of skull palpation, etc., should reinforce in the mind of sealers the need for theses practices to be adhered to, rather than being perceived as simply additional to what is needed, or not sufficiently clear Government regulations that need to be followed. Continuous scrutiny of any form of exploitation of animals, domestic or wild, should accompany such education programs. According to Grandin (2002), this kind of scrutiny in the USA has resulted in major improvements in stunning and handling practices for cattle at slaughter.

According to Malouf (1986), informal instruction on humane killing of harp seal pups in Canada was begun in the Magdalen Islands, province of Québec, Gulf of St. Lawrence, in the early 1970s, and an educational program that included humane killing was offered in Newfoundland in 1978. There is no evidence, however, that either of these programs was subsequently maintained, except for occasional presentations to groups of sealers by individual veterinarians. More recently, a Sealer's Training Manual and a video, with French and English versions, were prepared in the Magdalen Islands. A Training Manual and video, available in English, are currently being updated from older versions in Newfoundland for sealers of that province and will be available in early 2008 through the Department of Fisheries and Aquaculture of the Government of Newfoundland and Labrador. The Working Group was, however, unable to obtain specific information on how to obtain the training material from the province of Québec and did not have the opportunity to view the contents of the training material from either province.

The Canadian licensing policy requires that a commercial sealer works under an experienced sealer for two years before obtaining a professional licence. In Norway, seal hunters have to participate in an obligatory annual training course and to pass a written exam, and, additionally, riflemen need to pass an annual shooting test with their rifle before being issued a licence (Øen, 2006). A single course, given annually, can accommodate the majority of prospective sealers in Norway. In Canada, however, there are many more sealers spread over a very large territory, and several courses would need to be given in order for all prospective sealers to have access to formal training and education.

During the Norwegian harp seal hunt, inspectors who must be qualified veterinarians or have an equivalent qualification are assigned to each of the sealing vessels. These vessels, however, are much less numerous (4 in 2004, 6 in 2005 and 2006, and 5 in 2007) and much larger (>150 m) than those allowed to participate in the Canadian harp seal hunt (less than 20 m, with more than 350 vessels in the Gulf of St. Lawrence and more than 900 vessels at the Front during the 2006 hunt; P-Y Daoust, pers. comm.). It would therefore be much more difficult to institute a programme in Canada similar to that in Norway. Moreover, the smaller size of the Canadian sealing vessels means that, most often, all berths on board are filled by the captain and crew.

In the case of the Cape Fur seal hunts, Best (1990a) emphasized that skill and experience on the part of the hunters are essential for the killing process to be effective and efficient. In Namibia, the rights-holders are issued each year with "conditions for harvesting", which typically specify

that personnel must receive training before and during the season, that only clubbers performing at an adequate level may use clubs (having first gained experience as herders), and that marksmen must undergo weekly test to satisfy the control officers of their proficiency (Kirkman, 2006). However, Kirkman (2006) reports that he found no evidence of compliance with these conditions, and that various control officers acknowledged that neither they nor the rights-holders paid any attention to them.

7. Risk Assessment

7.1. Introduction

Risk analysis is a process consisting of the following three components: Risk Assessment, Risk Management and Risk Communication. **Risk Assessment** is the process of identifying hazards and evaluating the probability of an adverse event happening in a population as a consequence of exposure to certain hazards. **Risk Management** is the process of weighing policy alternatives in relation to the results of the Risk Assessment and if required, selecting and implementing appropriate control strategies and regulatory measures. **Risk Communication** is the communication and exchange of information and opinions concerning risk among risk assessors, risk managers, stakeholders and other interested parties. The purpose of the present Opinion is a Risk Assessment of the adverse welfare effects during killing and skinning seals. Risk Management and risk communication will not be further discussed in this Opinion.

The Risk Assessment should be scientifically based, well documented, objective, repeatable, transparent and open to review. A Risk Assessment can be qualitative or quantitative depending on data available. A **qualitative Risk Assessment** can be used and is useful as an initial assessment evaluating if the risk related to certain exposures should be further examined in more detail. Furthermore, qualitative Risk Assessment can be used in the case of absence of reliable data. According to WHO (1999), a qualitative Risk Assessment is a Risk Assessment based on data which permits ranking of risks or separation into risk categories (e.g. negligible, low, medium, high). An advantage of this approach is that it can be performed in cases where there is no or limited data and it, primarily, uses expert opinion. A **quantitative Risk Assessment** provides numerical expressions of risk and indication of the attendant uncertainties (WHO, 1999). A qualitative Risk Assessment has been used in the present Opinion and quantitative Risk Assessment will not be discussed further.

The first step in a qualitative Risk Assessment is to systematically gather, review and summarise available information. Risk Assessment includes hazard identification, hazard characterisation, exposure assessment and risk characterisation. **Hazard identification** consists of identification of features able to cause poor animal welfare. A **hazard** is defined as any event or factor which potentially can produce harm and cause an adverse effect (harm). Hazard identification is mainly a qualitative process. Hazards can be identified from scientific literature and expert opinion. At this step, hazards are evaluated in order to select those that represent a threat to animal welfare. The next step in the Risk Assessment is hazard characterisation. **Hazard characterisation** is a qualitative evaluation of the nature of the adverse effect associated with the hazard in terms of intensity and duration. Intensity will be used as a qualitative measure of severity of the adverse effect. Expert opinions can be used to develop ranking systems to characterise intensity and duration. When hazards have been identified and characterised, the next step in the Risk Assessment is exposure assessment. The **Exposure assessment** consists of the qualitative evaluation of the frequency of exposure to the hazard in the animal population. Finally, risk characterisation will be performed. A **risk** is a function of the probability of an adverse effect and the duration and intensity of that effect, consequent to a hazard for poor welfare. **Risk characterisation** consists of the process of

determination of the qualitative estimation of the probability of occurrence, intensity and duration of poor animal welfare in a population.

Currently, there is not an accepted methodology for carrying out an animal welfare Risk Assessment, but previous studies exist where Risk Assessment for animal welfare has been explored (EFSA, 2007a; EFSA, 2007b). A risk in animal welfare is a function of the probability of a negative animal welfare effect and the severity and duration of that effect, consequential to the exposure to a hazard(s). For any Risk Assessment involving animal welfare, it is important that all adverse states that comprise poor welfare (pain, stress, distress, fear, etc) are described in a way that makes them recognisable. Therefore, pain should be described not simply as mild, moderate, substantial and severe but rather as what observable signs that make it possible to distinguish between such categories of intensity. An important part of Risk Assessment in animal welfare is to look at it from the point of view of the animal and not in terms of managing the risk from a human viewpoint. After all, it does not matter to an animal whether it is being killed in a particular country, or by persons of a different cultural background. The impact on the animal is independent of those factors.

In summary, due to the limited amount of quantitative data on the adverse effects of hazards on animal welfare, a qualitative Risk Assessment has been used mainly based on expert opinion. The methodology used does not give a precise numerical estimate of the risk attributed to certain hazards. Nevertheless the output can be used to rank the problems and to designate areas of concern, as well as guidance for future research.

7.2. Risk Assessment and working procedures

When slaughtering food producing animals there are 3 distinct stages during which the welfare of animals may be compromised. The first is the stage when animals are taken to the abattoir, the second is the procedures that lead up to stunning and slaughter, and the third is compliance with the regulations, guidelines and codes. The general steps followed when slaughtering food producing animals are described below.

Stage 1: Involves the gathering of the animals in some way, either at markets or on the farm. If the animals are not to be slaughtered on the farm they will be transported to the abattoir. This will involve herding the animals to a point where they can be loaded onto the lorry or transporters. The animals will then be driven to the abattoir in a truck that will pose exposures to various hazards in addition to the quality of the journey and its length including new groupings, environmental effects, even stopping for food and water on long journeys, etc. The animals will then be placed in a lairage or within the curtilage (e. g. adjacent fields) until the time of slaughter at the abattoir.

Stage 2: Involves the processes whereby animals are taken to the slaughter hall or pen for stunning by electricity, gas or mechanical method. In some cases, animals like poultry are taken from the lorries and shackled directly onto a line, or their crates are delivered to a system of gas exposure. The efficacy, efficiency and humaneness of these are a consequence of exposure to various hazards, i.e. slaughter methods.

Stage 3: Are the animal welfare outcomes from exposure to various hazards such as compliance of staff with the rules as well as incompetence.

In the framework of the Risk Assessment developed to evaluate the different methods of killings seals all three stages apply. However, the Risk Assessment focused only on Stage 2, as explained below.

7.3. Risk Assessment for seals – General Approach

Stage 1: In some hunts and with some methods of killing (e. g. in the Namibian hunt) animals are corralled where they are killed by clubbing and sticking. The potential stressors are: herding and the consequent impact on nursing mothers and their pups as they are separated; the fear of being herding for all seals whether they are themselves killed or before they escape; the exposure of seals to other seals being killed; and then the subsequent mutual search between mother and offspring. These stressors may be repeated for several days in a row during the season. In non-herding hunts, sealers have to approach the seals to use a club or hakapik, whereas with firearms the seals are initially undisturbed until the dead or injured seals are picked up from the ice or are shot again, hit with a club or hakapik or bled-out.

Stage 2: This is the main Risk Assessment and focuses on the adverse animal effects that can occur during stunning, killing, monitoring for life and consciousness, bleeding-out, and skinning.

Stage 3: It has not been possible to deal with compliance issues, despite their importance, as there are few regulations available to the Working Group. Where there are regulations and prescribed methods the hunts are too varied, there is little meaningful inspection, too few data and it is too sparse for all the hunts to make any meaningful Risk Assessments. However, it has been observed by several independent groups that sealers in the Canadian hunt, on many occasions do not comply with the regulations (see Chapter 4; see also Standing Committee on Fisheries and Oceans, 2007).

For each part of the Risk Assessment, the WG agreed on the risk pathways, hazard identification and scoring categories. Each member of the WG (except the risk assessor) individually scored the intensity, duration, likelihood and data source for each hazard outcome. Subsequently, the WG discussed the differences in scorings. This resulted in minor adjustments. The Risk Assessment of poor animal welfare for different likely scenarios was finally performed based on the risk characterisation and exposure assessment performed.

In addition to the hazard outcomes, different weather and habitat conditions might result in different frequencies of the hazard outcomes to occur. Therefore, the likelihood of experiencing an adverse effect when exposed to the hazards has been estimated for two weather conditions (good and bad) in combination with two habitat conditions (good and bad). It has been assumed that the duration and intensity of the adverse welfare effect are the same for the different weather and habitat conditions.

7.4. Specific Risk Assessment Approach: adverse welfare effects during killing and skinning of seals

The risk of concern is that adverse welfare effects will be caused to seals during killing and skinning. This may include an increased risk of injury and of negative feelings, such as pain, distress, discomfort, fear etc. The duration of these adverse effects might vary from short to long and the intensity (or severity) can vary from mild to severe.

7.4.1. Pathways for killing and skinning of seals

Two different pathways have been identified - one for hunting using netting (Figure 3) and one for stunning using physical methods and firearms (Figure 4 a and b).

Figure 3. Risk pathways when hunting method is netting (underwater seal net).

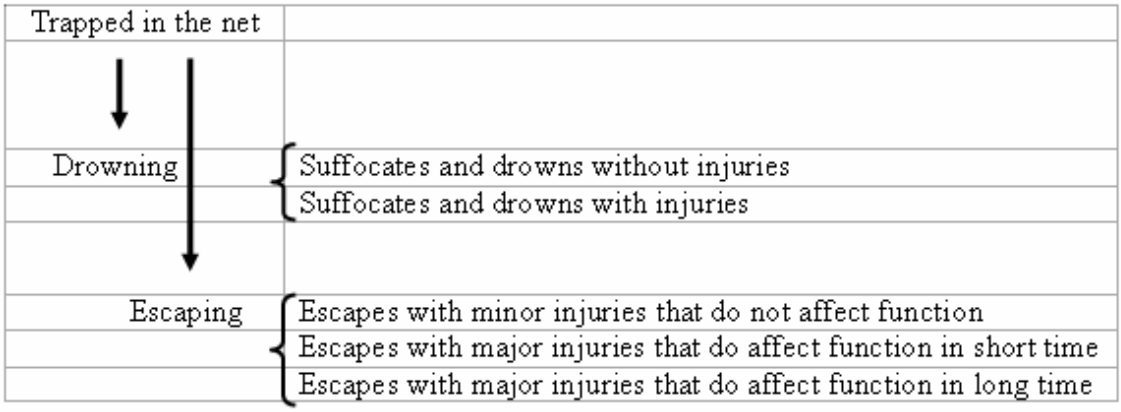


Figure 4.a. Optimal scenario when hunting methods are physical methods or firearms.

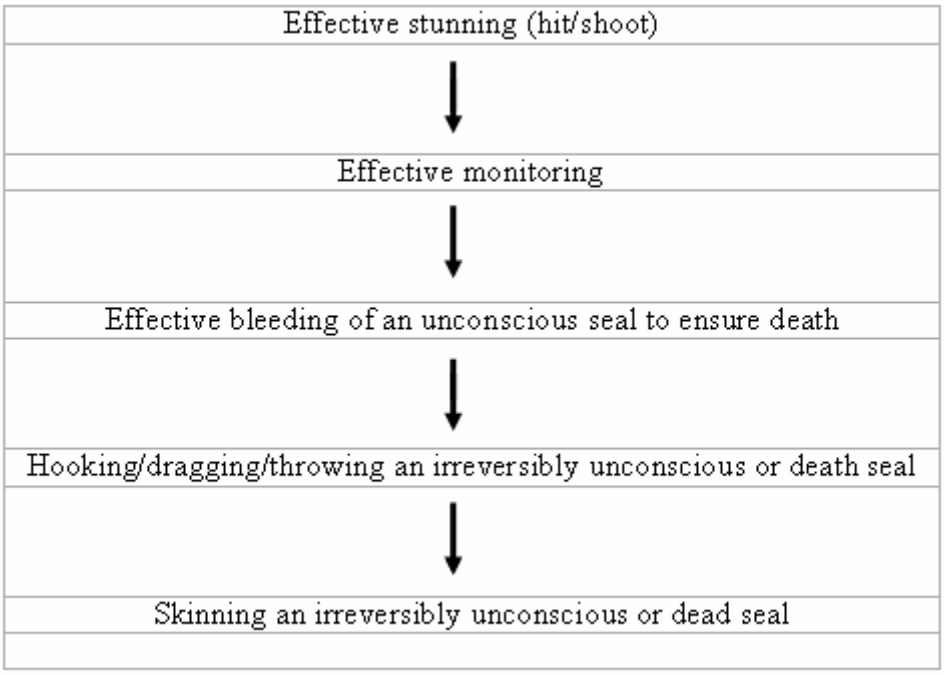
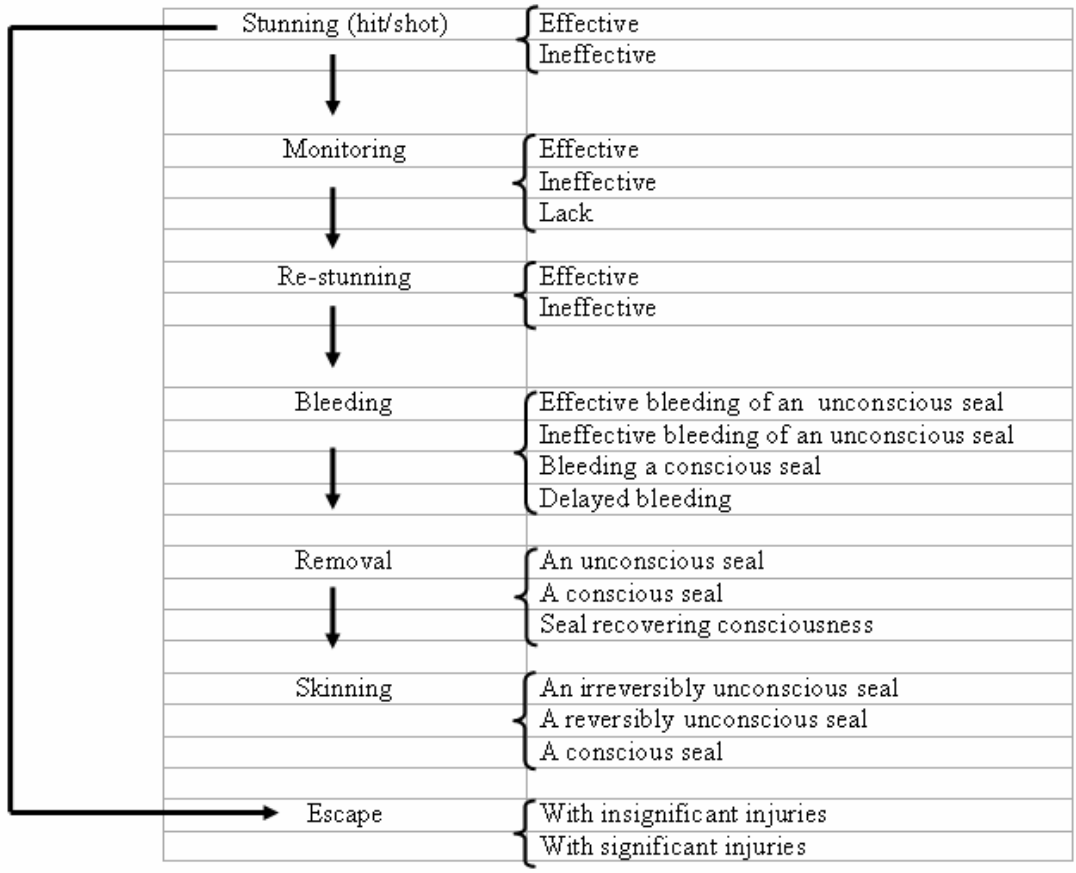


Figure 4.b. Steps in the risk pathway for Risk Assessment for poor animal welfare during killing and skinning using physical methods and firearms. Re-stunning can occur at different positions in the procedure if seals recover consciousness.



7.4.2. Hazard Characterisation and Exposure Assessment of welfare hazards

In total, 25 hazard outcomes in the stunning, killing and skinning of seals were identified (Table 4). The hazards are divided into categories corresponding to the different steps in the killing and skinning of seals. The scoring categories for hazard characterisation (duration and intensity), exposure assessment and data source are shown in Table 5. Four categories were used for each. The duration of adverse effects might vary considerable depending on the hunting methods (netting versus physical methods and firearms). Therefore, two scoring systems for ***duration*** were defined (one for netting and one for physical methods and firearms). The ***magnitude*** of an adverse welfare effect was defined by combining the duration and intensity of the adverse welfare effect (Table 6). A major magnitude of the adverse welfare effect is defined as severe intensity of the adverse effect combined with a long duration (Categories 3 and 4), as well as moderate intensity and long duration (Category 4). A negligible magnitude of the adverse welfare effect is defined as negligible intensity and very short duration (Category 1).

Table 4. List of potential hazards and possible outcomes considered in the Risk Assessment for adverse welfare effects of seals during killing and skinning.

Hunting method	Hazard	Outcome	
		No.	**Description**
Netting: Underwater seal net	Trapping	1	Trapping leading to suffocation without injuries
		2	Trapping leading to suffocation with major injuries
	Escaping	3	Escapes with minor injuries that do not affect the function
		4	Escapes with major injuries that do affect the function in a short term
		5	Escapes with major injuries or entanglement which obstruct swimming, retard hunting efficiency, or lead to physical injury that do affect the function in a long term
Physical methods: Hakapik, slagkrok and club	Stunning	6	Effective[16] hit or series of rapid hits without delay leading to irreversible unconsciousness or death
		7	Ineffective hit or hits at e.g. an inappropriate place causing injury in a conscious seal or seal that regains consciousness
	Re-stunning	8	Effective hit or series of rapid hits without delay leading to irreversible unconsciousness or death
		9	Ineffective hit or hits at e.g. an inappropriate place causing injury in a conscious seal or seal that regains consciousness
Firearms: shotgun (slug) and rifle followed by physical methods	Stunning	10	Effective shot, e.g. brain or upper neck and possible use of a physical method to ensure death
		11	Ineffective shot(s) without loss of consciousness or seal that regains consciousness and without being bled to death
	Re-stunning	12	Effective shot, e.g. brain or upper neck and possible use of physical method to ensure death
		13	Ineffective shot(s) without loss of consciousness or seal that regains consciousness and without being bled to death
Common hazards for physical methods and firearms	Monitoring	14	Effective monitoring[17] (sealer and/or sealing inspector checking for death or for irreversible unconsciousness)
		15	Ineffective monitoring that does not ensure death or irreversible unconsciousness
	Bleeding	16	Effective bleeding of an unconscious seal to ensure death
		17	Ineffective or no attempt to bleed-out a seal to prevent recovery of consciousness and to ensure death
		18	Bleeding-out of a conscious seal or one that regains consciousness during bleeding-out causing death
	Removal (hooking, dragging,	19	Removal of an irreversibly unconscious or dead seal (bled or unbled)
		20	Removal of a conscious seal or one that regains

[16] (In)Effective hit, shot or bleeding-out: this term is used in regard to the accuracy or efficiency of the method in achieving a goal (e.g. (re)stunning, killing, bleeding-out).

[17] (In)Effective monitoring: this term is used to denote that the procedure was either not carried out at all, or was only cursorily carried out.

	throwing)		consciousness (bled or unbled)
	Skinning	21	Skinning an irreversibly unconscious or dead seal
		22	Skinning a conscious seal or a reversibly unconscious seal that recovers consciousness during the process
	Escaping	23	Struck, killed and lost
		24	Escape after hit, without significant injury that could affect function or cause pain
		25	Escape after hit, with significant injury that affects function and may cause significant pain

Table 5. Scoring categories used for hazard characterisation (intensity and duration), exposure assessment (frequency) and data source in the Risk Assessment for adverse welfare effects of seals during killing and skinning.

Evaluation	Code	Category
Hazard characterisation - Intensity (intensity of the adverse effect - recognition of pain and distress)	Se	Severe
	Mo	Moderate
	Mi	Mild
	Ne	Negligible
Hazard characterisation - Duration (duration of the adverse effect) ***Physical methods and firearms***	4	>1 min
	3	30-60 sec
	2	5-30 sec
	1	<5 sec
Netting	4	>30 min
	3	15-30 min
	2	5-15 min
	1	<5 min
Exposure assessment[18] (The likelihood of seals - in the population using the actual hunting method - exposed to the specific hazard outcome)	VL	Very likely
	L	Likely
	U	Unlikely
	VU	Very unlikely
Data source	3	Scarce or no data available. Unpublished data or opinion. Expert opinion.
	2	Technical opinion. Peer reviewed publications with contradictory results. Non-peer reviewed publication. Some but incomplete data. Comparative data from other species.
	1	Solid and complete data available. International peer reviewed publication.

[18]It is assumed that all seals will experience the adverse welfare effect given exposure to the hazard (the likelihood of the adverse welfare effect given exposure is 100%).

Table 6. Categories of magnitude of adverse welfare effect based on duration and intensity of adverse welfare effects. A definition of intensity and duration is given in Table 5.

Magnitude of the adverse welfare effect		Duration of adverse welfare effect			
		4	3	2	1
Intensity of adverse welfare effect	Severe	Major	Major	Moderate	Moderate
	Moderate	Major	Moderate	Moderate	Minor
	Mild	Moderate	Moderate	Minor	Minor
	Negligible	Moderate	Minor	Minor	Negligible

7.4.3. Outcomes from the Risk Assessment based on the working group experts' opinions

Due to the limited amount of quantitative data on many effects of the hazards on adverse welfare effects, a qualitative Risk Assessment has been used. Furthermore, the Risk Assessment was mainly based on expert opinion. The methodology used does not give a precise numerical estimate of the risk attributed to certain hazards; however, the output can be used to rank the problems and designate areas of concern, as well as guidance for future research.

The results of the hazard characterisation and exposure assessment performed by the WG are illustrated in the Tables and the Figures in Annex A of the Scientific Opinion. In most cases scores were agreed upon by the WG Members. However, in cases where agreement was not reached, the number of experts giving each score was indicated in the Table in brackets (see Tables and Figures in annex A). Furthermore, for a number of hazard outcomes the experts agreed upon a range of scores instead of one specific value for intensity, duration (the combination is the magnitude) and/or the likelihood. Therefore, two different evaluations appear in the Figures. For each hazard outcome, the lower bar indicates the lowest likelihood combined with smallest magnitude and upper bar indicates the largest likelihood combined with largest magnitude (see Annex A).

These Risk Assessment outcomes interpret what is shown in the Figures obtained from the experts' opinions.

Hazards 1 to 5 – Netting

1. It is Very Likely that a seal trapped in a net without injuries that does not escape will experience Moderate to Major adverse welfare effects (1). It is Unlikely to sustain major physical injury at the same time (2).
2. It is Unlikely that an animal escapes with Minor injuries (3).
3. It is Very Unlikely that an animal will escape with major injuries but if that happens, major animal adverse effects will have to be considered (4,5).

Hazards 6 to 9 - Hakapik

1. There is not a great variation on the magnitude and likelihood of the adverse effect with varying weather and habitat.
2. The probability of a seal suffering an adverse effect when it is effective hit with a hakapik varies from Low (Unlikely) to Very High (Very Likely) and its magnitude from Negligible to Moderate. There is a disagreement regarding how likely it is that the seal is effectively hit by the hakapik (6).
3. The magnitude of the adverse effect from an ineffective hit, or hits at an inappropriate place with a hakapik, ranges from Minor to Major and the probability ranges from Very

Unlikely to Likely. There is a disagreement regarding how likely it is that the seal is ineffectively hit or hit at an inappropriate place (7).
4. There was a general agreement that re-stunning could cause Negligible to Minor suffering, but that it is Very Likely to occur, for all weathers and habitats considered (8).
5. Seals regaining consciousness or being ineffectively re-stunned is Very Unlikely but it could lead to Moderate to Major suffering (9).
6. Although the magnitude of the adverse effect ranges from Minor to Major, it is Unlikely or Very Unlikely that a seal suffers due to ineffective hits or hits in an inappropriate place with a hakapik (9).
7. In principle, the hazards from the hakapik were not essentially different from other forms of clubbing.

It should be taking into account that the interval of time between the first shot/hit (ineffective) and the re-stunning has not been considered in the Risk Assessment.

Hazard 10 to 13 - Firearms

1. The weather and habitat were not considered to affect welfare by more than one category, but in bad weather and on bad habitat, the chances of an effective hit were less and that greater suffering was Likely to occur.
2. It is Very Likely to Likely that a seal would be effectively shot and that suffering would be Negligible, especially if death was ensured by another method of killing (10).
3. It is Unlikely that a seal is ineffectively shot or killed and remain conscious, but if it does happen, then suffering will be high (11). The same is true for a failed re-stun (13).
4. If the first shot does not kill a seal and it has to be re-stunned, then that is Likely to be effective and any suffering to be low (12).

Monitoring, bleeding, moving and skinning (Hazards 14-22)

1. As before, in the case of monitoring, bleeding, removal, skinning and escaping evaluation no consistent differences were observed between the different weather and habitats.
2. The probability of effective monitoring being carried out was Very Unlikely to Unlikely and that the consequences for the seals could range from Negligible to Moderate suffering (14).
3. It was likely to Very Likely that ineffective monitoring occurred, and the consequences for the seals could range from Negligible to Severe (15).
4. Effective bleeding after a successful stunning is Unlikely to happen but if it does then it will have Negligible adverse effects on the animal.
5. There is a clear agreement that ineffective bleeding or no attempt to bleed is Likely or Very Likely to occur, and that can result in adverse effects ranging from Negligible to Major (17).
6. Although the adverse effect of bleeding a conscious animal is agreed to be Moderate or Major it is also agreed that the probability of its occurrence is Unlikely or Very Unlikely (18).
7. Removal or skinning an unconscious or dead seal is Likely to occur with Negligible adverse effect to the animal. Removal or skinning of a conscious animal is Unlikely or Very Unlikely to happen but it will cause Moderate to Major adverse effects (19-22).
8. The probability that a struck animal escapes with or without any injury is Low or Very Low. The magnitude of the adverse effect depends on the effectiveness of the hit ranging from Negligible when the animal is dead (obviously) to Moderate and Major

effects in the case of animal escaping with or without injury as it depends on what the injury is exactly (23-25).

7.4.4. Risk Assessment of different scenarios

Different scenarios may occur during the killing and skinning of seals. The risk of adverse welfare effects of the seals has been evaluated for each of these scenarios so they are viewed from an animal welfare perspective. The scenarios have been selected to represent a wide range of possible scenarios. The 11 scenarios listed below are based on the risk pathways (Figures 3 and 4a and b).

Scenarios 1-8 are for using hakapik, club or firearms. Scenario 1 is the ideal situation, scenarios 2-8 have increasing adverse welfare effects involved. Scenarios 9-11 are for netting. For each scenario the magnitude of the adverse welfare effect and the likelihood of the seal experiencing the hazard outcomes are illustrated. The adverse welfare effect for each scenario is illustrated for the hazard outcomes involved.

Annex B of the Scientific Opinion include the Tables and Figures of the 11 scenarios considered for hakapik, club, firearms and netting.

For a number of the hazard outcomes, the experts agreed on a range of scorings for duration, intensity and likelihood that the seal is exposed to the hazard outcome. In a few cases the experts did not agree on the scorings. Therefore, two different evaluations appear in the Figures about the magnitude and likelihood of the adverse effects. For each hazard outcome, lower indicates the lowest likelihood combined with smallest magnitude and upper indicates the largest likelihood combined with largest magnitude.

Scenario 1 (hakapik) illustrates that it is Unlikely to Very Likely to be effectively hit when the habitat is good (Figure 1, Annex B). The magnitude of the adverse welfare effect is Negligible to Moderate. Effective monitoring and bleeding are Very Unlikely to Unlikely with Negligible to Moderate and Negligible to Minor magnitude of the adverse welfare effects, respectively. Removal and skinning an irreversibly unconscious or death seal is likely to Very Likely (very likely for skinning) with a Negligible magnitude of adverse welfare effect. The weather condition has only a minor influence on the likelihood, however, the habitat has a larger influence. In case of a bad habitat the likelihood of an effective hit is Unlikely to Likely and in case of both a bad weather and habitat, also the likelihood of an effective monitoring is changed to Very Unlikely.

Scenario 6 involves ineffective hit, monitoring and bleeding as well as removal of a conscious seal (or a seal that regains consciousness) and skinning a conscious seal (or a seal that regains consciousness). The magnitude of the adverse welfare effects for the upper level for each hazard outcome is major.

List of Scenarios:

1. The animal is hit/shot and is dead, or irreversibly unconscious or unconscious, effective monitored, effective bleed-out, possibly moved in some way, and skinned.
   Hazard outcomes: 6 (or 10), and 14, 16, 19, 21.
2. The animal is hit/shot and is rendered unconscious, ineffectively monitored, regains consciousness, is then is effectively re-stunned, bled-out and killed, possibly moved in some way and skinned.
   Hazard outcomes: 7 (or 11), 15, 8 (or 12), 16, 19, 21.
3. The animal is hit/shot and is rendered unconscious, ineffectively monitored, regains consciousness during bleed-out but is then is effectively re-stunned (dead), possibly moved in some way and then skinned.
   Hazard outcomes: 7 (or 11), 15, 18, 8 (or 12), 19, 21.

4. The animal is hit/shot and is rendered unconscious, ineffectively monitored, ineffectively bled-out, but regains consciousness while being moved, is then effectively re-stunned (dead), and skinned.
   Hazard outcomes: 7 (or 11), 15, 17, 20, 8 (or 12), 21.
5. The animal is hit/shot and is rendered unconscious, ineffectively monitored, ineffectively bled-out, possibly moved in some way but regains consciousness during being skinned and is effectively re-stunned.
   Hazard outcomes: 7 (or 11), 15, 17, 20, 22, 8 (or 12), 21.
6. The animal is hit/shot and is not rendered unconscious, ineffectively monitored, ineffectively bled-out, possibly moved, and then skinned while conscious.
   Hazard outcomes: 7 (or 11), 15, 17, 20, 22.
7. The animal is hit/shot and is not rendered unconscious, and escapes into the water where it may die or survive.
   Hazard outcomes: 7 (or 11), 15, 24 (or 25).
8. The animal is hit/shot and is not rendered unconscious, and escapes onto the land where it is chased and killed.
   Hazard outcomes: 7 (or 11), 15, 8 (or 12), 14, 19, 21.
9. The animal is trapped in a net that leads to suffocation with or without prior injury
   Hazard outcomes: 1 (or 2).
10. The animal is trapped in a net and escapes with no injuries.
    Hazard outcomes: 3.
11. The animal is trapped in a net and escapes with minor or major injuries.
    Hazard outcomes: 4 (or 5).

Annex B of the Scientific Opinion shows the Tables (1-11) and Figures (1 to 25) for the 11 scenarios considered. Figures 1 to 24 deal with physical methods and Figure 25 deals with netting. Figures for the three physical methods involving weapons, i.e. hakapik, club and firearms are broken down by hazard and by weather conditions. The x axis represents "likelihood" of that hazard occurring (i.e. Very Unlikely, Unlikely, Likely, Very Likely). The y axis give the specific hazard i.e. stunning (and sometimes re-stunning), monitoring, bleeding-out, removal and skinning. The shading of the bars represents the magnitude of the adverse effect ranging from Negligible to Major.

For each weapon, Scenario 1 is the ideal situation. Scenarios 2-8 for each weapon have increasing adverse welfare effects varying with the specific hazard. The lower and upper ranges of expert opinion are given in the bars for each hazard. The figures also show the possible influence of weather for each weapon, and which turns out to have only a minor effect.

Scenarios 9-11 are for netting.

For each scenario the magnitude (suffering intensity x duration) of the adverse welfare effect and the likelihood of the seal experiencing the hazard outcomes are illustrated. The adverse welfare effect for each scenario is illustrated for the hazard outcomes involved. For a number of the hazard outcomes, the experts agreed on a range of scorings for duration, intensity and likelihood that the seal is exposed to the hazard. In a few cases the experts did not agree on the scorings. Therefore, two different evaluations appear in the figures about the magnitude and likelihood of the adverse effects. For each hazard outcome, the lower bar indicates the lowest likelihood combined with smallest magnitude and the upper bar indicates the largest likelihood combined with largest magnitude.

Scenario 1 (hakapik) illustrates that it is Unlikely to Very Likely for seals to be effectively hit when the habitat is good (Figure 1, in Annex B) and the magnitude of the adverse welfare effect is Negligible to Moderate. Effective monitoring and bleeding are Very Unlikely to Unlikely to occur with Negligible to Moderate and Negligible to Minor magnitude of the adverse welfare effects, respectively. Removal and skinning an irreversibly unconscious or death seal is Likely to Very Likely (very likely for skinning) with a Negligible magnitude of an adverse welfare effect. The weather condition has only a minor influence on the likelihood, however, habitat has a larger influence. In case of a bad habitat the likelihood of an effective hit is Unlikely to Likely and in case of both a bad weather and a bad habitat, the likelihood of an effective monitoring is changed to Very Unlikely.

As a second example, the worst case, Scenario 6 (see the list of 11 above, and Figure 6 in Annex B for each of the three weapons) involves an ineffective hit, followed by ineffective monitoring, ineffective bleeding-out, as well as removal of a conscious seal (or a seal that regains consciousness) and skinning a conscious seal (or a seal that regains consciousness). The magnitude of the adverse welfare effects for the upper level for each hazard outcome, agreed by the experts, is Major but the likelihood of it happening varies to Very Likely depending on the specific hazard being considered.

CONCLUSIONS AND RECOMMENDATIONS

1. SEAL SPECIES, THEIR DISTRIBUTION AND THE HUNTS

1.1. CONCLUSIONS

1. At least fifteen species are killed and skinned by humans for commercial purposes, and to satisfy subsistence and cultural needs; those commonly hunted include harp, ringed, grey, hooded, and Cape Fur seals.
2. Seal hunting is commonly carried out around the Arctic, but also in Namibia, and some three quarters of a million seals are killed annually worldwide. The three largest hunts are in Canada, Greenland and Namibia accounting for approximately 60% of all seals killed in 2006.
3. The degree to which such seal hunting is regulated by law and is routinely monitored by observers varies in different countries and range states. Commercial seal hunting is more regulated than traditional hunting. In some countries, regulations include references to the welfare aspects of killing of seals and in others they do not.
4. Very little robust information is available on the extent of use of different hunting methods at different times of the year; the efficacy of each of these methods in the different environments; and their respective advantages and disadvantages in relation to animal welfare.
5. The use of rifles appears to have increased at the expense of hakapiks and other methods.
6. Netting is usually prohibited for commercial hunting but is practised in traditional subsistence hunting.

2. PRACTICES FOR KILLING ANIMALS IN ABATTOIRS AND IN THE WILD

2.1. CONCLUSIONS

1. Seal killing can be considered in the context of killing wild animals as well as killing domesticated animals for food in an abattoir.
2. Seal hunts are heterogeneous in several respects compared with the slaughter of farmed animals in abattoirs; however, the goal is the same i.e. to kill animals with the minimum of pain, fear, and distress and not to cause avoidable suffering.
3. Unlike farmed animals, very few experimental and reliable data are available on the effectiveness and efficacy of most of the methods used to kill seals, particularly with respect to the physical methods and monitoring unconsciousness, time to recovery of consciousness in relation to bleeding-out, position of the strike, etc. (see Chapters 4 and 5).
4. Unlike in an abattoir where the floor should be stable, even and not slippery, seals are killed on different substrates e.g. on land, in the water, on solid ice, loose pack ice, moving ice floes, in environmental conditions that may rapidly alter the position of both sealer and seal, and in weather conditions that may affect visibility (see Chapter 7).
5. The efficacy of the methods used to kill domesticated and wild animals, in terms of the intensity and duration of poor welfare they potentially inflict, will vary according to the species of animals, methods used and the skills of the person using them. In both cases some animals will not be killed without causing some pain, distress and other forms of suffering, as there is no perfect killing method that will work at all times, and under all circumstances.

2.2. RECOMMENDATIONS

1. Whenever animals (wild, domesticated and captive) are to be killed the methods used should be those that do not cause avoidable pain, distress and other forms of suffering.

3. DESCRIPTION OF THE KILLING METHODS

3.1. HAKAPIK

3.1.1. CONCLUSIONS

1. The hakapik is currently used as a means of killing young harp and hooded seals (normally less than 3 - 4 months old) is effective when sufficient care is taken to apply the blows accurately to the head and to verify their results.
2. It should also be noted that seal species vary in important aspects in relation to the efficacy of killing methods such as their anatomy, age and the degree of ossification of the skull. For several reasons, including skull thickness and animal movements, a hakapik is not considered to be an effective stunning or killing weapon for adult seals.
3. If the first blow from the hakapik does not hit the calvarium but hits another part of the body, the animal may not be immediately stunned and this will then cause pain in conscious animals, and they may also escape with such injuries.
4. The accuracy of the strike may be compromised if the seal moves its head, or moves away and this depends very much on the behaviour of the seal species, the skill of the hunter and the environmental conditions in which the hunt takes place.
5. No equivalent data to that obtained in laboratory studies for methods used in the abattoir is available for seals, in particular:
   the time to loss of consciousness or onset of death;
   clear and unambiguous monitoring points for (un)consciousness that can be applied under field conditions;
   the effects of the use of the hakapik in seals of different species and ages.

3.2. CLUBS (NO SPIKE)

3.2.1. CONCLUSIONS

1. As the force of impact with the club is likely to be less than that for a hakapik, it is concluded that in some cases, the club is not as effective as the hakapik for killing.
2. Club failure rate may be greater and therefore cause more pain and suffering.

3.3. FIREARMS

3.3.1. CONCLUSIONS

1. In the case of Arctic seals hunts, a shot to the head or upper neck of a seal with ammunition of appropriate power, is likely to cause immediate death because of its impact power and the large ensuing wound.
2. When a seal is shot from a distance, it is mostly likely that a targeted animal will experience little or no fear or distress associated with human intrusion immediately prior to the shot.
3. There is a risk of a targeted animal being hit with insufficient force and accuracy to cause instantaneous death or unconsciousness, and possibly escaping wounded.
4. Missed shots may be caused by one or more of the following: poor marksmanship, excessive distance, unstable platforms (e.g. a boat or ice floe in rough weather conditions), unanticipated movement by the animal or inappropriate firearms or ammunition.
5. Shooting animals where the likelihood of reaching them quickly is reduced or questionable (e.g. on thin and loose pack ice, open deep water), poses an unknown risk of causing avoidable pain, distress and suffering.
6. In any seal hunt, it is likely that an unknown proportion of the animals will be only wounded, regardless of the power of the ammunition.
7. The use of the rifle in Arctic hunts is likely to increase if ice conditions in winter and spring continue to be poor as they have been in recent years, as this limits the ability of sealers with hakapiks to reach live seals.

3.3.2. RECOMMENDATIONS

1. The operator must be sufficiently trained and competent with the rifle used in the hunt and use the appropriate ammunition.
2. Shooting should be not carried out when weather conditions are poor.
3. The rifle, sightings and ammunition must be well maintained.
4. The time between shooting and monitoring of the state of the shot animal should be short.

3.4. NETTING AND TRAPPING UNDERWATER

3.4.1. CONCLUSIONS

1. Death by suffocation of seals trapped in nets underwater is clearly protracted, and will cause considerable suffering as their diving reflexes may influence the time taken to die, and the manner of death, and behaviour during dying.

3.4.2. RECOMMENDATIONS

1. Netting of seals and holding them underwater is not an appropriate killing method and so its use should be avoided.

3.5. OTHER METHODS

3.5.1. CONCLUSIONS

None of the alternative tested methods (e.g. pistol, captive bold, poisoning) has been considered to be practical or provide a humane killing.

3.6. BLEEDING-OUT, HAULING, AND SKINNING

3.6.1. CONCLUSIONS

1. Bleeding out of animals to ensure rapid death is an important part of the killing process if animals are shot or struck with a club or hakapik.
2. Animals that have been killed outright may still be bled-out to ensure death.
3. In the Arctic, seals may be bled and skinned on the ice or be gaffed and hauled onto a boat. In Namibia, animals may be gaffed and hauled, dragged by the flippers, carried, or tossed through the air, as they are removed from the colony and onto a truck for transport to the factory, where they are skinned and butchered.
4. Skinning of dead or irreversibly unconscious animals does not pose a welfare problem. However, skinning of animals that are conscious or regain consciousness during the bleeding, hauling or skinning processes, constitute a serious welfare problem.

3.6.2. RECOMMENDATIONS

1. Seals should be bled-out as soon as possible and, preferably immediately, after they have been successfully stunned and checked to ensure they are irreversibly unconscious or dead.
2. Unless they are in the water, animals should not be moved, i.e. gaffed, hauled or moved from the position they have come to rest, until it has been confirmed that they are dead or irreversibly unconscious, or have been bled-out.
3. If they are in water or located where they cannot be bled-out immediately, they should be monitored as soon as possible for consciousness and, if not dead or irreversibly unconscious, they should be re-stunned or killed.
4. Skinning should not be initiated until irreversible unconsciousness or death has been confirmed.

3.6.3. AREAS WHERE INFORMATION IS LACKING

1. The time taken for seals to bleed out to cause unconsciousness or death.
   Incision of other major blood vessels such as the jugular veins and common carotid arteries could be carried out, but this would need to be investigated further, both anatomically and under field conditions, to see if it reduced bleed-out time. There are no laboratory studies determining the time taken for animals to die from the point at which blood vessels are cut and bleeding starts.

4. EVALUATION OF THE KILLING METHODS USED IN PRACTICE

4.1. EVALUATION OF THE METHODS USED FOR KILLING AND SKINNING IN CANADA'S COMMERCIAL SEAL HUNT

4.1.1. CONCLUSIONS

1. There are few, if any, robust and reliable quantitative data to evaluate killing methods employed in various seal hunts around the world.
2. Without continuity of evidence it is impossible to determine the sequence of events for an individual seal and hence the time of unconsciousness and death in relation to the killing or stunning procedures used, i.e. uncertainty is high in data interpretation.
3. Without adequate sampling that is representative of the entire hunt with respect to sample size and design, it is not possible to establish reliably the exact proportion of animals that are killed outright, or that are irreversible unconscious, or that are reversibly unconscious, or that are conscious at the various stages of the killing and skinning processes, i.e. uncertainty is high in obtaining relevant and representative data for a specific seal hunt.
4. The conclusions of the various independent reports are conflicting, and different observers come to different conclusions based on the same data, i.e. uncertainty is high in data interpretation.
5. There is evidence that, during the Canada's commercial seal hunt, some animals do, and others may, suffer pain and distress at different stages of the killing process. This could be largely avoided if sealers complied with the Canadian regulations in relation to manually checking the skull or administering a blink reflex test.
6. Seals are struck and lost in varying proportions, depending on several factors associated with the hunt.

4.2. EVALUATION OF THE METHODS USED FOR KILLING AND SKINNING CAPE FUR SEALS IN THE NAMIBIAN HUNT

4.2.1. CONCLUSIONS

1. The Namibian hunt for Cape Fur seal pups causes considerable disturbance to breeding colonies and fear distress and other forms of suffering to the animals.
2. Both targeted and non-targeted animals may sustain injuries before they are killed or escape, during the pup hunt.
3. Some non-targeted animals may sustain injuries before being released or escaping.
4. Not all animals which are clubbed or shot are killed or rendered irreversibly unconscious therefore sticking and bleeding-out is required to ensure death.
5. Reportedly, pups are frequently not properly bled out after stunning, resulting in some animals regaining consciousness or remaining conscious for considerable periods of time.

5. NEUROPHYSIOLOGICAL ASPECTS

5.1. DESTRUCTION OF THE BRAIN AND BLEEDING-OUT

5.1.1. CONCLUSIONS

1. Seals are sentient beings and able to experience pain, fear, distress and other forms of suffering.
2. When it can be assured that a seal has been killed outright then the recognition of consciousness, unconsciousness and irreversible unconsciousness are not necessary.
3. Although some reports indicate that cutting the brachial arteries and veins leads to severe haemorrhaging there are no reliable data on how quickly this leads to death.
4. Animals will feel the cuts at the start of the skinning process if they are not unconscious or have not been sufficiently bled-out.

5.1.2. RECOMMENDATIONS

1. Pinnipeds (fur seals, seal lions, walrus and true seals) should be recognized as sentient marine mammals.
2. Seals should be protected from acts during killing and skinning that cause them unnecessary pain and distress, and avoidable suffering, by rapidly ensuring animals are dead or are irreversibly unconscious, or are unconscious and bled-out.

5.2. PHYSIOLOGICAL DIFFERENCES BETWEEN SEALS AND OTHER MAMMALS

5.2.1. CONCLUSIONS

1. Seals have several unique features that facilitate them staying underwater for long periods. The impact of these physiological mechanisms on the duration of suffering is uncertain but may prolong fear and distress e.g. during netting suffocation.

5.3. MECHANICAL METHODS

5.3.1. CONCLUSIONS

1. The degree and the extent of brain damage will be different depending on the instrument used and how it is used.
2. Clubs and hakapiks are penetrative methods where the skull bones are fractured, and the instrument and bone fragments penetrate and destroy the brain tissue.
3. The accurate use of an appropriate firearm and ammunition to kill seals will involve hitting the skull, or the neck immediately behind the skull, allowing the bullets to expand.

5.4. MONITORING POINTS FOR INSENSIBILITY AND DEATH

5.4.1. CONCLUSIONS

1. Stunning and stun-kill methods are developed to induce, when applied correctly, pathological brain states that are incompatible with the persistence of consciousness and sensibility.

5.5. MONITORING MUSCLE TONE AND BODY MOVEMENTS

5.5.1. CONCLUSIONS

1. In farmed animals, occurrence of tonic and clonic seizures are considered to be signs of a successful mechanical stun.
2. Harp seals, when stunned and killed by acute trauma to the brain, may undergo a period of tonic and clonic seizures and these may be the reaction of a successfully stunned animal and can last for a considerable period of time.
3. A behaviour known as “fear - induced paralysis”, characterized by immobility and tonic contraction of the whole body, has been described in young harp seals. These animals are not stunned and may be interpreted as dead by inexperienced sealers.

5.6. MONITORING EYE REFLEXES

5.6.1. CONCLUSIONS

1. The absence of corneal reflex is used as a criterion for ascertaining brain death in humans and depth of anaesthesia in many vertebrates and its absence may be used as an indicator of brain damage or brain failure.
2. Visual cues and reflexes that are used in domestic animals to assess the success of a

mechanical stunning procedure could also apply to seals, such as the loss of corneal reflexes or pupillary dilatation.

5.7. MONITORING PHYSICAL DAMAGE E. G. PALPATION OF THE SKULL

5.7.1. CONCLUSIONS

1. Palpation of the skull can be used for assessing and monitoring the severity of brain damage.
2. The presence of an intact skull would not necessarily mean that an animal was not rendered unconscious.
3. A partial fracture (one side of the cranium or at the front or the back of the skull) could still be compatible with consciousness and sensibility.

5.7.2. RECOMMENDATIONS

1. Certain criteria would have to be established in order to ensure that the degree or extent of damage felt during palpation provides a reliable method of verifying in the field that a seal has been properly stunned.

5.8. A COMPARISON WITH TRAUMATIC BRAIN INJURY IN HUMANS

5.8.1. CONCLUSIONS/SYNTHESIS

1. If animals still have coordinated movements and actions, such as responses to stimuli, they are clearly still conscious.
2. Absence of breathing is difficult to interpret as it may indicate that the animal is dead or that it has just stopped breathing (apnoea) mimicking a diving reflex. However, return of rhythmic breathing indicates they are still alive.
3. It is possible to use clinical signs such as paralysis, immobility and bilateral dilatation of pupils or a corneal reflex, to determine unconsciousness in seals.

6. EDUCATION, TRAINING AND COMPETENCE OF SEALERS AND INSPECTORS

6.1. CONCLUSIONS

1. For commercial hunting, training of sealers is mandatory in some countries such as Norway. Only hunters (either shooters or clubbers) performing at an adequate level and who have passed a separate shooting proficiency test (competence) may shoot seals or use clubs during the hunt.
2. No information exists on the effectiveness of education, training or information programs for seal hunters that pertain to animal welfare issues.

6.2. RECOMMENDATIONS

1. Any programme that sets out to explain the anatomical and physiological foundations of humane hunting practices should reinforce in the mind of sealers the need for these practices to be adhered to, rather than being perceived as regulations to be followed.
2. Training and enforcement should aim to produce a degree of competence whereby irreversible unconsciousness is achieved immediately and rapid death with no avoidable suffering is ensured.
3. Continuous scrutiny of any form of exploitation of animals, domestic or wild, should accompany any education programme, and result in an adequate humane standard for killing and skinning practices.
4. Education, training and licensing procedures should be harmonized and be based on

sound science.
5. Training materials should be periodically updated.

GENERAL CONCLUSIONS AND RECOMMENDATIONS

GENERAL CONCLUSIONS

1. Seals are sentient mammals that can experience pain, distress, fear and other forms of suffering.
2. There are only a very limited number of studies published in peer-reviewed journals that can be used to evaluate, with a high degree of certainty, the efficacy of the various killing methods employed in different seal hunts around the world on a quantitative basis. This is why the Risk Assessment had to take a qualitative approach. Nevertheless, there are studies (e.g. by NGOs, industry linked groups) that highlight serious deficiencies and concerns in the hunts, but they may contain potentially unproven serious biases.[19]
3. Many seals can be, and are, killed rapidly and effectively without causing avoidable pain, distress, fear and other forms of suffering, using a variety of methods that aim to destroy sensory brain functions.
4. There is strong evidence that, in practice, effective killing does not always occur but the degree to which it does not happen has been difficult to assess, partly because of a lack of objective data and partly because of the genuine differences in interpretation of the available data.
5. If seals are hit or shot but are not dead, they may be hit or shot again or may be moved or skinned whilst conscious, resulting in avoidable pain, distress, fear and other forms of suffering.
6. Seals may be struck and lost with injuries that may cause avoidable pain, distress and suffering that may affect their survival in the wild.
7. If seals are dead, or have been bled out after adequate stunning from which they do not recover consciousness, then skinning is not a welfare problem.
8. Monitoring each seal to ensure death or unconsciousness before bleeding-out is not always carried out effectively, and this will lead to seals feeling the skinning cuts before loss of consciousness and death due to bleeding-out.
9. Bleeding-out stunned seals to ensure death is frequently not carried out in some hunts.
10. Seal hunts that involve herding before killing can cause fear and other forms of suffering in addition to any avoidable pain at the time of killing.
11. Seals that are herded but are not targeted to be killed may suffer fear and, if the suckling young are separated from their nursing dams, they may also experience hunger until they are reconnected, if that happens.

GENERAL RECOMMENDATIONS

1. Seals should be killed without causing avoidable pain, distress, fear and other forms of suffering.
2. Seals should be killed and skinned in a way that meets the three steps of effective stunning or killing, effective monitoring and effective bleeding out, before being skinned.
3. When killing seals using firearms, this should only be done with appropriate guns and

[19] No exact figures on incidence could be given as scientifically the data had always to be qualified in some way. Nevertheless the data were sufficient for the Panel to draw firm conclusions and to make recommendations. The available data can be found in Chapter 4 (4.2.3 and 4.3.1) of this Scientific Opinion.

ammunition, and at appropriate distances.

4. When killing seals using hakapiks or other forms of club, this should only be done on young animals (not adults), with instruments of an appropriate design and used with adequate force and accuracy.
5. After an attempted kill, each seal should be effectively monitored to ensure death or unconsciousness before bleeding-out and before skinning.
6. Unless death is absolutely certain, death should be ensured before skinning by bleeding-out.
7. Hunters should be trained and competent in the procedures they use, including killing methods, monitoring death, unconsciousness and consciousness, and in rapid bleeding and skinning.
8. Attempts should not be made to kill seals that cannot be adequately visualised (e.g. harpooning through the snow), or that do not pose a stable target or where the sealer may be unbalanced (e.g. in adverse weather conditions, moving substrates) as it can cause avoidable pain, distress, fear and other forms of suffering.
9. Some methods should not be used to kill seals as they are inherently inhumane e.g. trapping seals underwater that causes death by suffocation.
10. Adequate time should be ensured for effective killing, monitoring and bleeding, and practices that reduce such necessary time should be avoided.
11. Independent monitoring of hunts (without commercial/industry and NGO links) to provide certain critical information on seal killing and stunning from a welfare perspective should be instigated.
12. Hunts should be opened up to inspections without undue interference.

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APPENDICES

APPENDIX A. FIGURES AND TABLES

Figure 5. Global distribution of pinnipeds (black), noting approximate locations where individual species and subspecies are currently killed and skinned (provided by S. Fink and D. M. Lavigne, after Davies 1958; Lavigne and Kovacs, 1988).

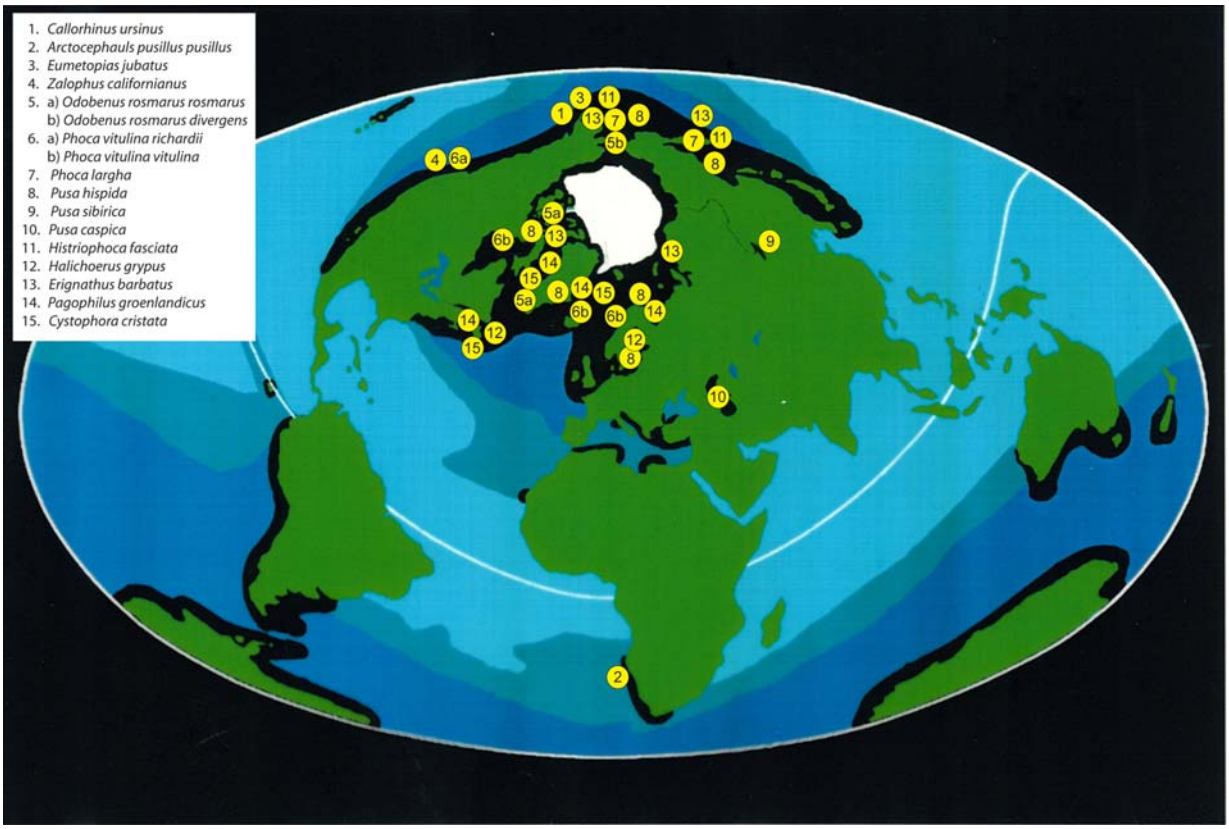


Figure 6. Total estimated population size (and 95% C.I.) of Northwest Atlantic hooded seals between 1960 and 2006 (Hammill and Stenson, 2006).

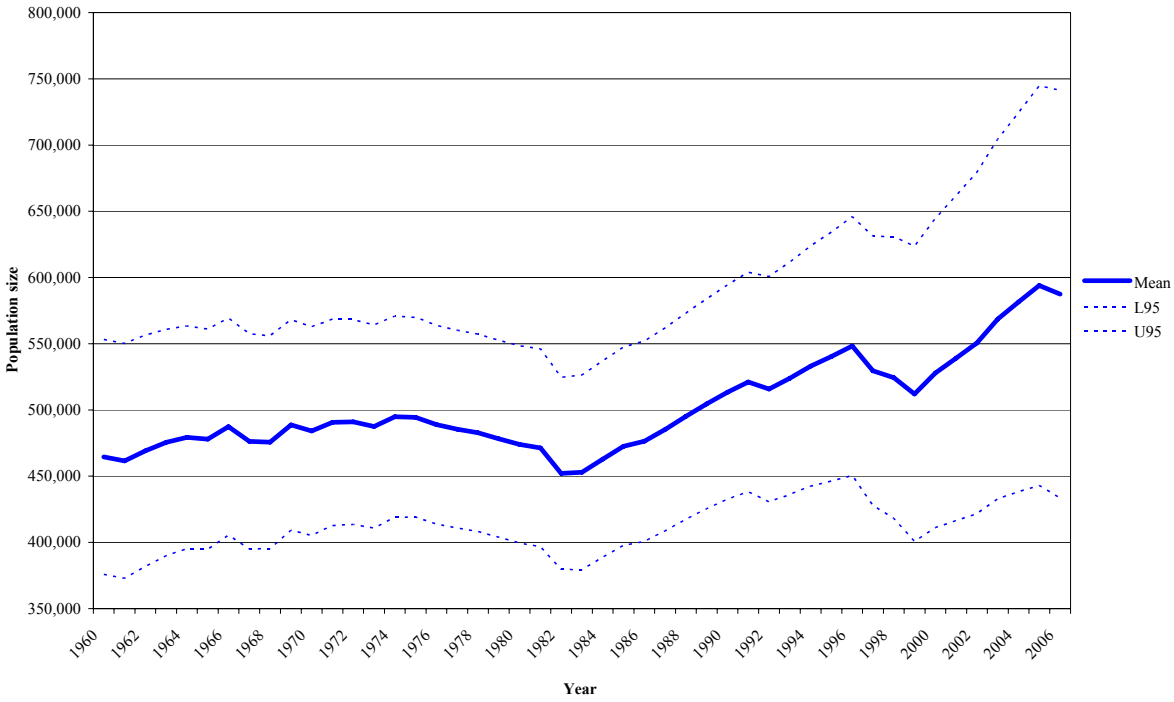


Figure 7. Abundance of Northwest Atlantic harp seals (1960 - 2006) (Hammill and Stenson, 2005; G.B. Stenson, pers. comm.).

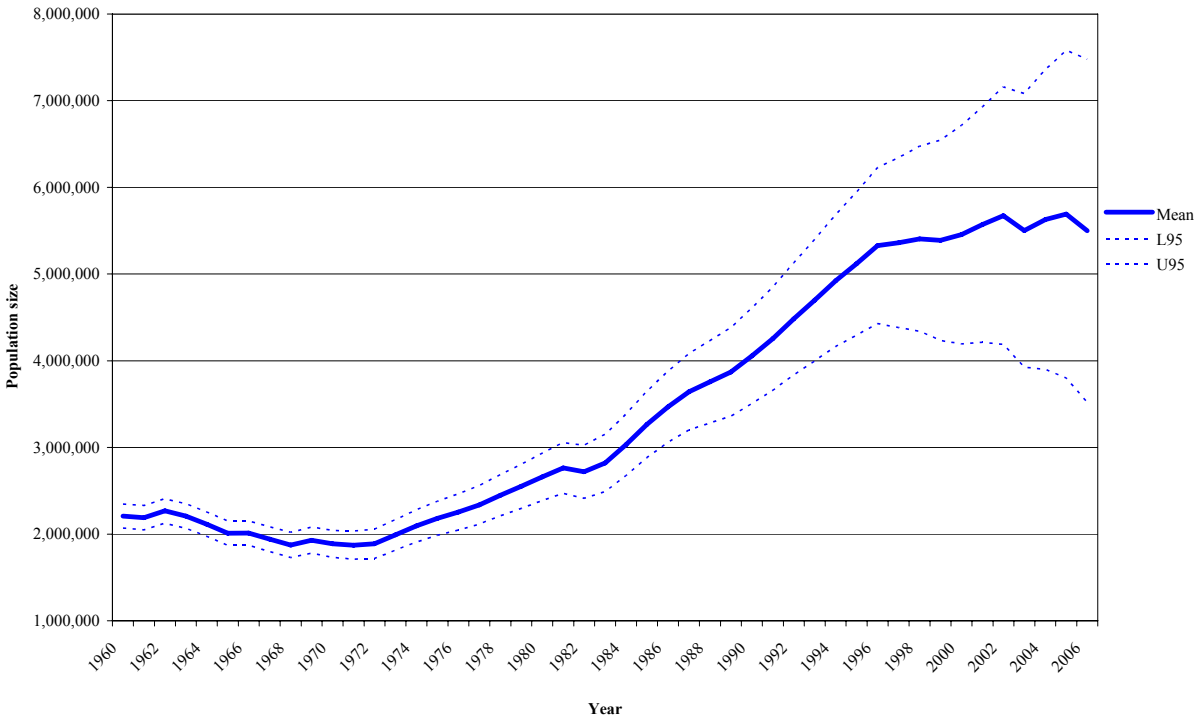


Figure 8. Harp seal range in the North Atlantic (yellow) showing the locations of pupping areas (red dots) in the Gulf of St. Lawrence, and off Newfoundland and Labrador (NW Atlantic population); East of Greenland (West Ice Population), and in the White Sea off the coast of Russia (White Sea population) (reprinted from Fink, 2007a).

Figure 9. Distribution of Cape Fur seals (*Arctocephalus pusillus pusillus*) in southern Africa (provided by S. P. Kirkman)

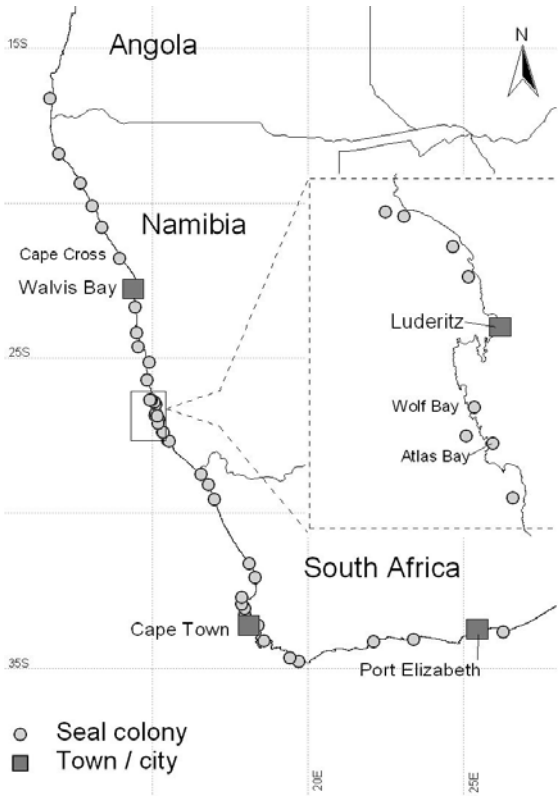


Table 7. Landed catches by age (pups, 1+ animals), and total removals of Northwest Atlantic harp seals by Canada's commercial seal hunt, 2000-2007.

Year	Seals < 1 year	Seals > 1 year	% <1	Total landed catch	TAC	Total removals (including struck and lost)
2000	85,035	7,020	92	92,055	275,000	103,550
2001	214,754	11,739	95	226,493	275,000	249,535
2002	297,764	14,603	95	312,367	275,000	342,642
2003	280,174	9,338	97	289,512	289,512*	343,596
2004	353,553	12,418	97	365,971	350,000*	396,997
2005	323,800	6,029	98	329,829	319,500*	376,167
2006	345,903	8,441	98	354,344	335,000	380,991
2007**	221,488	3,257	98	224,745	270,000	239,659
* TAC DFO 2003–2005 was 975,000, with a maximum of 350,000 in 2 of the 3 years.						
** preliminary figures, as of November 27, 2007.						

Table 8. Landed catches (all age groups) and estimated total removals of Northwest Atlantic harp seals during Greenland's summer hunt, 2000-2007. Number of young (<1 year) and older (1+) seals based upon age structure of the catch obtained between 1984 and 1993 (Stenson, 2005).

Year	Seals < 1 year	Seals > 1 year	%<1	Total landed catch	Total removals (including struck and lost)
2000	14,549	87,392	14	101,941	203,882
2001	12,790	76,827	14	89,617	179,234
2002	9,975	59,920	14	69,895	139,790
2003	9,776	58,723	14	68,499	136,998
2004	10,084	61,943	14	72,027	n/a
2005	12,490	76,726		89,216	n/a
2006	n/a	n/a		n/a	n/a
2007	–	–		–	–
2000–2003 from Stenson, 2005. Estimates of Human Induced Mortality in Northwest Atlantic Seals. 2004 – From Greenland white paper on Sealing (DFHA, 2006); includes a small number of animals (~1,000) from Greenland Sea population. 2005 – from A.. Rosing-Asvid, pers. comm.					
Total removals for 2005–2007 estimated, assuming a loss rate of 0.50 for animals shot in water.					

Table 9. Landed catches (all age groups) and estimated total removals of Northwest Atlantic harp seals in the eastern Canadian Arctic, 2000-2007.

Year	Seals < 1 year	Seals >1 year	% < 1	Total landed catch	Total removals (including struck and lost)
2000	9	271		280	560
2001	14	391		405	810
2002	n/a	n/a		n/a	n/a
2003	n/a	n/a		n/a	n/a
2004	n/a	n/a		n/a	n/a
2005	n/a	n/a		n/a	n/a
2006	n/a	n/a		n/a	n/a
2007	-	-		-	-
2000-2003 from Stenson, 2005. Estimates of Human Induced Mortality in Northwest Atlantic Harp Seals.					
Total removals for 2004-2007 estimated, assuming a loss rate of 0.50 for animals shot in water.					

Table 10. Landed catches by age (pups, adult males, adult females) and total allowable catches (TACs) for Cape Fur seals (*Arctocephalus pusillus pusillus*) in Namibia, 2000-2007.

TAC			**Reported Catches**	
Year	Pups <1 year	Adult males	Pups	Adult males
2000	60,000	7,000	38,054	3,605
2001	60,000	5,000	39,926	4,202
2002	50,000	5,000	35,082	4,496
2003	60,000	5,000	29,577	4,005
2004	60,000	5,000	54,496	4,911
2005	65,000	5,000	n/a	n/a
2006	85,000	6,000	77.800	5.300
2007	80,000	6,000	-	-
2008	80,000	6,000	-	-
2009	80,000	6,000	-	-
Sources: Years 2000-2005, compiled by Kirkman (2006) from various sources (S.P. Kirkman, pers. comm.); years 2006 and 2007 from Nolen (2007). Catches from 2005 and 2006 have yet to be reported (Kirkman, 2006) and the 2007 hunt is on-going at the time of writing (September 2007).				

APPENDIX B. DEFINITIONS OF HUMANE KILLING[20]

A few examples that deal with marine mammals, livestock, and humane euthanasia are provided for reference below.

1. **United States Marine Mammal Protection Act (MMPA, 1972):** Humane killing of marine mammals "involves the least possible degree of pain and suffering practicable to the mammal involved."
2. **American Veterinary Medical Association's (AVMA) definition of "euthanasia" (meaning "good death")**: "Euthanasia techniques should result in rapid loss of consciousness followed by cardiac or respiratory arrest and the ultimate loss of brain function". In addition, the technique should minimize distress and anxiety experienced by the animal prior to loss of consciousness. Like the MMPA, the AVMA "recognized that the absence of pain and distress cannot always be achieved." The AVMA Guidelines on Euthanasia (AVMA, 2001) therefore "attempts to balance the ideal of minimal pain and distress with the reality of the many environments in which euthanasia is performed", and "recommends that a veterinarian with appropriate training and expertise for the species involved should be consulted to ensure that proper procedures are used" .
3. **The U.S. Humane Slaughter Act (1958)**: In the case of large mammals (livestock) animals should be "rendered insensible to pain by a single blow or gunshot or…other means that is rapid and effective, before being…hoisted, thrown, cast, or cut."
4. **Criminal Code of Canada (section 446) (1985)**: "Prohibits anyone from wilfully causing animals to suffer from neglect, pain, or injury."
5. **Meat Inspection Act of Canada (section 62) (1996)**: "No food animal shall be handled in a manner that subjects the animal to avoidable distress or avoidable pain".

The above definitions provide a framework for evaluating the animal welfare aspects of Canada's commercial seal hunt.

[20] See also the definition of Humane killing in the Glossary.

APPENDIX C. CANADA'S MARINE MAMMAL REGULATIONS, SECTIONS 28, 29

28.

1. No person shall fish for seals, for personal or commercial use, in any of Sealing Areas 4 to 33 except with

    a) a round club made of hardwood that measures not less than 60 cm and not more than 1 m in length and that, for at least half of its length, beginning at one end, measures not less than 5 cm and not more than 7.6 cm in diameter;
    b) an instrument known as a hakapik, consisting of a metal ferrule that weighs at least 340 g with a slightly bent spike not more than 14 cm in length on one side of the ferrule and a blunt projection not more than 1.3 cm in length on the opposite side of the ferrule and that is attached to a wooden handle that measures not less than 105 cm and not more than 153 cm in length and not less than 3 cm and not more than 5.1 cm in diameter;
    c) a rifle and bullets that are not full metal-jacketed that produce a muzzle velocity of not less than 1,800 feet per second and a muzzle energy of not less than 1,100 foot pounds; or
    d) a shotgun of not less than 20 gauge and rifled slugs.

2. Every person who strikes a seal with a club or hakapik shall strike the seal on the forehead until its skull has been crushed and shall manually check the skull, or administer a blinking reflex test, to confirm that the seal is dead before proceeding to strike another seal.

3. If a firearm is used to fish for a seal, the person who shoots that seal or retrieves it shall administer a blinking reflex test as soon as possible after it is shot to confirm that it is dead.

4. Every person who administers a blinking reflex test on a seal that elicits a blink shall immediately strike the seal with a club or hakapik on the forehead until its skull has been crushed, and the blinking reflex test confirms that the seal is dead.

SOR/2003-103, s. 6.

29.

No person shall start to skin or bleed a seal until a blinking reflex test has been administered, and it confirms that the seal is dead.

APPENDIX D. REGULATIONS RELATING TO THE EXPLOITATION OF MARINE RESOURCES. NAMIBIA[21]

Part I.
Definitions

"adult seal" means a seal of at least three years of age;
"clubber" means a member of a sealing team equipped with a sealing club;
"marine mammal" means any individual of the taxonomic categories Sirenia, Cetacea or Pinnipedia;
"pup" means a seal in its first year of life;
"rifle" means a rifle which is used with ammunition capable of killing an adult seal instantaneously by penetrating the brain case and destroying the brain without exiting on the opposite side of the brain case;
"seal" means any Cape Fur seal (*Arctocephalus pusillus*);
"sealing club" means a straight wooden or fibreglass club with a mass of at least 1 kg, but not exceeding 2 kg, and a length of at least 0,9 m but not exceeding 1,9 m and of which one end is thicker than the other;
"sticker" means a member of a sealing team equipped with a knife;

Part IV
Seals

20. (1) Seals must be harvested in the presence of at least one fisheries Inspector.
(2) A holder of a right relating to the harvest of seals must identify a group of pups to be harvested, which must be driven away from the sea and allowed to settle down before clubbing begins, care being taken to facilitate the escape of adult seals.
(3) After the identified pups have settled down, they must be harvested as follows:
(a) a group of pups must be released from the group referred to in subregulation (2) in the direction of the sea;
(b) a clubber must kill a pup by clubbing it on the top of the head with a sealing club, when a group released in terms of paragraph (a) moves past the clubbers;
(c) the inspector overseeing the harvest must be satisfied that a pup, which has been clubbed, is dead;
(d) a sticker must pierce the heart of the pup with a knife, after the pup has been clubbed;
(4) Adult seals selected for harvesting must -
(a) be killed on land by shooting the seal with a rifle in the head so that the bullet immediately kills the seal;
(b) the inspector overseeing the harvest must be satisfied that a seal, which has been shot, is dead.

[21] Ministry of Fisheries and Marine Resources, 2001.

GLOSSARY

All definitions have to be interpreted in the context of the seal hunt.

Avoidable suffering: additional suffering, over and above the minimum level of intensity or duration needed to kill an animal using a given method.

Beater: a weaned harp seal pup that has completely moulted its white fetal hair (lanugo), aged about 3 weeks to 13-14 months. The term has also been applied to moulted grey seal pups, more traditionally known as "moulters".

Bedlamer: a harp seal with a black-spotted pelt, after it has moulted its beater pelt at the age of 13-14 months. Harp seals retain the bedlamer pelt until the black harp, characteristic of adult animals, begins to appear at the age of 4 years or older.

Bleeding: a consequence of sticking, i.e. the act of severing major blood vessels often in the neck or axillary regions (see sticking).

Blink reflex: see corneal reflex.

Blubber: the layer of fat found just below the skin in marine mammals including seals and whales.

Calvarium: "the domelike superior portion of the cranium, composed of the superior portions of the frontal, parietal, and occipital bones" (Dorland's Medical Dictionary).

Consciousness: the mental state of awareness of a normal animal when it can perceive stimuli from its external environment, including pain, fear and distress, and respond physiologically and behaviourally.

Corneal reflex: closure of the eyelids (i.e. blinking) when the outer surface of the eye (the cornea) is touched. In the pinniped literature, the "corneal reflex" is often termed the "blink[ing] reflex". The absence of a bilateral corneal reflex is often considered to be indicative of "brain death" in mammals, but it can occur due to localised damage to certain cranial nerves. The presence of a unilateral reflex indicates one-sided brain or nerve damage.

Cull: an action designed to reduce the size of a population by killing animals.

Effective: applying to a hit or shot, re-stunning, monitoring, bleeding-out, i.e. the accuracy or proficiency of achieving a stated goal.

East Ice: Greenland Sea.

Front: The traditional sealing area off the coast of Northeast Newfoundland and southern Labrador, Canada; one of the locations where harp and hooded seals congregate on pack ice each year to reproduce.

Gulf: usually refers to an area in the southern Gulf of St. Lawrence around the Magdalene Islands and Prince Edward Island which is one of the areas where harp and hooded seals congregate to reproduce.

Hakapik: a form of club with a metal head used to strike seals with the intention of killing or stunning them and also used occasionally for human safety.

Humane killing: the act of killing an animal that reduces as much as possible unnecessary pain, distress and suffering i.e. that causes no avoidable pain, distress, fear or other suffering (see Appendix B).

Hunt: a hunt, such as a seal hunt, usually means a sustainable culling or killing of animals from a population.

Ineffective: applying to a hit or shot, re-stunning, monitoring, bleeding-out, i.e. the lack of accuracy or proficiency of achieving a stated goal, or when it is not carried out at all, or carried out in a cursory manner.

Inhumane killing: the act of killing an animal in a way that causes it unnecessary or avoidable pain, suffering, fear and distress (see humane).

Lairage: means pens, yards and other holding areas used for accommodating animals in order to give them necessary attention (such as water, feed, rest) before they are moved on or used for specific purposes including slaughter.

Lanugo: the covering of fine hair found in most mammals including humans, while still in the womb or uterus. This fetal hair is usually moulted before birth. For a number of true seals, this lanugo is retained after birth as a well-developed pelt. Seals such as the harp seal, and most ice-breeding seals in the northern hemisphere, have a white lanugo, giving the pups their common name – "whitecoat". Other seals, such as those that live in the Antarctic, have a dark lanugo.

Longliner: in Canada's commercial seal hunt, sealing vessels that are 35 feet (*ca* 10.7 metres) to 64 feet, 11 inches (*ca* 19.8 metres) in length.

Nociception: the system in the body for the detection of potentially noxious stimuli leading to a feeling of pain.

Nuisance seals: individual seals that are perceived to be in conflict with human activities, e.g. Canada's Marine Mammal Regulations define nuisance seals to include animals that represent a danger to fishing equipment despite deterrence efforts, or animals that are determined to be inflicting damage on anadromous or catadromous fish stocks along estuaries and in rivers and lakes during the migration of those species. Individual nuisance seals are often subject to culling. Synonym: rogue seals.

Pack ice: extensive, free floating areas of local, annually formed ice, occasionally containing multiyear (Arctic) ice.

Pain: "an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage" (IASP, 1979).

Pedal reflex: a somato-sensory muscular withdrawal reflex when a noxious stimulus is applied to the foot, toe, web or flipper.

Pinniped: meaning fin- or web-footed; a group of marine mammals that includes fur seals, sea lions (family Otariidae), walrus (family Odobenidae) and true seals (family Phocidae).

Pithing: the process involving the mechanical destruction of the brain and upper spinal cord often by insertion of a rod via the hole made by the captive bolt in farmed animals.

Pup: a generic term often used in the scientific literature to describe a young pinniped, usually under the age of one year (as in Namibia's "Regulations relating to the exploitation of marine resources", see Appendix 4). Depending on the species, seal pups are frequently given descriptive names based on their pelage (e.g. white-coated harp seal pups, blueback hooded seal pups), or stage of development (suckling – sometimes also referred to as nursing – pups, weaned pups or weaners, ragged jackets – a moulting harp seal pup – moulted pups or moulters, beaters, etc.). After their first birthday, pups are typically referred to as 1+ animals, or sexually immature juveniles.

Pupillary dilatation: dilated pupil(s) in the eye(s); it can also be used as a reflex response to light when the iris constricts, indicative of a functional brain stem. Unilateral dilatation indicates one-sided brain damage. Gross bilateral dilatation usually indicates deep medullary paralysis or death.

Ragged Jackets: a weaned harp seal pup, approximately two to three weeks old, that is in the process of moulting its white fetal hair (white coat or lanugo) to reveal the darker beater pelt, which is growing underneath.

Range states: in this Opinion, all territories where seals are present and are (or could be) hunted, including EU Member States and Overseas Territories.

Seizure: convulsion that may occur with or without loss of consciousness or a pathological EEG.

Slagkrok: a form of club with a metal head used to strike seals with the intention of killing or stunning them.

Slaughter: in this opinion, slaughter means the process of bleeding to induce death, usually by severing major blood vessels in the neck or thorax supplying oxygenated blood to the brain.

Sticking: the act of severing major blood vessels near to the heart in the thorax (chest) to cause bleeding so that a stunned animal is killed. It can also be done in the neck through a stab wound (neck stick).

Struck and lost: seals that are hit or shot by sealers but are not retrieved. If shot in water, such animals may be conscious, unconscious or dead, and they may sink. If shot or struck on land or ice, such animals may fall into the water. Seals that are struck and lost include animals that are dead, or animals that may eventually die from fatal injuries. Animals may subsequently recover from minor injuries. Animals that are struck and lost are usually not included in reported landings but are estimated in some hunts (e.g. Canada's commercial hunt).

Stun or stunning: stunning before slaughter is a process applied to individual animals to induce immediate unconsciousness and insensibility, so that slaughter including bleeding can be performed without causing animals avoidable fear, anxiety, pain, suffering and distress.

Suffering: can be described as a negative emotional state which derives from adverse physical, physiological and psychological circumstances, depending on the cognitive capacity of the species and of the individual being, and its life's experience. It could include mental states such as fear, not being able to move freely and anxiety, and other states such as prolonged hunger and thirst.

Unconsciousness: a mental state of unawareness (loss of consciousness) in which there may be temporary or permanent damage to normal brain function and the individual is unable to respond to normal sensory stimuli, including pain.

Unnecessary suffering: see avoidable suffering.

Weaned pup: a young seal that is no longer physiologically dependent its mother's milk. The exact age varies greatly according to the species.

West Ice: Barents Sea/White Sea.

Whelp: to give birth. Synonym: to pup.

Whitecoat: a neonatal harp seal before it begins to shed its white lanugo (fetal hair) at the age of about 12 days. The term may also be applied to other ice-breeding seals that give birth to pups retaining white lanugo (e.g. grey seals, Caspian seals, etc.).

1+ animal: term used to refer to seals one year of age and older. Includes sexually immature and mature seals.

ABBREVIATIONS

AHAW: Animal Health and Animal Welfare.

CI: Confidence Interval.

CITES: Convention on the International Trade in Endangered Species.

EU: European Union.

MMR: Marine Mammal Regulations.

MS: EU Member States.

NMFS: National Marine Fisheries Service.

OIE: Office International des Epizooties (World Organisation for Animal Health).

SCAHAW: (former) Scientific Committee on Animal Health and Animal Welfare (DG for Health and Consumer Protection – EC).

TAC: Total Allowable Catch.

WG: Working Group.

LIST OF TABLES AND FIGURES

ANNEXES

ANNEX A

Tables a-e. Risk characterisation of adverse welfare effects of seals during killing and skinning: intensity, duration, likelihood, data source and data certainty evaluated for each hazard. The number in bracket after each qualitative score denotes the number of experts scoring for that score or range of scores. No numbers are given when the experts agreed on the scoring.

Table a – Netting

Hazard outcome number (see Table 4 of the Scientific Opinion for a detailed description of hazards and possible outcomes)	**Intensity**	**Duration**	**Magnitude**	**Likelihood that the seal is exposed to the hazard given the seal is hunted by netting. For each of four combinations of weather and habitat conditions[1]**				**Data source**
	of the adverse welfare effect			**GW/GH**	**GW/BH**	**BW/GH**	**BW/BH**	
1	**Mo (1) Se (6)**	**2-4**	**Mo-Ma**	**VL**	**VL**	**VL**	**VL**	**2-3**
2	**Se**	**2-4**	**Mo-Ma**	**VU**	**VU**	**VU**	**VU**	**3**
3	**Ne (3) Mi (4)**	**1-4**	**Ne-Mo**	**U**	**U**	**U**	**U**	**3**
4	**Mi-Mo**	**4**	**Mo-Ma**	**VU**	**VU**	**VU**	**VU**	**3**
5	**Se**	**4**	**Ma**	**VU**	**VU**	**VU**	**VU**	**3**

[1] Weather and habitat conditions
GW/GH: Good weather and good habitat; GW/BH: Good weather and bad habitat; BW/GH: bad weather and good habitat; BW/BH: bad weather and bad habitat. Good weather refers e.g. to fine and ideal weather and bad weather refers e.g. to poor visibility, heavy swells and gusty winds.
Good habitat refers e.g. to dry land and solid ice and bad habitat refers e.g. to loose pack ice and open water.

Table b – Hakapik

Hazard outcome number (see Table 4 of the Scientific Opinion for a detailed description of hazards and possible outcomes)	**Intensity**	**Duration**	**Magnitude**	**Likelihood that the seal is exposed to the hazard given the seal is hunted using a hakapik. For each of four combinations of weather and habitat conditions**				**Data source**
	of the adverse welfare effect			**GW/GH**	**GW/BH**	**BW/GH**	**BW/BH**	
6	**Ne (1) Ne-Mi (6)**	**1**	**Ne-Mi**	**L-U (1) L (2) VL (4)**	**U (1) L (6)**	**L-U (1) L (3) VL (3)**	**U (4) L (3)**	**2**
7	**Mo-Se**	**1-4**	**Mi-Ma**	**L-U (1) U (2) VU (4)**	**U (6) L (1)**	**L-U (1) U (3) VU (3)**	**L (4) U (3)**	**2**
8	**Ne (1) Ne-Mi (6)**	**1**	**Ne-Mi**	**VL**	**L-VL**	**VL**	**L**	**2**
9	**Mo-Se**	**1-4**	**Mi-Ma**	**VU**	**U-VU**	**VU**	**U**	**2**

Table c – Club

Hazard outcome number (see Table 4 of the Scientific Opinion for a detailed description of hazards and possible outcomes)	**Intensity**	**Duration**	**Magnitude**	**Likelihood that the seal is exposed to the hazard given the seal is hunted using a club[2]. For each of four combinations of weather and habitat conditions**				**Data source**
	of the adverse welfare effect			**GW/GH**	**GW/BH**	**BW/GH**	**BW/BH**	
6	**Ne-Se**	**1-2**	**Ne-Mo**	**L-U (1) L (2) VL (4)**	**U (1) L (6)**	**U-L) L (3) VL (3)**	**U (3) L (4)**	**3**
7	**Mo-Se**	**1-4**	**Mi-Ma**	**L-U (1) U (2) VU (4)**	**U (6) L (1)**	**L-U (1) U (3) VU (3)**	**L (3) U (4)**	**3**
8	**Ne-Se**	**1-2**	**Ne-Mo**	**VL**	**L-VL**	**VL**	**L (5) VL (2)**	**3**
9	**Mo-Se**	**1-4**	**Mi-Ma**	**VU**	**U-VU**	**VU**	**U (5) VU (2)**	**3**

[2] Club used primarily in Canada and Namibia.

Table d – Firearms

Hazard outcome number (see Table 4 of the Scientific Opinion for a detailed description of hazards and possible outcomes)	**Intensity**	**Duration**	**Magnitude**	**Likelihood that the seal is exposed to the hazard given the seal is hunted using firearms[3] For each of four combinations of weather and habitat conditions**				**Data source**
	of the adverse welfare effect			**GW/GH**	**GW/BH**	**BW/GH**	**BW/BH**	
10	**Ne**	**1**	**Ne**	**L (2) VL (5)**	**L (2) VL (5)**	**L**	**L**	**2**
11	**Mo-Se**	**2-4**	**Mo-Ma**	**U(2) VU (5)**	**U (2) VU (5)**	**U**	**U**	**2**
12	**Ne**	**1**	**Ne**	**L**	**L**	**L**	**L(3) U-L(4)**	**2**
13	**Mo-Se**	**2-4**	**Mo-Ma**	**U**	**U**	**U**	**U(3) U-L(4)**	**2**

[3] Refers to all seal species.

Table e. Common for hakapik, club and firearms

Hazard outcome number (see Table 4 of the Scientific Opinion for a detailed description of hazards and possible outcomes)	**Intensity**	**Duration**	**Magnitude**	**Likelihood that the seal is exposed to the hazard given the seal is hunted using physical methods or firearm For each of four combinations of weather and habitat conditions**				**Data source**
	of the adverse welfare effect			**GW/GH**	**GW/BH**	**BW/GH**	**BW/BH**	
14	**Ne**	**1-4**	**Ne-Mo**	**U-VU**	**U-VU**	**U-VU**	**VU**	**2**
15	**Ne-Se**	**1-4**	**Ne-Ma**	**L-VL**	**L-VL**	**L-VL**	**L-VL**	**2**
16	**Ne**	**2**	**Mi**	**U-VU**	**U-VU**	**U-VU**	**U-VU**	**2**
17	**Ne-Se**	**1-4**	**Ne-Ma**	**L-VL**	**L-VL**	**L-VL**	**L-VL**	**2**
18	**Se**	**2-3**	**Mo-Ma**	**VU (6) U (1)**	**VU (6) U (1)**	**VU (6) U (1)**	**VU (6) U (1)**	**2-3**
19	**Ne**	**1**	**Ne**	**VL (6) L (1)**	**L**	**VL (6) L (1)**	**L**	**2-3**
20	**Mo-Se(2) Se(5)**	**2-4**	**Mo-Ma**	**VU (6) U (1)**	**U**	**VU (6) U(1)**	**U**	**2-3**
21	**Ne**	**1**	**Ne**	**VL**	**VL**	**VL**	**VL**	**2-3**
22	**Se**	**2-3**	**Mo-Ma**	**VU**	**VU**	**VU**	**VU**	**2-3**
23	**Ne**	**1**	**Ne**	**VU**	**VU-U**	**VU**	**VU-U**	**3**
24	**Mi**	**4**	**Mo**	**VU**	**VU-U**	**VU**	**VU-U**	**3**
25	**Mo-Se**	**4**	**Ma**	**VU**	**VU-U**	**VU**	**VU-U**	**3**

Figures a – **e.** Magnitude of adverse welfare effects and likelihood that the seal is exposed to the hazard given a specific hunting method (see Table 4 of the Scientific Opinion for hazard details). For netting, the likelihood of seals exposed to the specific hazard outcome is the same for the four weather and habitat combinations. For each hazard outcome, lower indicates the lowest likelihood combined with smallest magnitude and upper indicates the largest likelihood combined with largest magnitude.

Figure a. Netting

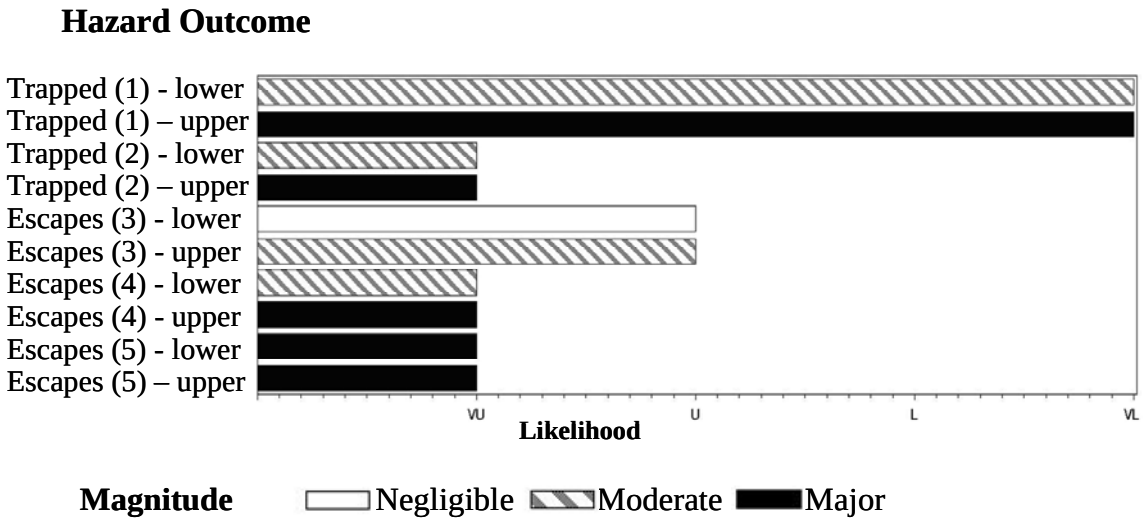


Figure b. Hakapik

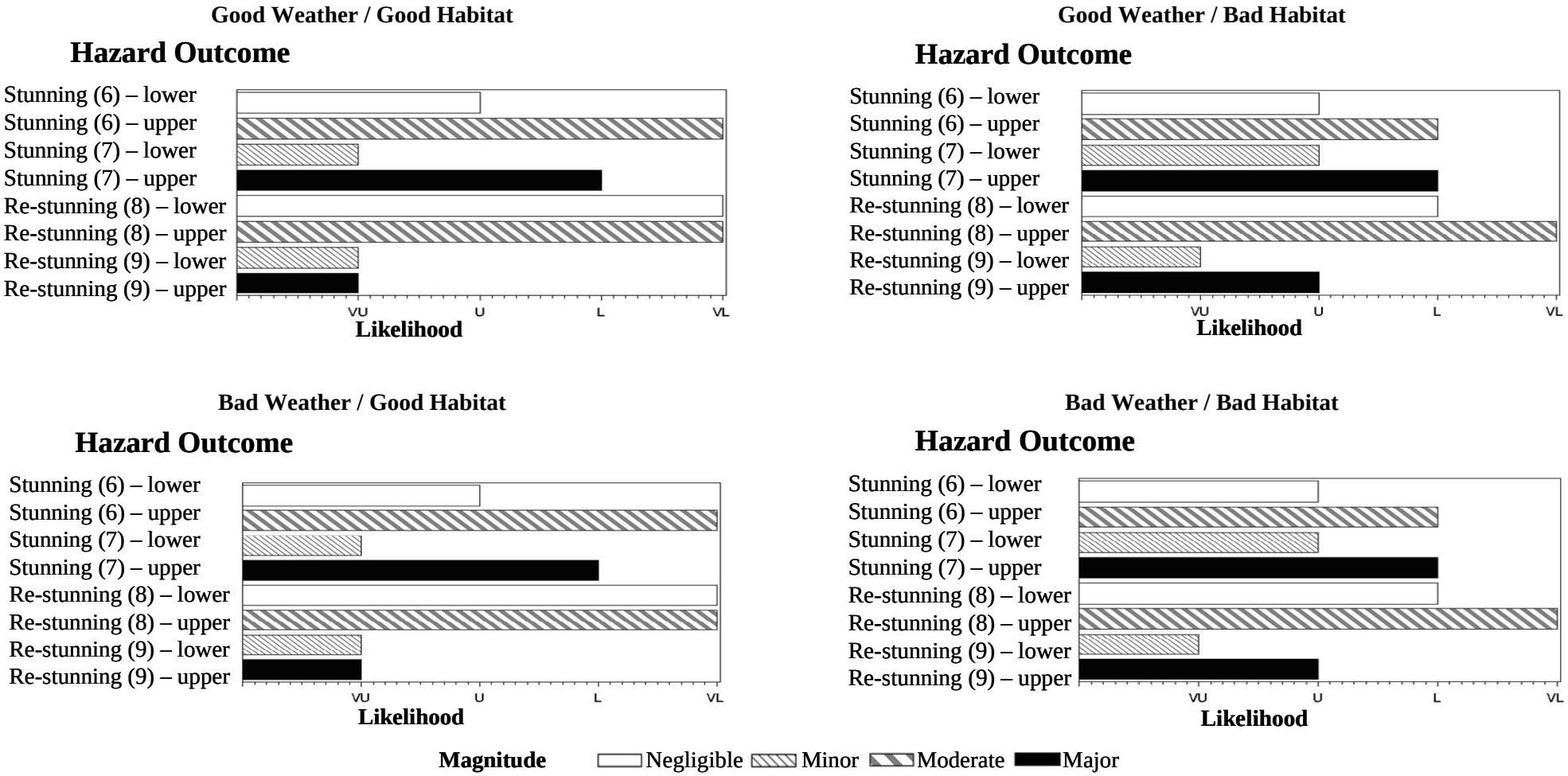


Figure c. Club

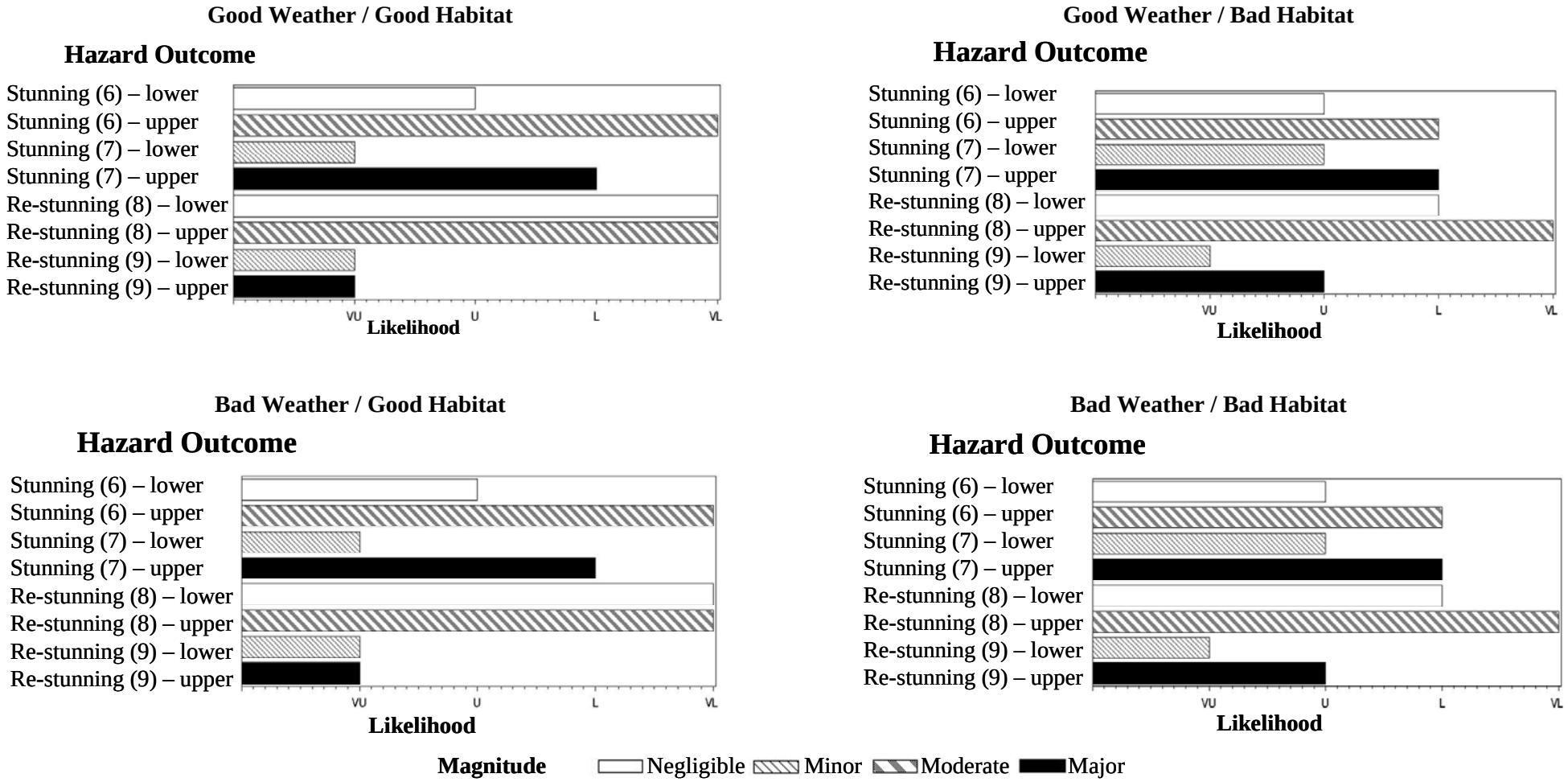


Figure d. Firearms

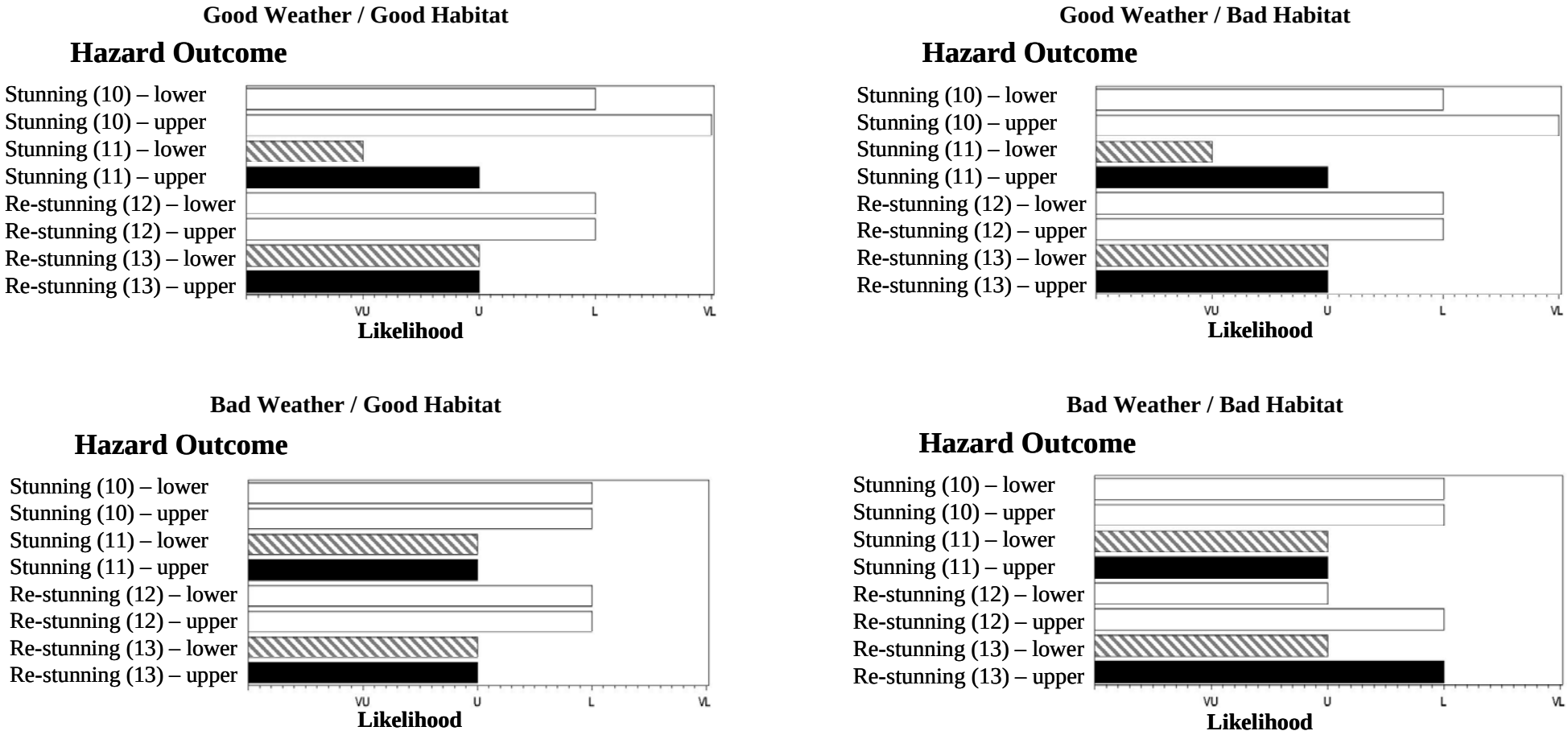
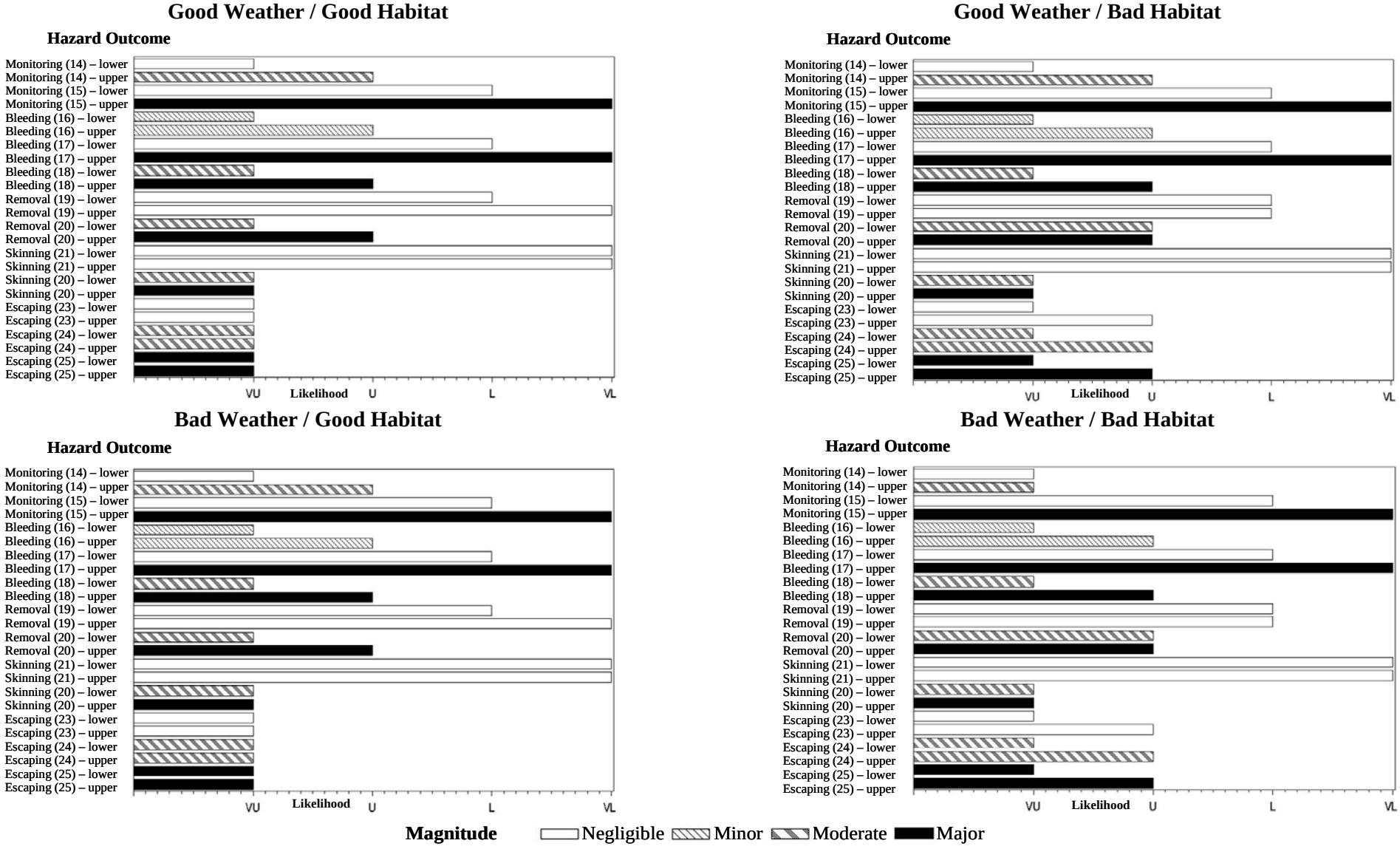


Figure e. Common for Hakapik, club and firearms



ANNEXES

ANNEX B - RISK ASSESSMENT FOR ADVERSE WELFARE EFFECT OF SEALS FOR DIFFERENT SCENARIOS

Tables 1-11. Risk characterisation of adverse welfare effects of seals during killing and skinning in the considered scenarios.

Table 1. Scenario 1: The animal is hit/shot and is dead, or irreversibly unconscious or unconscious, effective monitored, effective bleed-out, possibly moved in some way, and skinned.

Hazard		Magnitude of hazard	Likelihood				Data uncertainty	Data source
No	Description		GW/GH	GW/BH	BW/GH	BW/BH		
Scenario 1								
6 or	**Effective hit - hakapik**	Ne-Mi	L-U (1) L (2) VL (4)	U (1) L (6)	L-U (1) L (3) VL (3)	U (4) L (3)	M	2
6 or	**Effective hit - club**	Ne-Mo	L-U (1) L (2) VL (4)	U (1) L (6)	U-L) L (3) VL (3)	U (3) L (4)	H	3
10	**Effective shot - firearm**	Ne	L (2) VL (5)	L (2) VL (5)	L	L	M	2
and								
14	**Effective monitoring**	Ne-Mo	U-VU	U-VU	U-VU	VU	M	2
16	**Effective bleeding**	Mi	U-VU	U-VU	U-VU	U-VU	M	2
19	**Removal of an unconscious or dead seal**	Ne	VL (6) L (1)	L	VL (6) L (1)	L	H	2-3
21	**Skinning an unconscious or dead seal**	Ne	VL	VL	VL	VL	L-M	2-3

Table 2. Scenario 2: The animal is hit/shot and is rendered unconscious, ineffectively monitored, regains consciousness, is then is effectively re-stunned, bled-out and killed, possibly moved in some way and skinned.

Hazard		Magnitude of hazard	Likelihood				Data uncertainty	Data source
No	Description		GW/GH	GW/BH	BW/GH	BW/BH		
Scenario 2								
7 or	**Ineffective hit - hakapik**	Mi-Ma	L-U (1) U (2) VU (4)	U (6) L (1)	L-U (1) U (3) VU (3)	L (4) U (3)	M	2
7 or	**Ineffective hit - club**	Mi-Ma	L-U (1) U (2) VU (4)	U (6) L (1)	L-U (1) U (3) VU (3)	L (3) U (4)	H	3
11 or	**Ineffective shot - firearm**	Mo-Ma	U(2) VU (5)	U (2) VU (5)	U	U	M	2
and								
15	**Ineffective monitoring**	Ne-Ma	L-VL	L-VL	L-VL	L-VL	M	2
and								
8 or	**Effective re-hit - hakapik**	Ne-Mi	VL	L-VL	VL	L	M	2
8 or	**Effective re-hit - club**	Ne-Mo	VL	L-VL	VL	L (5) VL (2)	H	3
12 or	**Effective re-shot - firearm**	Ne	L	L	L	L(3) U-L(4)	M	2
and								
16	**Effective bleeding-out**	Mi	U-VU	U-VU	U-VU	U-VU	M	2
19	**Removal of an unconscious or dead seal**	Ne	VL (6) L (1)	L	VL (6) L (1)	L	H	2-3
21	**Skinning an unconscious or dead seal**	Ne	VL	VL	VL	VL	L-M	2-3

Table 3. Scenario 3: The animal is hit/shot and is rendered unconscious, ineffectively monitored, regains consciousness during bleed-out but is then is effectively re-stunned (dead), possibly moved in some way and then skinned.

Hazard		Magnitude of hazard	Likelihood				Data uncertainty	Data source
No	Description		GW/GH	GW/BH	BW/GH	BW/BH		
Scenario 3								
7 or	**Ineffective hit - hakapik**	Mi-Ma	L-U (1) U (2) VU (4)	U (6) L (1)	L-U (1) U (3) VU (3)	L (4) U (3)	M	2
7 or	**Ineffective hit - club**	Mi-Ma	L-U (1) U (2) VU (4)	U (6) L (1)	L-U (1) U (3) VU (3)	L (3) U (4)	H	3
11	**Ineffective shot - firearm**	Mo-Ma	U(2) VU (5)	U (2) VU (5)	U	U	M	2
and								
15	**Ineffective monitoring**	Ne-Ma	L-VL	L-VL	L-VL	L-VL	M	2
18	**Bleeding-out conscious seal**	Mo-Ma	VU (6) U (1)	VU (6) U (1)	VU (6) U (1)	VU (6) U (1)	H	2-3
and								
8 or	**Effective re-hit - hakapik**	Ne-Mi	VL	L-VL	VL	L	M	2
8 or	**Effective re-hit - club**	Ne-Mo	VL	L-VL	VL	L (5) VL (2)	H	3
12 or	**Effective re-shot - firearm**	Ne	L	L	L	L(3) U-L(4)	M	2
and								
19	**Removal of an unconscious or dead seal**	Ne	VL (6) L (1)	L	VL (6) L (1)	L	H	2-3
21	**Skinning an unconscious or dead seal**	Ne	VL	VL	VL	VL	L-M	2-3

Table 4. Scenario 4: The animal is hit/shot and is rendered unconscious, ineffectively monitored, ineffectively bled-out, but regains consciousness while being moved, is then effectively re-stunned (dead), and skinned.

Hazard		Magnitude of hazard	Likelihood				Data uncertainty	Data source
No	Description		GW/GH	GW/BH	BW/GH	BW/BH		
Scenario 4								
7 or	**Ineffective hit - hakapik**	Mi-Ma	L-U (1) U (2) VU (4)	U (6) L (1)	L-U (1) U (3) VU (3)	L (4) U (3)	M	2
7 or	**Ineffective hit - club**	Mi-Ma	L-U (1) U (2) VU (4)	U (6) L (1)	L-U (1) U (3) VU (3)	L (3) U (4)	H	3
11	**Ineffective shot - firearm**	Mo-Ma	U(2) VU (5)	U (2) VU (5)	U	U	M	2
and								
15	**Ineffective monitoring**	Ne-Ma	L-VL	L-VL	L-VL	L-VL	M	2
17	**Ineffective bleeding-out**	Ne-Ma	L-VL	L-VL	L-VL	L-VL	M	2
20	**Removal of an unconscious seal**	Mo-Ma	VU (6) U (1)	U	VU (6) U(1)	U	H	2-3
and								
8 or	**Effective re-hit - hakapik**	Ne-Mi	VL	L-VL	VL	L	M	2
8 or	**Effective re-hit - club**	Ne-Mo	VL	L-VL	VL	L (5) VL (2)	H	3
12 or	**Effective re-shot - firearm**	Ne	L	L	L	L(3) U-L(4)	M	2
and								
21	**Skinning an unconscious or dead seal**	Ne	VL	VL	VL	VL	L-M	2-3

Table 5. Scenario 5: The animal is hit/shot and is rendered unconscious, ineffectively monitored, ineffectively bled-out,

possibly moved in some way but regains consciousness during being skinned and is effectively re-stunned.

Hazard		Magnitude of hazard	Likelihood				Data uncertainty	Data source
No	Description		GW/GH	GW/BH	BW/GH	BW/BH		
Scenario 5								
7 or	**Ineffective hit - hakapik**	Mi-Ma	L-U (1) U (2) VU (4)	U (6) L (1)	L-U (1) U (3) VU (3)	L (4) U (3)	M	2
7 or	**Ineffective hit - club**	Mi-Ma	L-U (1) U (2) VU (4)	U (6) L (1)	L-U (1) U (3) VU (3)	L (3) U (4)	H	3
11 and	**Ineffective shot - firearm**	Mo-Ma	U(2) VU (5)	U (2) VU (5)	U	U	M	2
15	**Ineffective monitoring**	Ne-Ma	L-VL	L-VL	L-VL	L-VL	M	2
17	**Ineffective bleeding-out**	Ne-Ma	L-VL	L-VL	L-VL	L-VL	M	2
20	**Removal of a conscious seal**	Mo-Ma	VU (6) U (1)	U	VU (6) U(1)	U	H	2-3
22	**Skinning a conscious seal**	Mo-Ma	VU	VU	VU	VU	L-M	2-3
and								
8 or	**Effective re-hit - hakapik**	Ne-Mi	VL	L-VL	VL	L	M	2
8 or	**Effective re-hit - club**	Ne-Mo	VL	L-VL	VL	L (5) VL (2)	H	3
12 or	**Effective re-shot - firearm**	Ne	L	L	L	L(3) U-L(4)	M	2
and								
21	**Skinning an unconscious or dead seal**	Ne	VL	VL	VL	VL	L-M	2-3

Table 6. Scenario 6: The animal is hit/shot and is not rendered unconscious, ineffectively monitored, ineffectively bled-out, possibly moved, and then skinned while conscious.

Hazard		Magnitude of hazard	Likelihood				Data uncertainty	Data source
No	Description		GW/GH	GW/BH	BW/GH	BW/BH		
Scenario 6								
7 or	**Ineffective hit - hakapik**	Mi-Ma	L-U (1) U (2) VU (4)	U (6) L (1)	L-U (1) U (3) VU (3)	L (4) U (3)	M	2
7 or	**Ineffective hit - club**	Mi-Ma	L-U (1) U (2) VU (4)	U (6) L (1)	L-U (1) U (3) VU (3)	L (3) U (4)	H	3
11 and	**Ineffective shot - firearm**	Mo-Ma	U(2) VU (5)	U (2) VU (5)	U	U	M	2
15	**Ineffective monitoring**	Ne-Ma	L-VL	L-VL	L-VL	L-VL	M	2
17	**Ineffective bleeding-out**	Ne-Ma	L-VL	L-VL	L-VL	L-VL	M	2
20	**Removal of a conscious seal**	Mo-Ma	VU (6) U (1)	U	VU (6) U(1)	U	H	2-3
22	**Skinning a conscious seal**	Mo-Ma	VU	VU	VU	VU	L-M	2-3

Table 7. Scenario 7: the animal is hit/shot and is not rendered unconscious, and escapes into the water where it may die or survive.

Hazard		Magnitude of hazard	Likelihood				Data uncertainty	Data source
No	Description		GW/GH	GW/BH	BW/GH	BW/BH		
Scenario 7								
7 or	**Ineffective hit - hakapik**	Mi-Ma	L-U (1) U (2) VU (4)	U (6) L (1)	L-U (1) U (3) VU (3)	L (4) U (3)	M	2
7 or	**Ineffective hit - club**	Mi-Ma	L-U (1) U (2) VU (4)	U (6) L (1)	L-U (1) U (3) VU (3)	L (3) U (4)	H	3
11 and	**Ineffective shot - firearm**	Mo-Ma	U(2) VU (5)	U (2) VU (5)	U	U	M	2
15	**Ineffective monitoring**	Ne-Ma	L-VL	L-VL	L-VL	L-VL	M	2
and								
24	**Escapes without significant injury**	Mo	VU	VU-U	VU	VU-U	H	3
25	**Escapes with significant injury**	Ma	VU	VU-U	VU	VU-U	H	3

Table 8. Scenario 8: the animal is hit/shot and is not rendered unconscious, and escapes onto the land where it is chased and killed.

Hazard		Magnitude of hazard	Likelihood				Data uncertainty	Data source
No	Description		GW/GH	GW/BH	BW/GH	BW/BH		
Scenario 8								
7 or	**Ineffective hit - hakapik**	Mi-Ma	L-U (1) U (2) VU (4)	U (6) L (1)	L-U (1) U (3) VU (3)	L (4) U (3)	M	2
7 or	**Ineffective hit - club**	Mi-Ma	L-U (1) U (2) VU (4)	U (6) L (1)	L-U (1) U (3) VU (3)	L (3) U (4)	H	3
11 and	**Ineffective shot - firearm**	Mo-Ma	U(2) VU (5)	U (2) VU (5)	U	U	M	2
15	**Ineffective monitoring**	Ne-Ma	L-VL	L-VL	L-VL	L-VL	M	2
and								
8 or	**Effective re-hit - hakapik**	Ne-Mi	VL	L-VL	VL	L	M	2
8 or	**Effective re-hit - club**	Ne-Mo	VL	L-VL	VL	L (5) VL (2)	H	3
12 or	**Effective re-shot - firearm**	Ne	L	L	L	L(3) U-L(4)	M	2
and								
14	**Effective monitoring**	Ne-Mo	U-VU	U-VU	U-VU	VU	M	2
19	**Removal of an unconscious or dead seal**	Ne	VL (6) L (1)	L	VL (6) L (1)	L	H	2-3
21	**Skinning an unconscious or dead seal**	Ne	VL	VL	VL	VL	L-M	2-3

Table 9. Scenario 9: the animal is trapped in a net that leads to suffocation with or without prior injury.

Hazard		Magnitude of hazard	Likelihood				Data uncertainty	Data source
No	Description		GW/GH	GW/BH	BW/GH	BW/BH		
Scenario 9								
1 or	**Trapped in net leading to suffocation without injuries**	Mo-Ma	VL	VL	VL	VL	L-M	2-3
2	**Trapped in net leading to suffocation with injuries**	Mo-Ma	VU	VU	VU	VU	H	3

Table 10. Scenario 10: the animal is trapped in a net and escapes with no injuries

Hazard		Magnitude of hazard	Likelihood				Data uncertainty	Data source
No	Description		GW/GH	GW/BH	BW/GH	BW/BH		
Scenario 10								
3	**Escapes with minor injury**	Ne-Mo	U	U	U	U	H	3

Table 11. Scenario 11: the animal is trapped in a net and escapes with minor or major injuries

Hazard		Magnitude of hazard	Likelihood				Data uncertainty	Data source
No	Description		GW/GH	GW/BH	BW/GH	BW/BH		
Scenario 11								
4 or	**Escapes with major injury that do affect function in a short term**	Mo-Ma	VU	VU	VU	VU	H	3
5	**Escapes with major injury that do affect function in a long term**	Ma	VU	VU	VU	VU	H	3

Figure 1. Scenario 1 – Hakapik

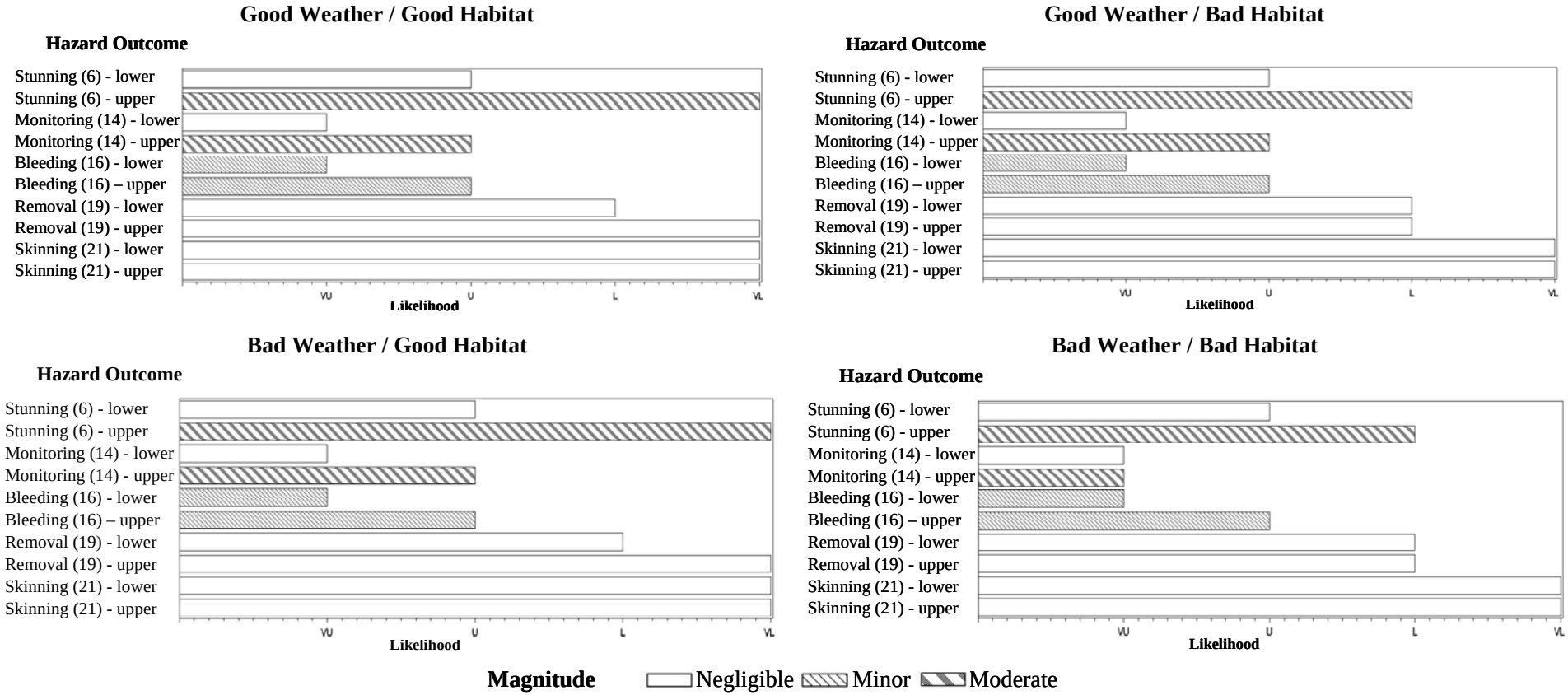


Figure 2. Scenario 2 – Hakapik

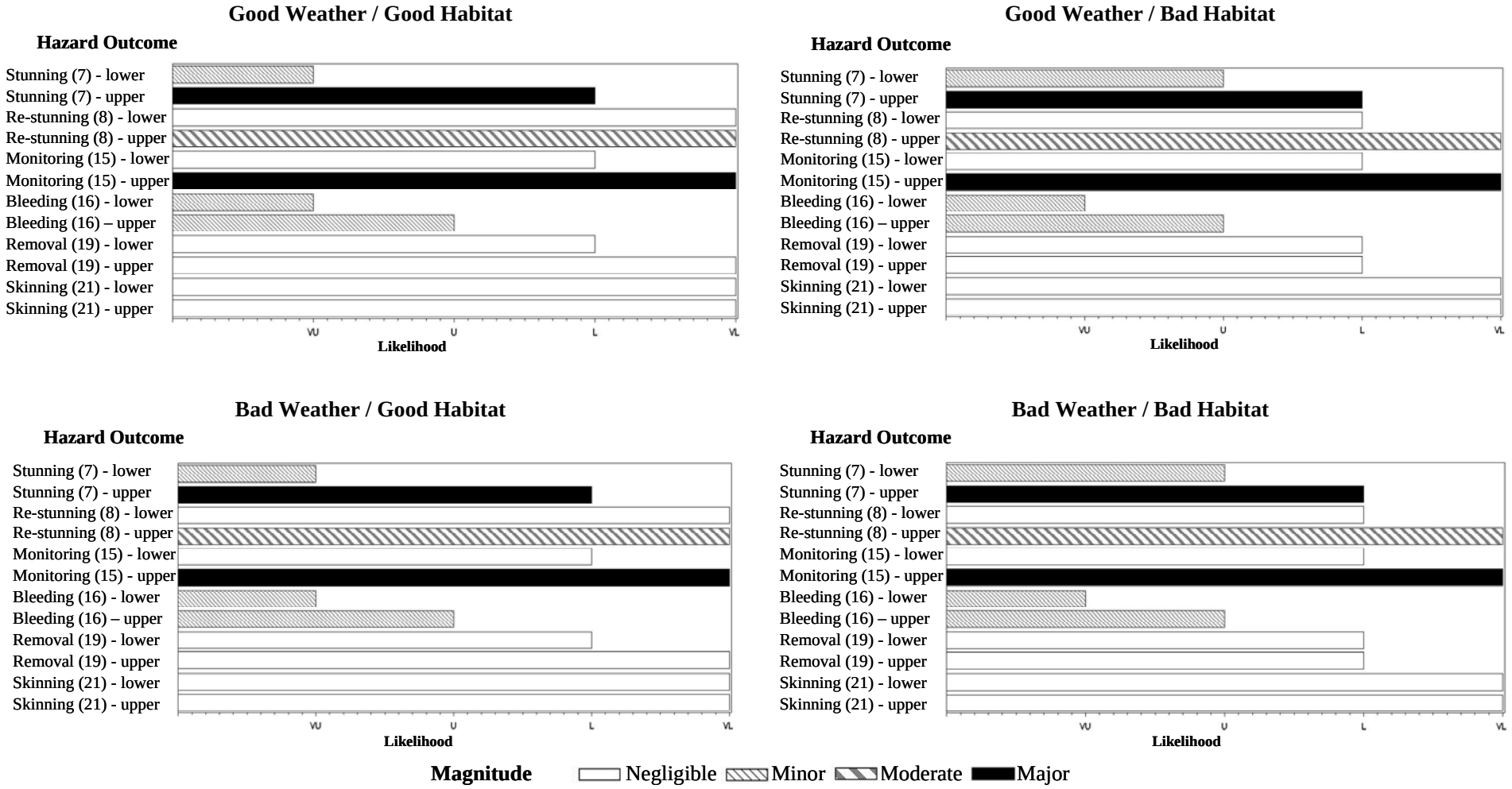


Figure 3. Scenario 3 – Hakapik

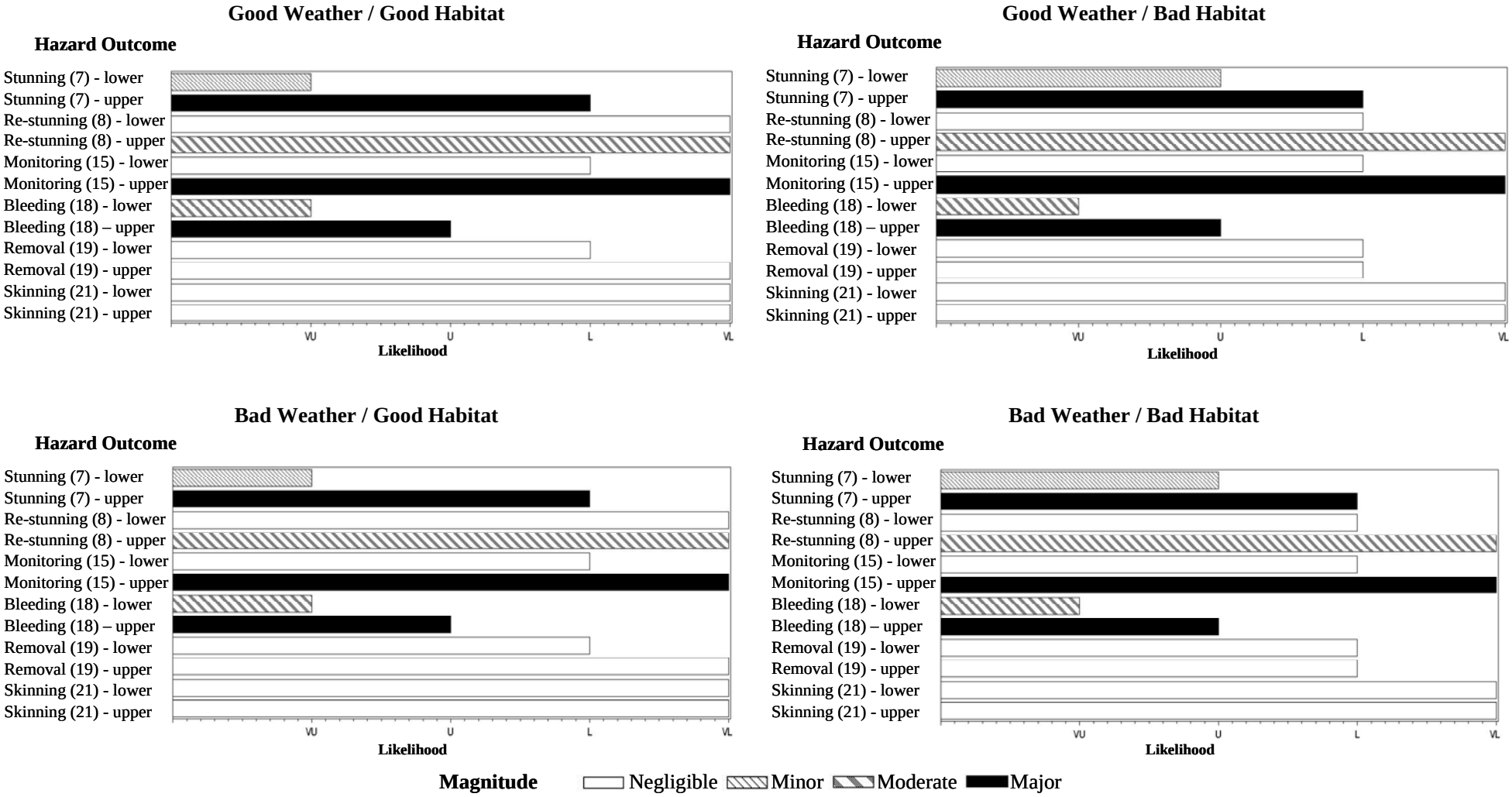


Figure 4. Scenario 4 – Hakapik

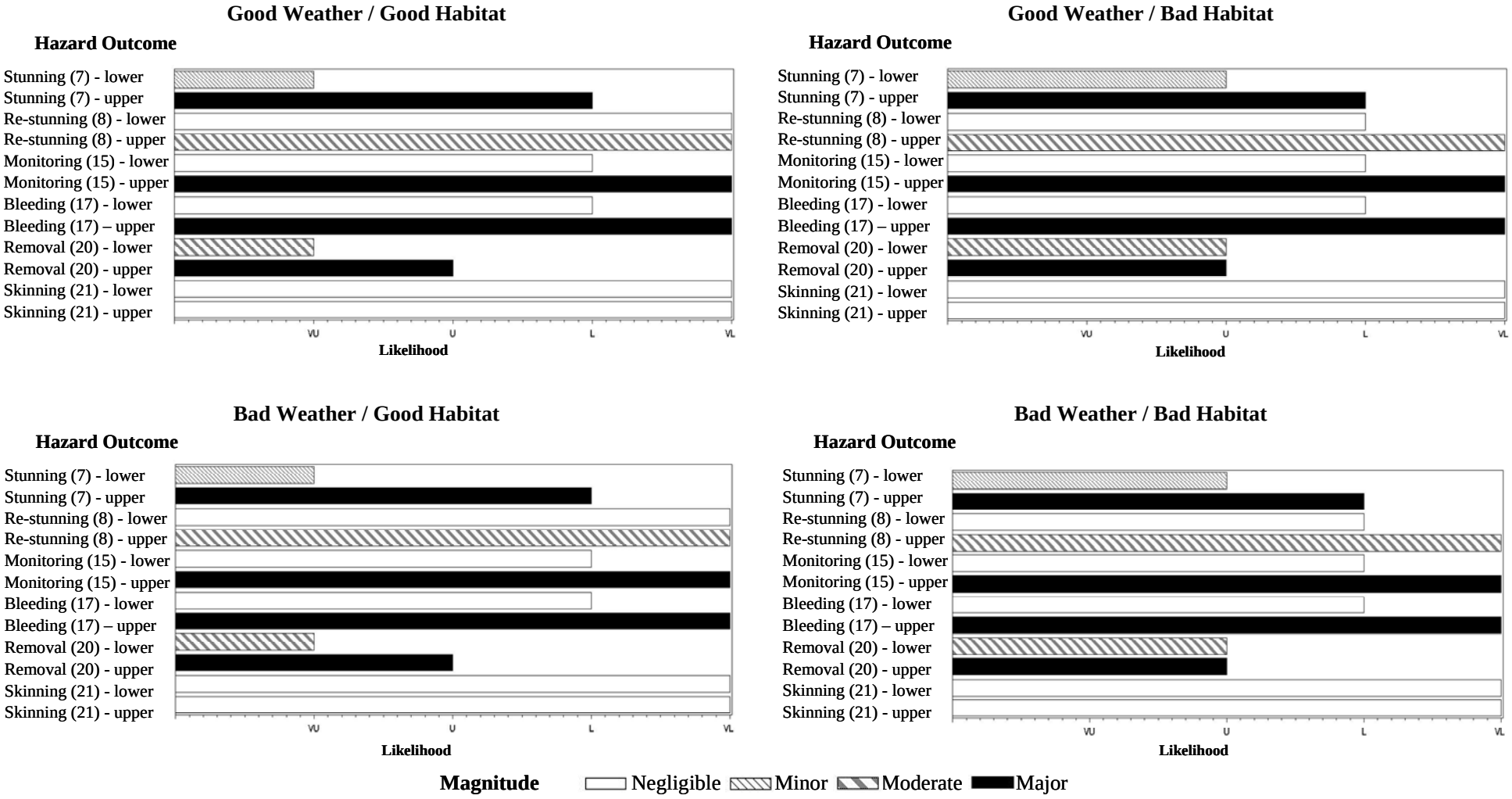


Figure 5. Scenario 5 – Hakapik

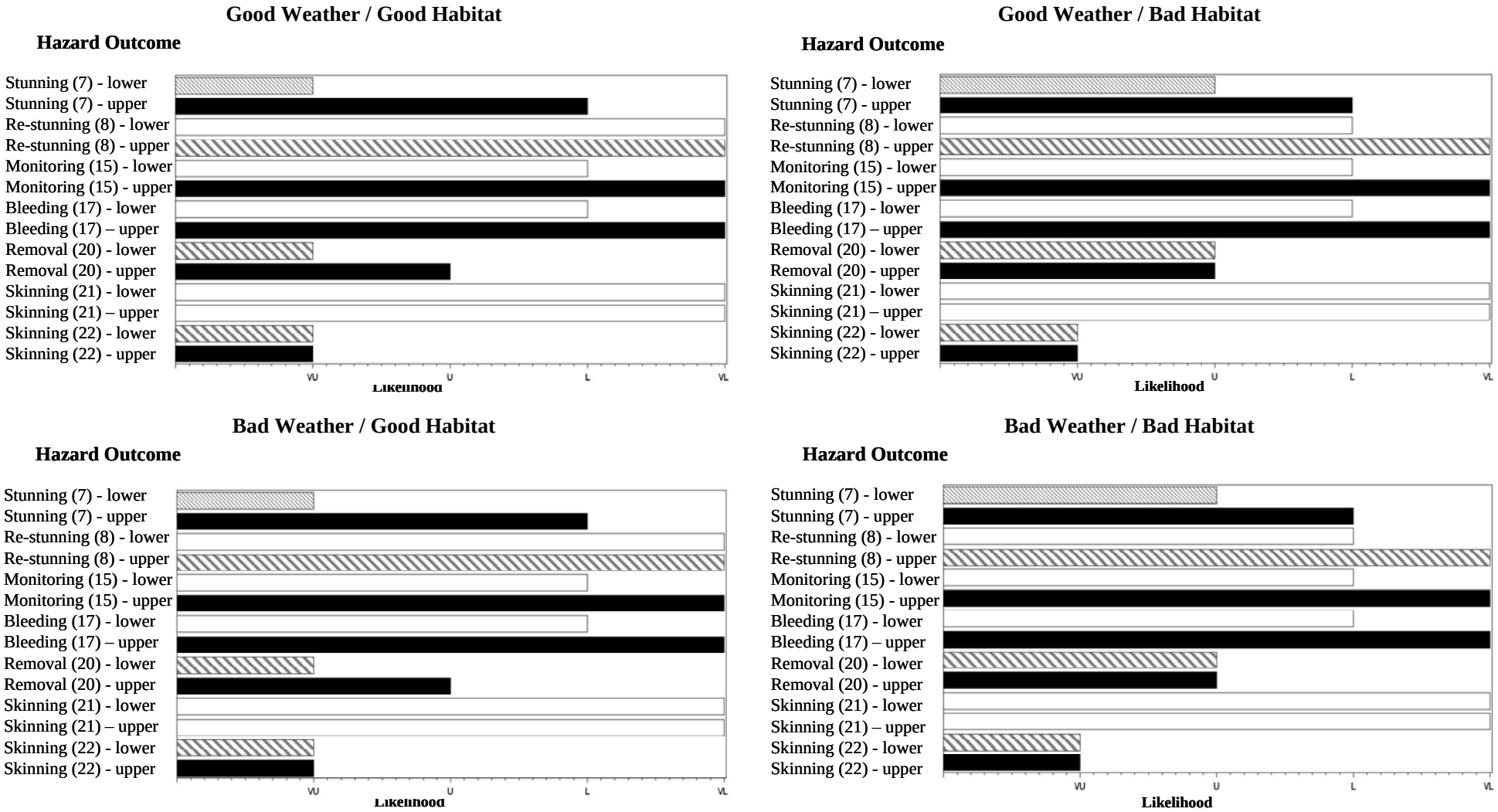


Figure 6. Scenario 6 – Hakapik

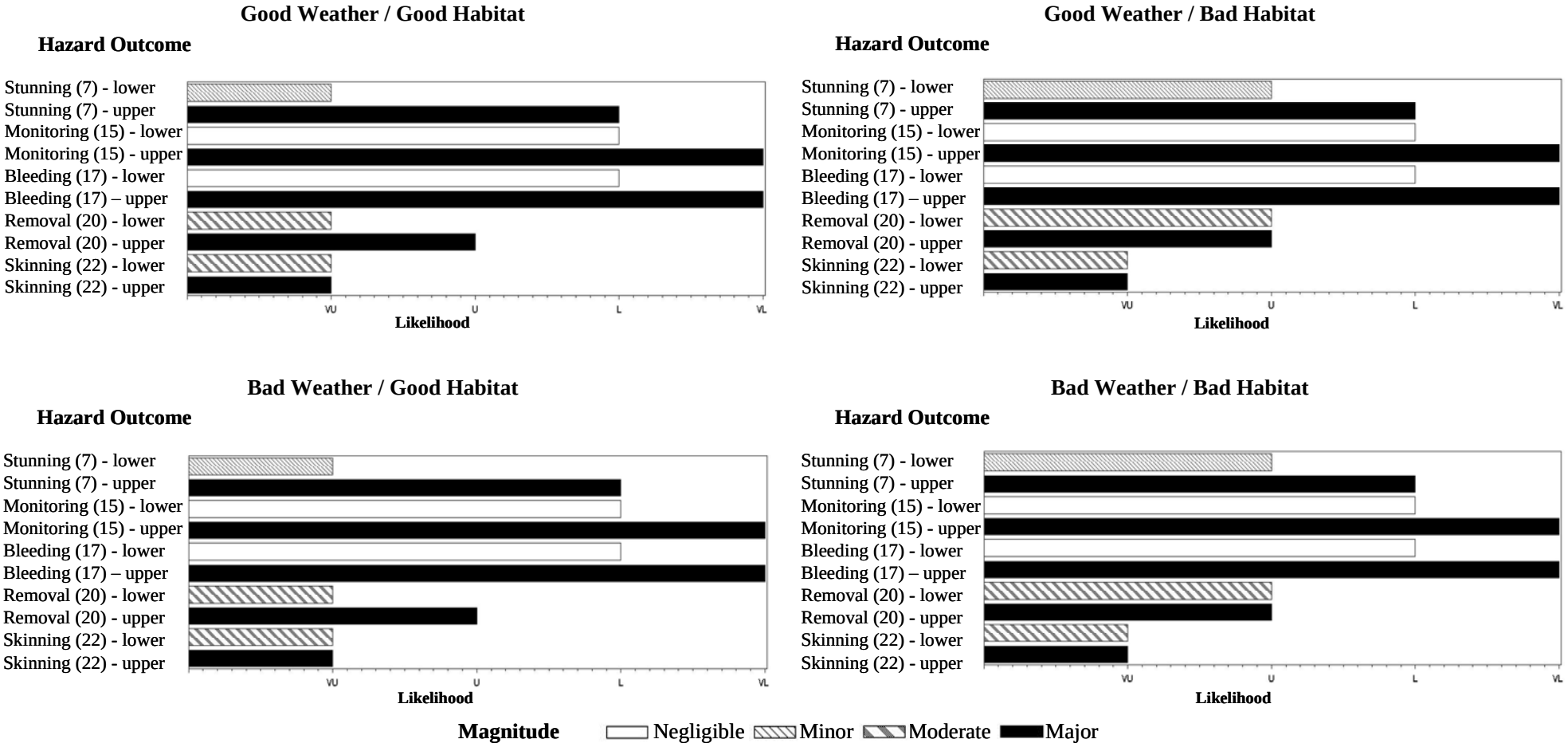


Figure 7. Scenario 7 – Hakapik

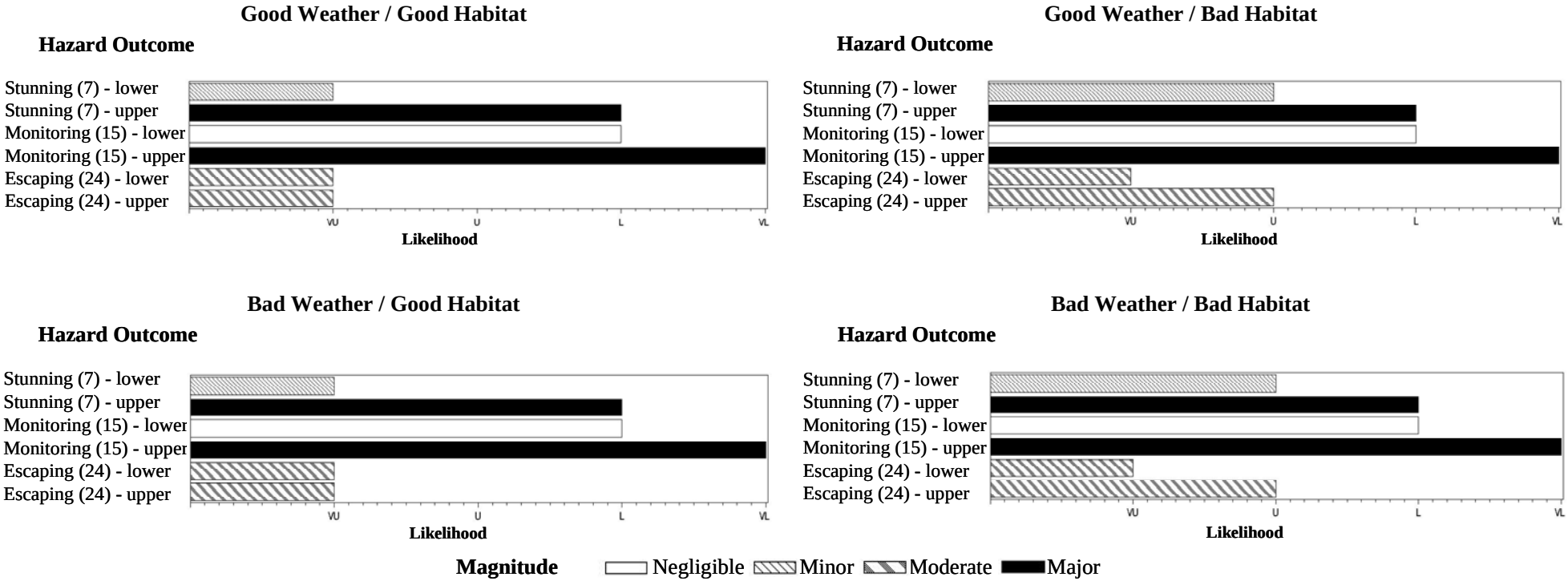


Figure 8. Scenario 8 – Hakapik

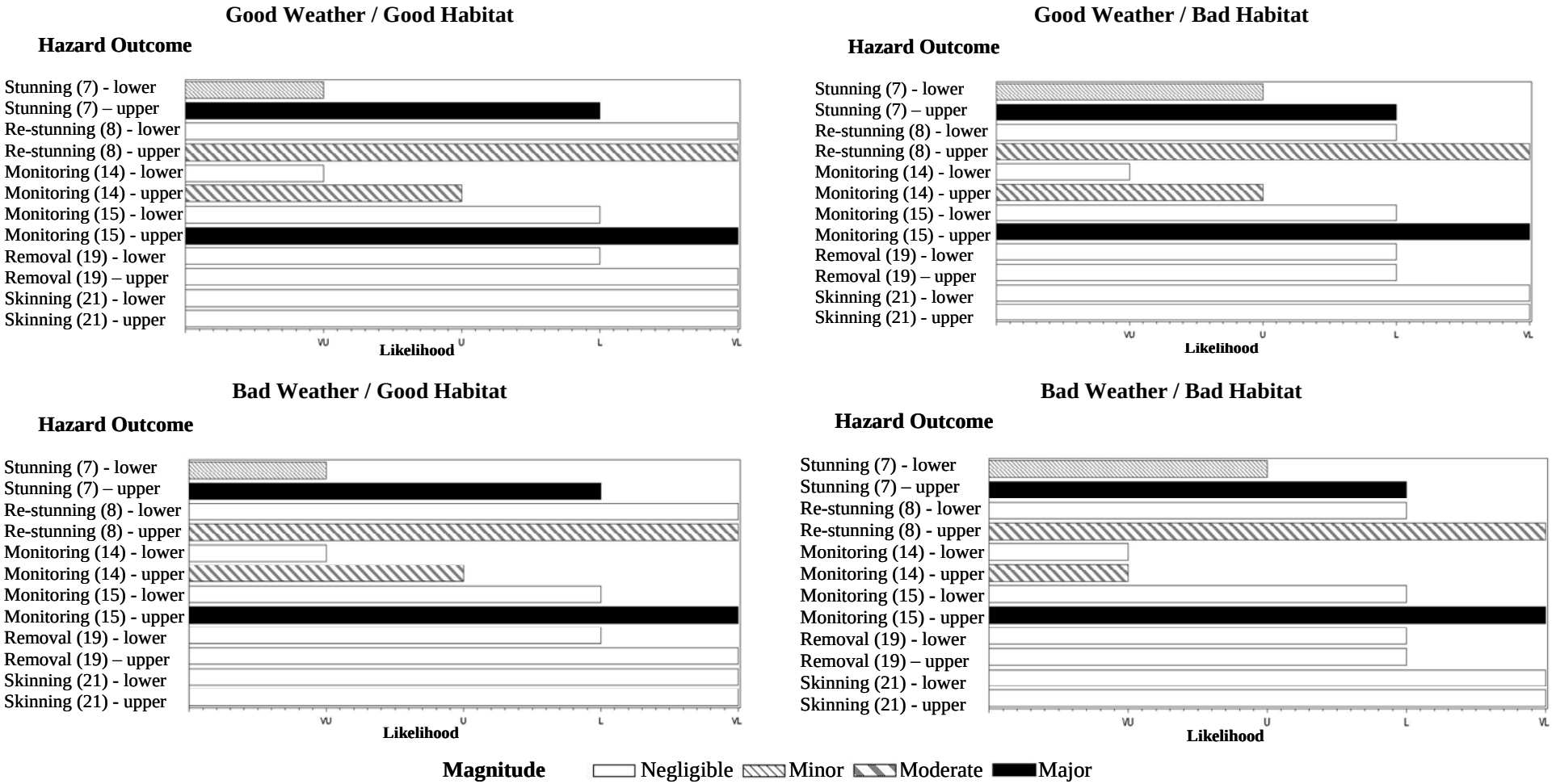


Figure 9. Scenario 1 – Club

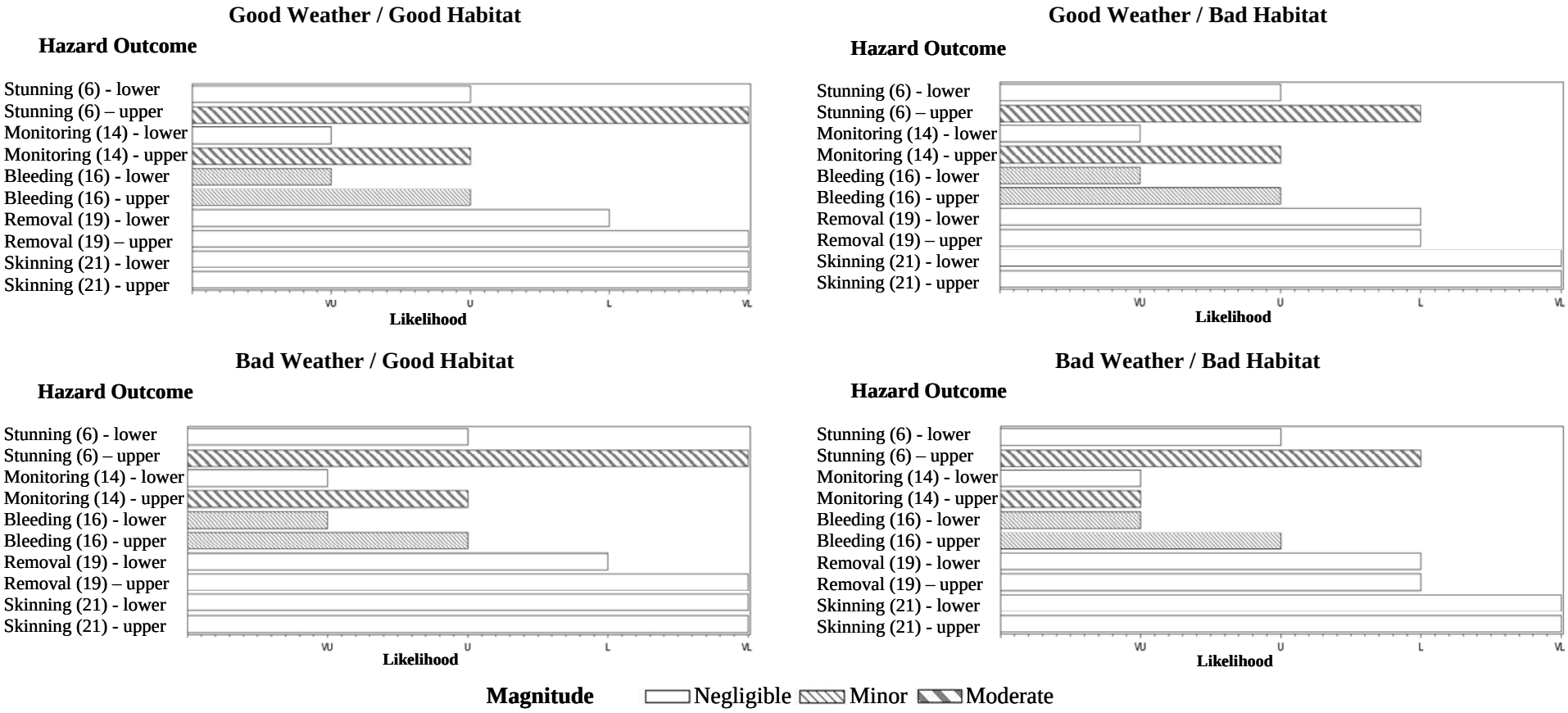


Figure 10. Scenario 2 – Club

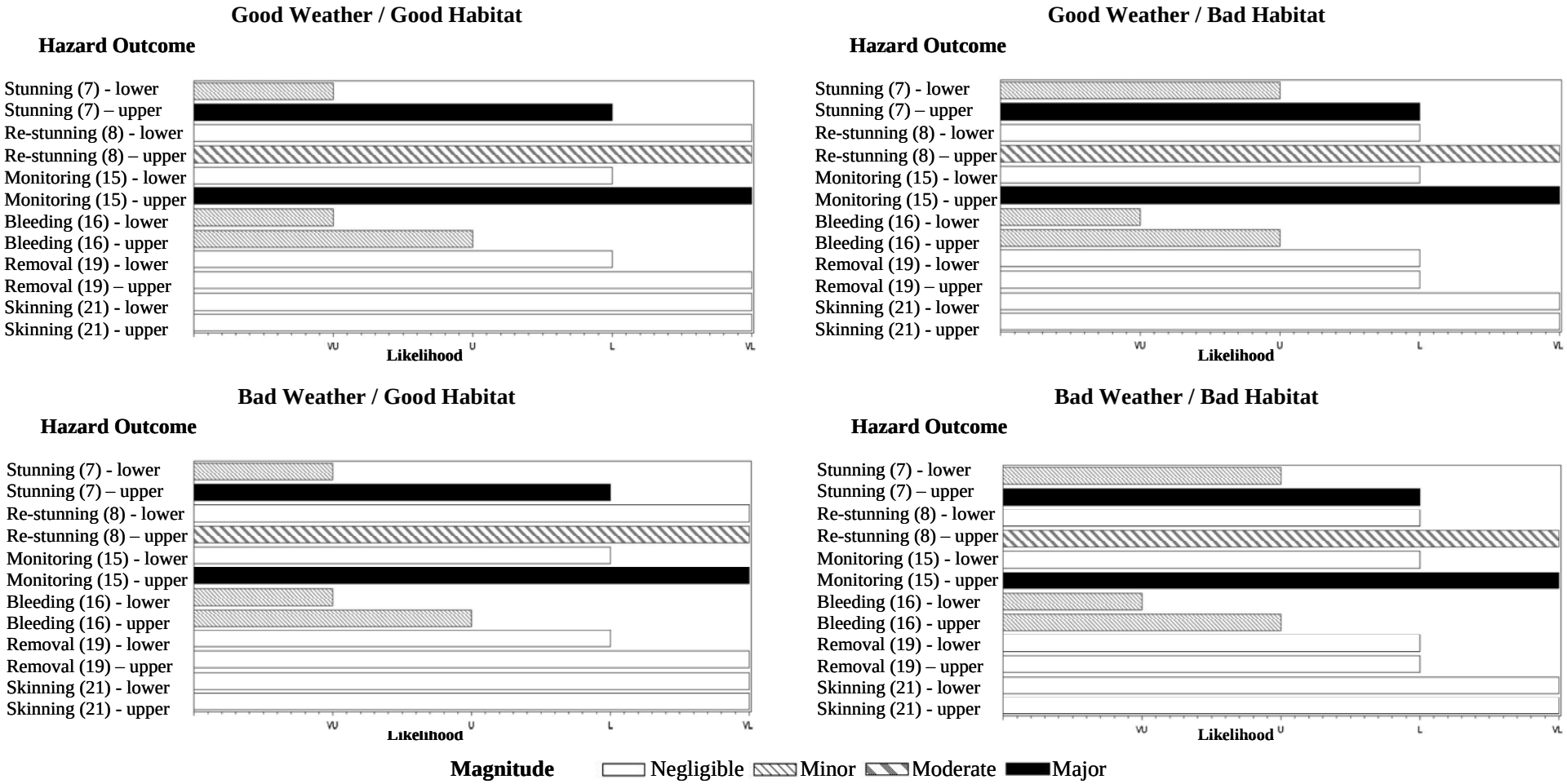


Figure 11. Scenario 3 – Club

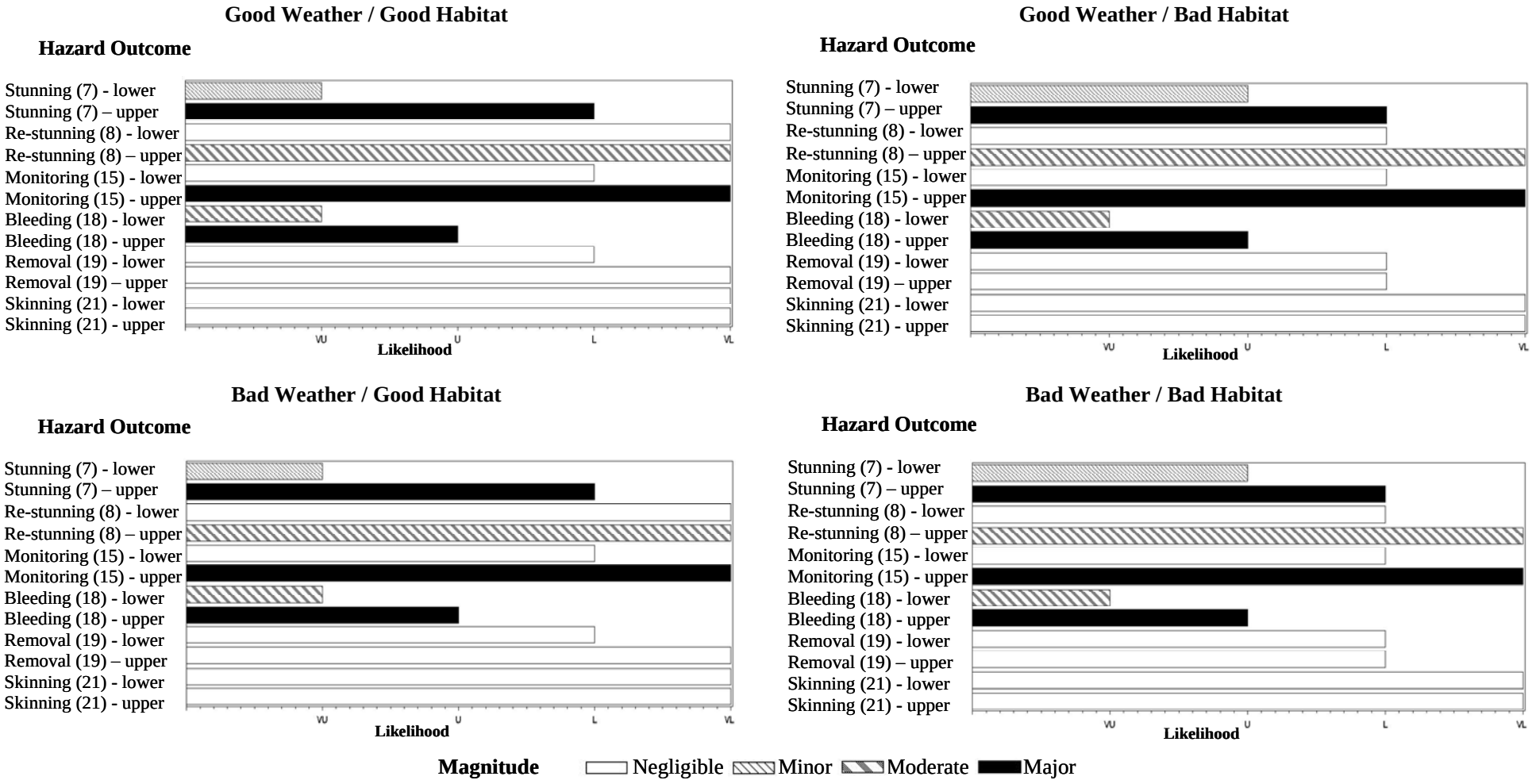


Figure 12. Scenario 4 – Club

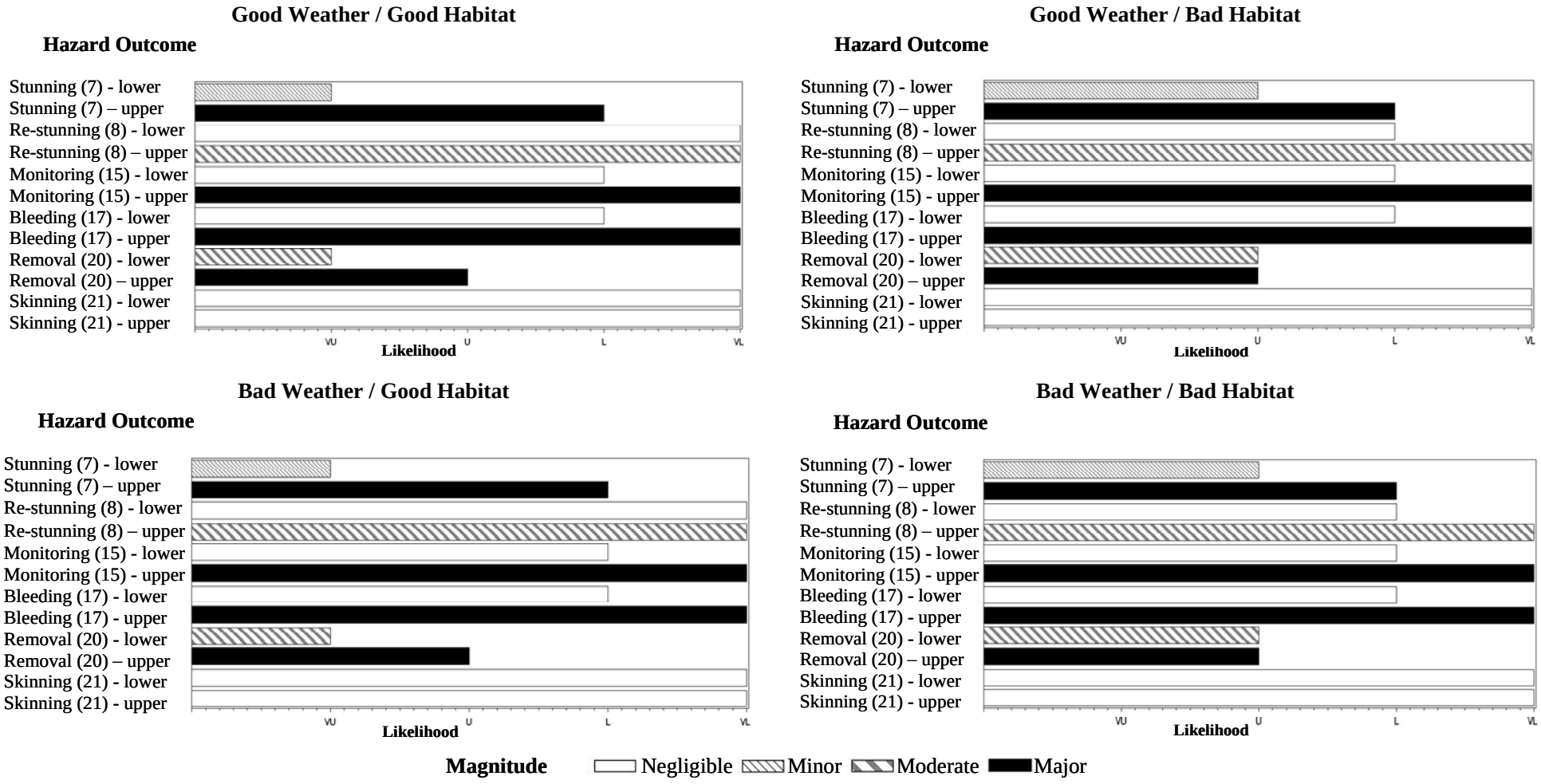


Figure 13. Scenario 5 – Club

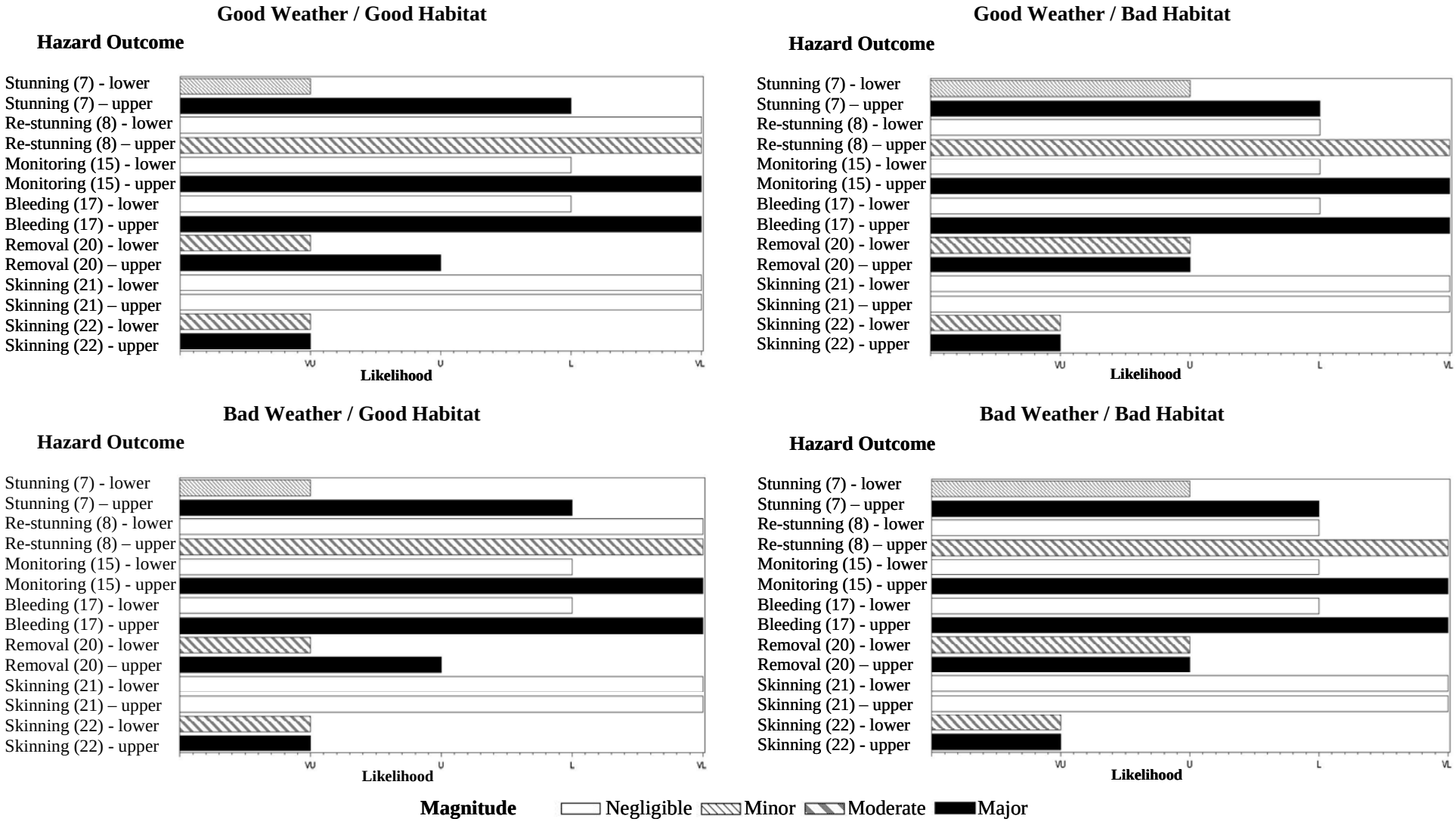


Figure 14. Scenario 6 – Club

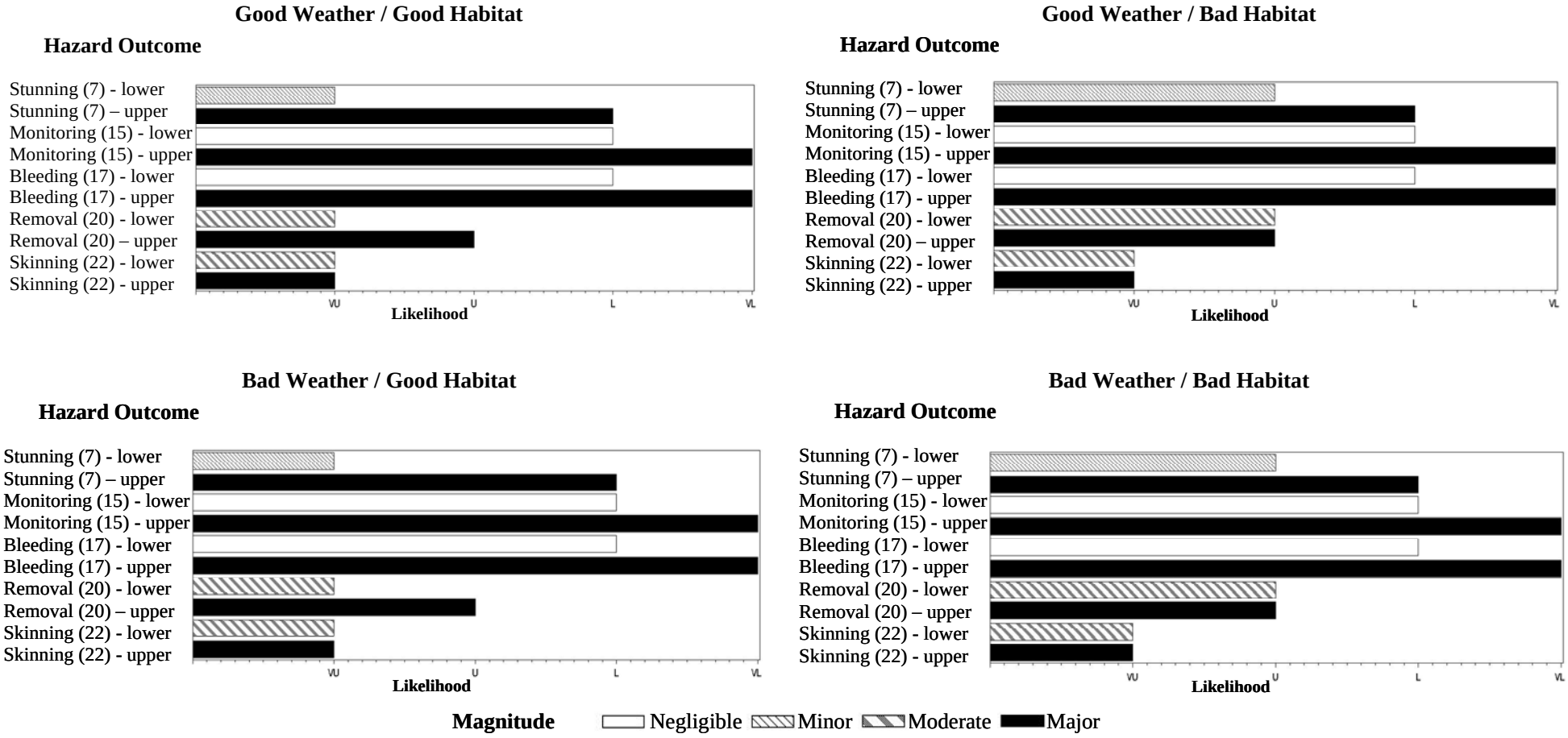


Figure 15. Scenario 7 – Club

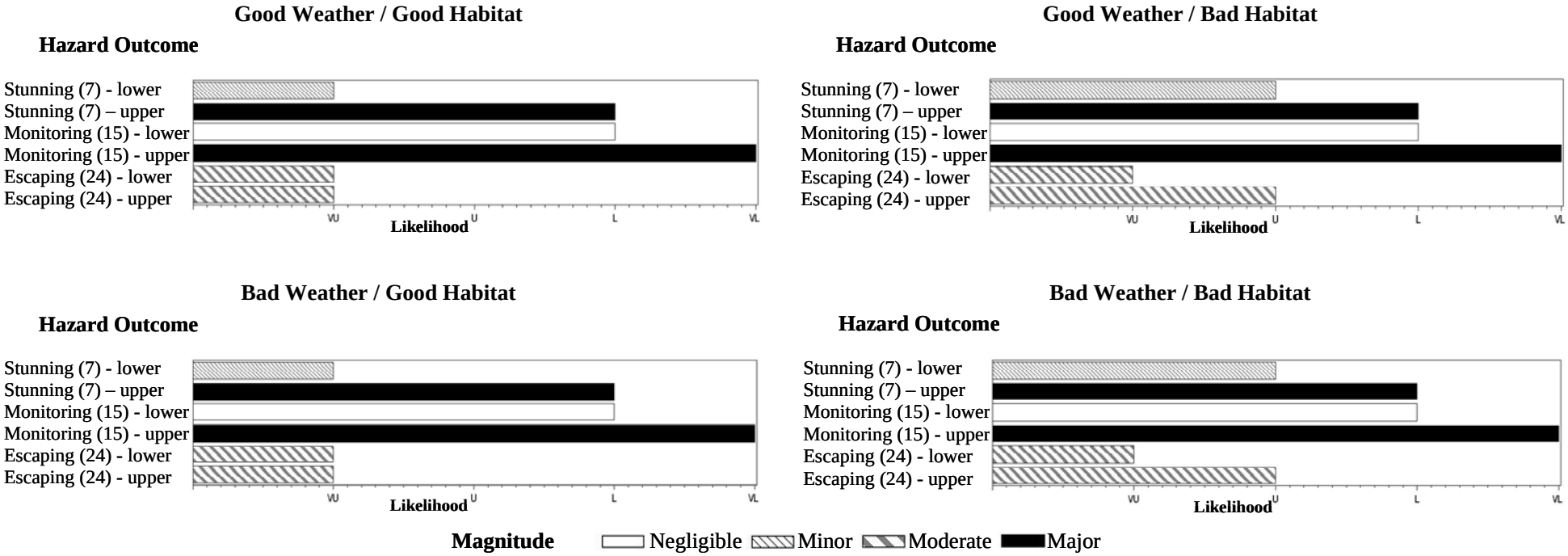


Figure 16. Scenario 8 – Club

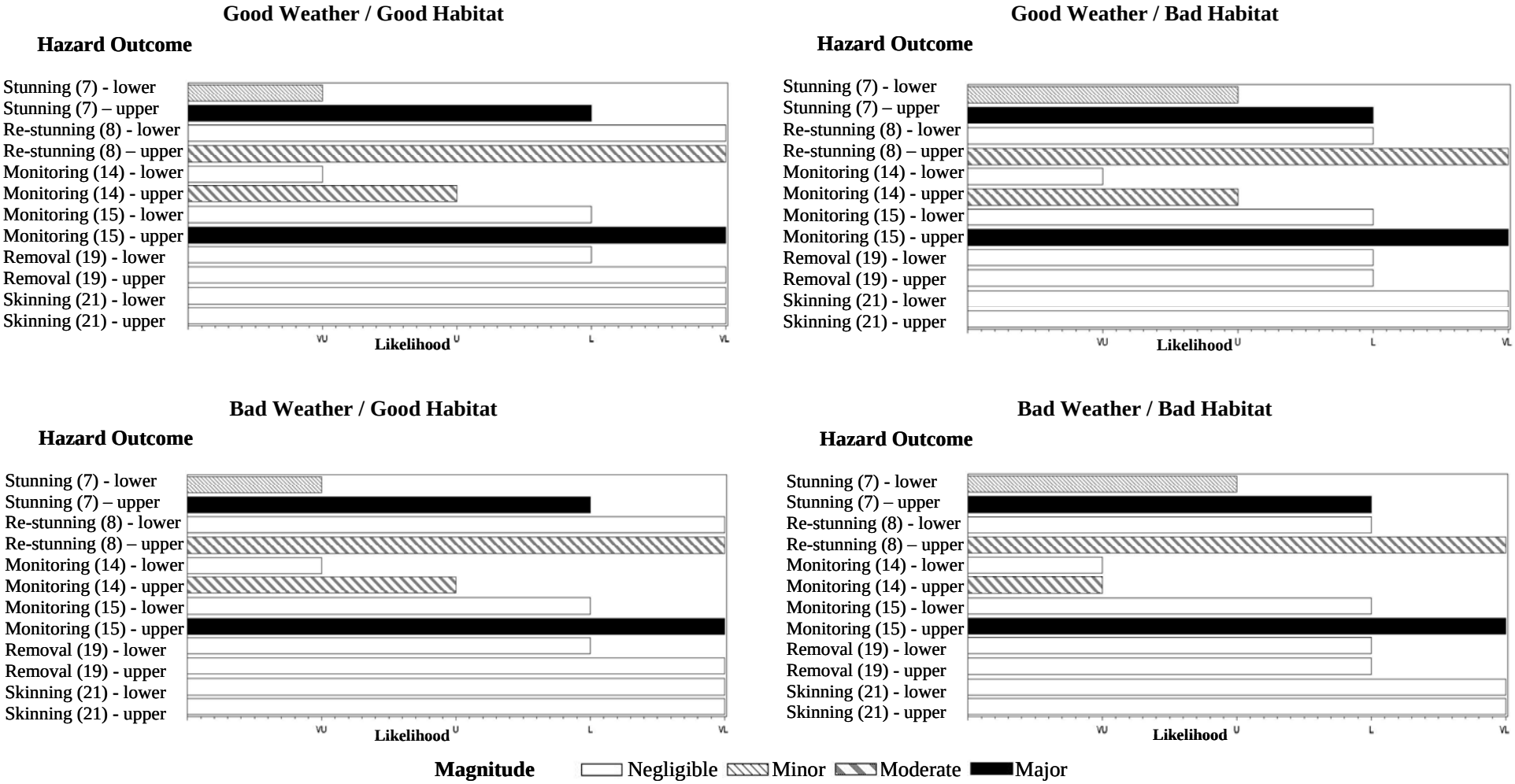


Figure 17. Scenario 1 – Firearms

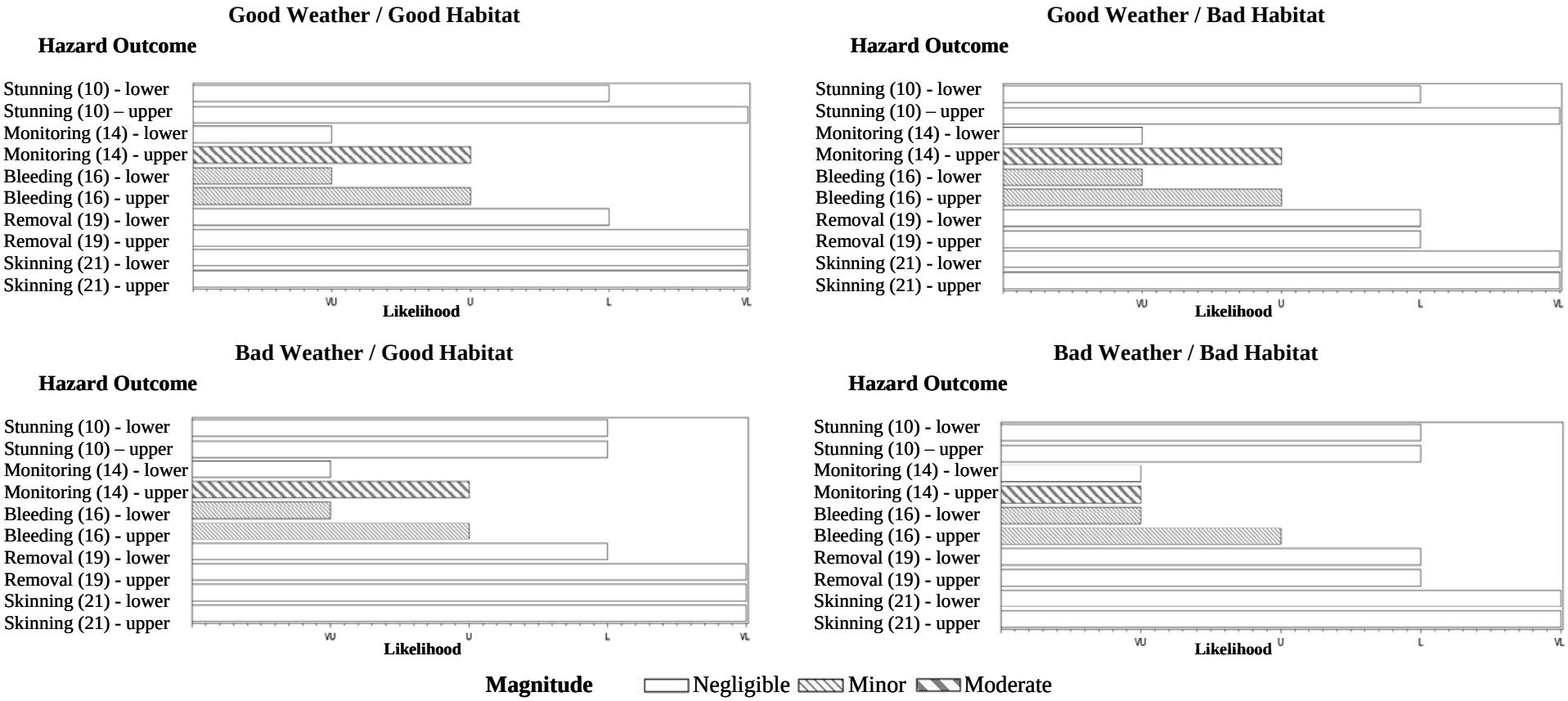


Figure 18. Scenario 2 – Firearms

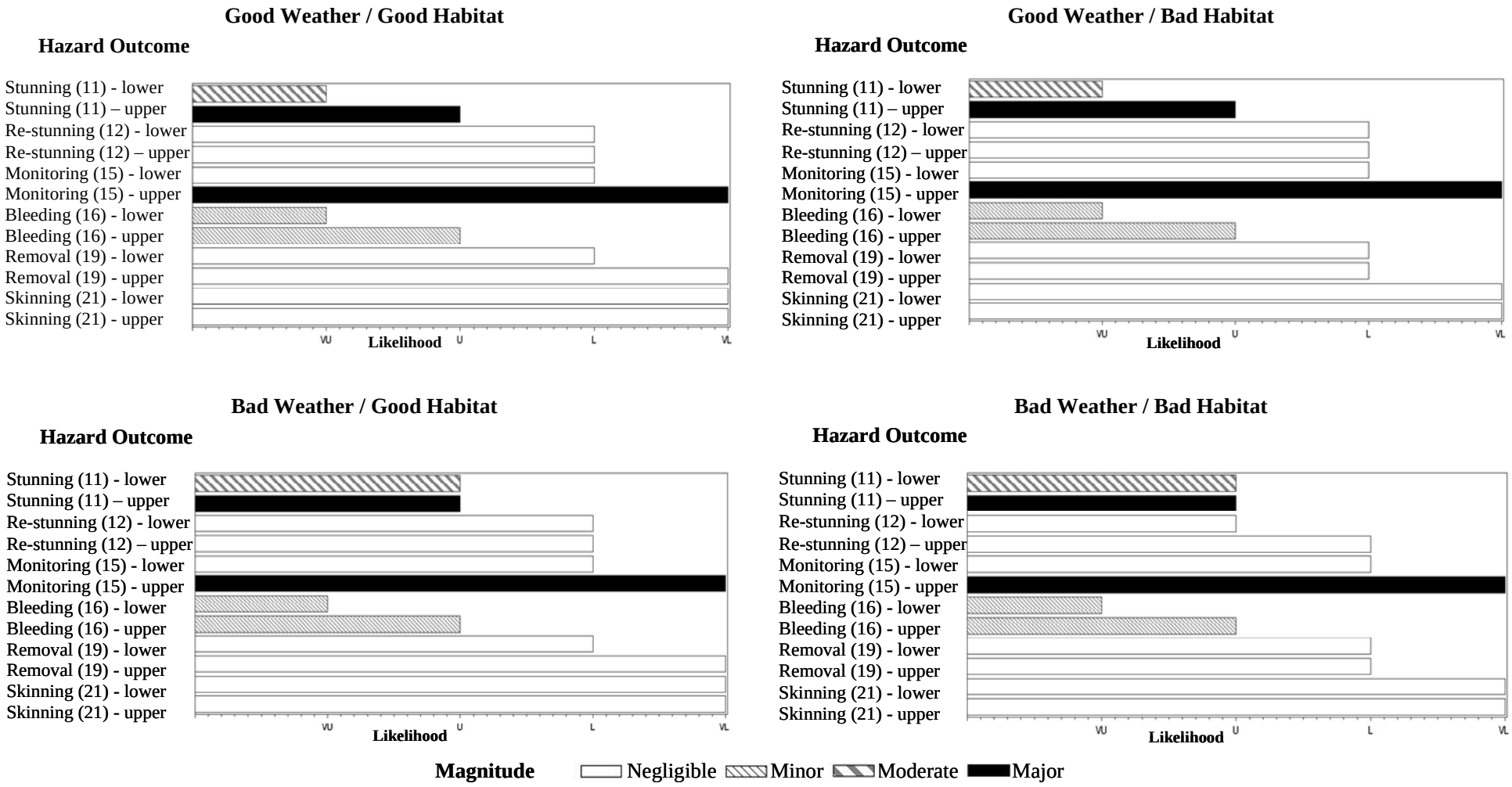


Figure 19. Scenario 3 – Firearms

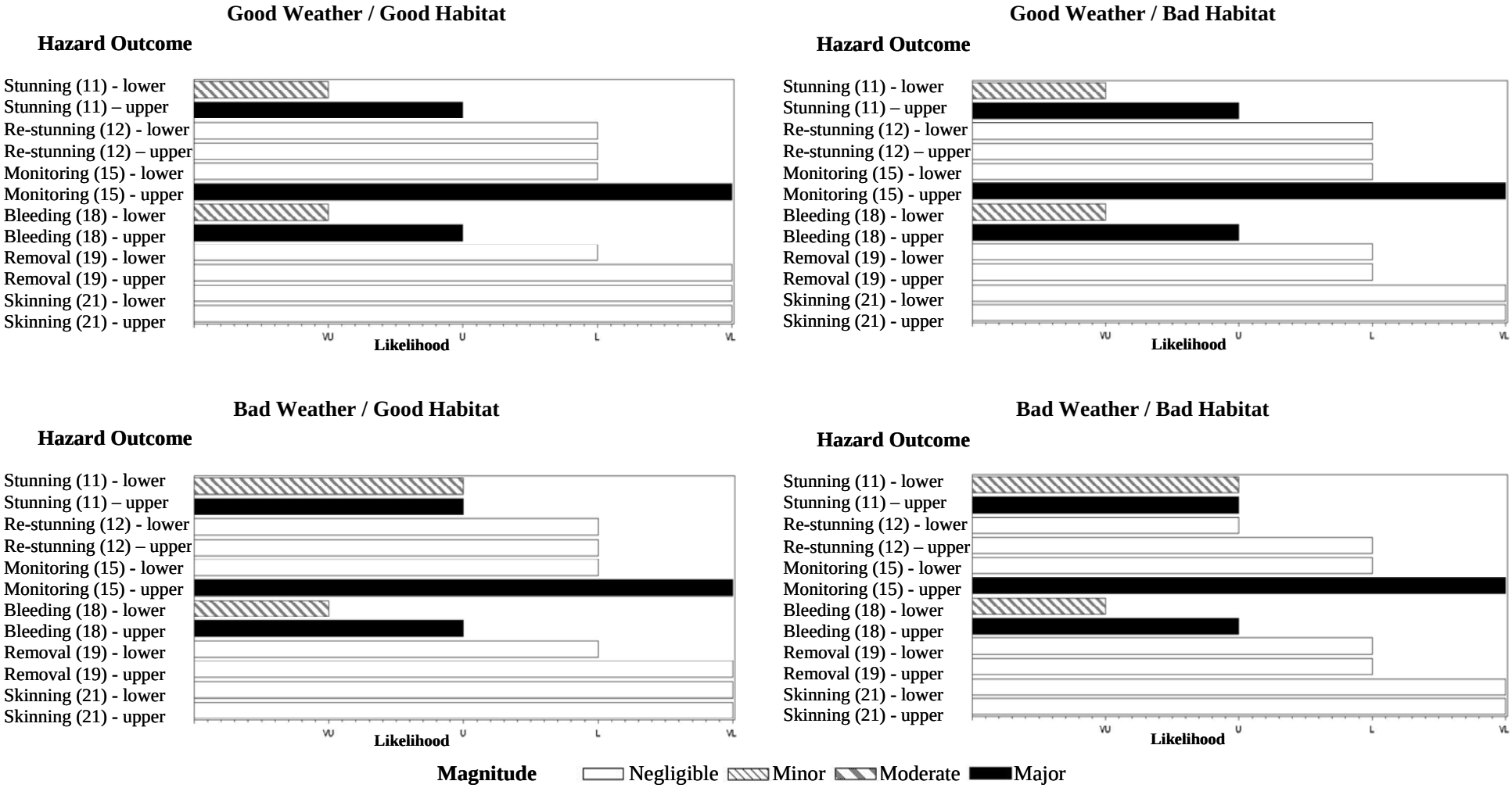


Figure 20. Scenario 4 – Firearms

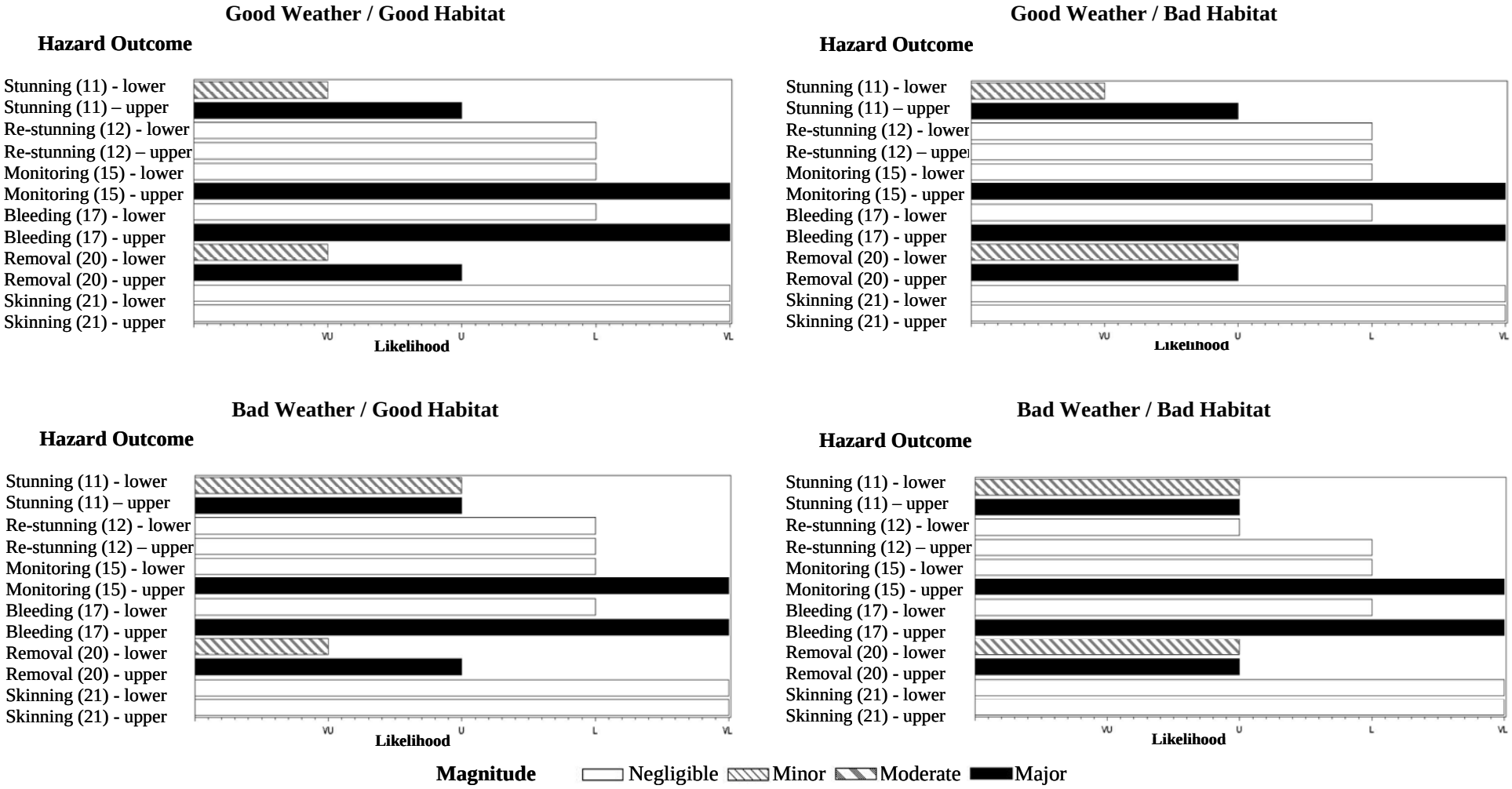


Figure 21. Scenario 5 – Firearms

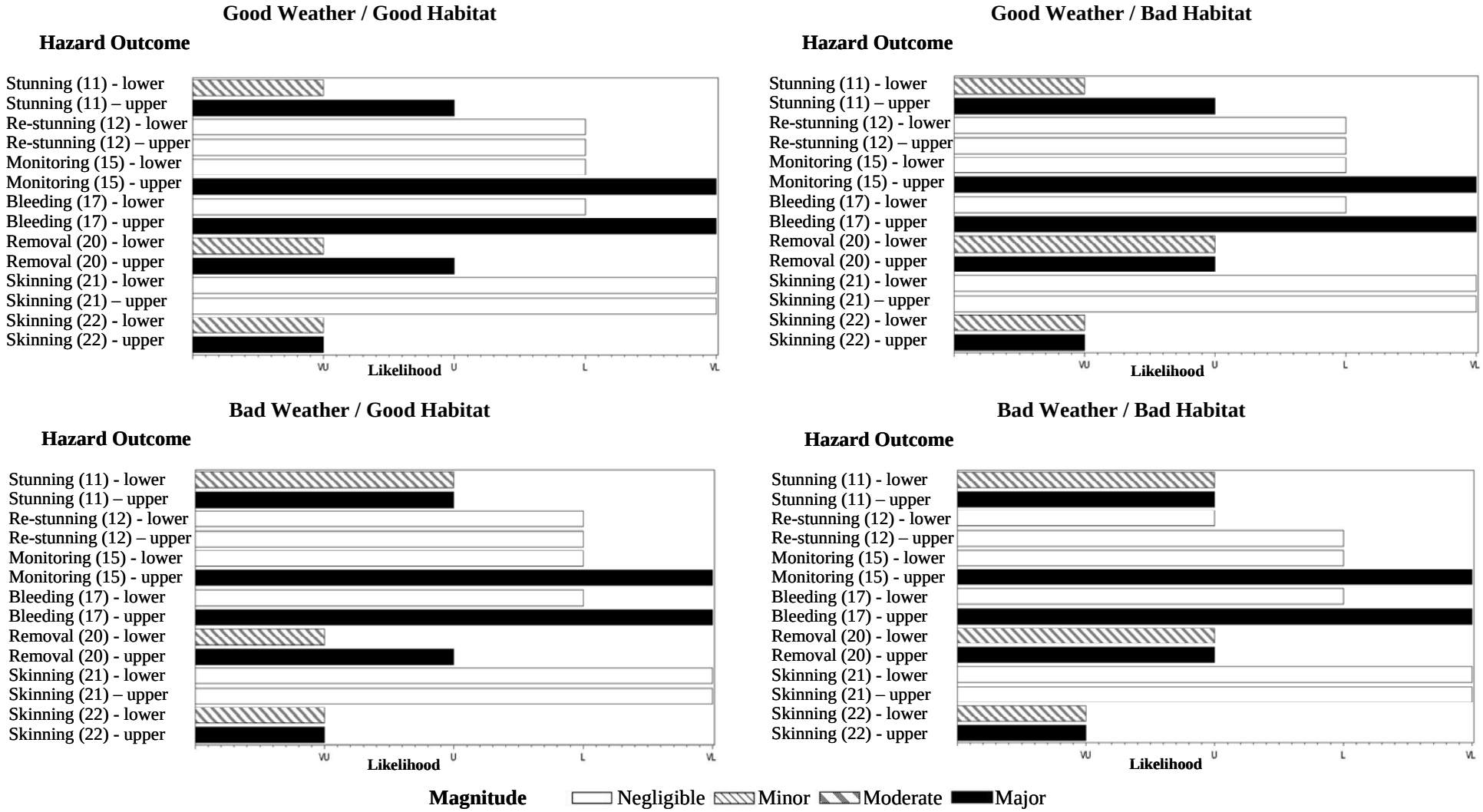


Figure 22. Scenario 6 – Firearms

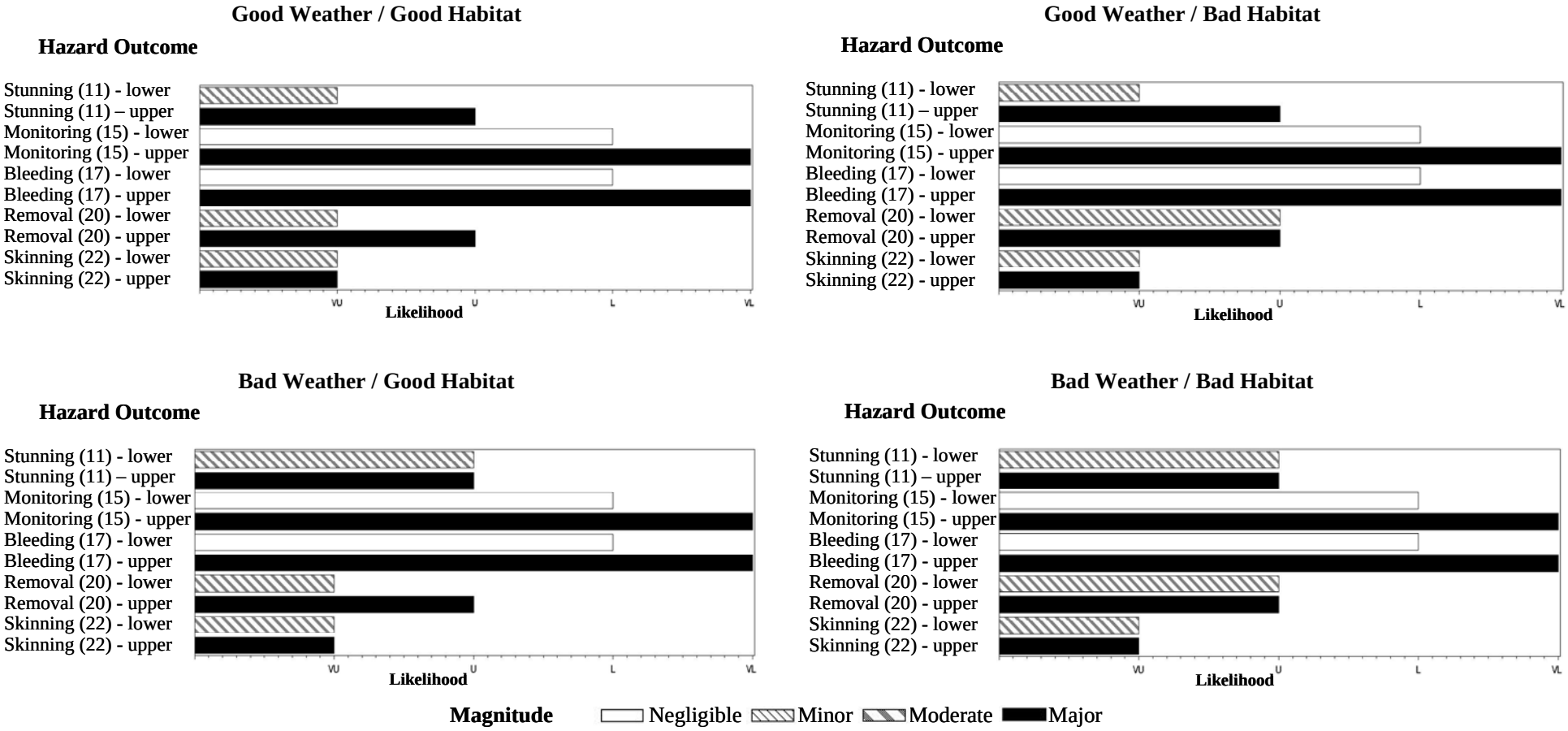


Figure 23. Scenario 7 – Firearms

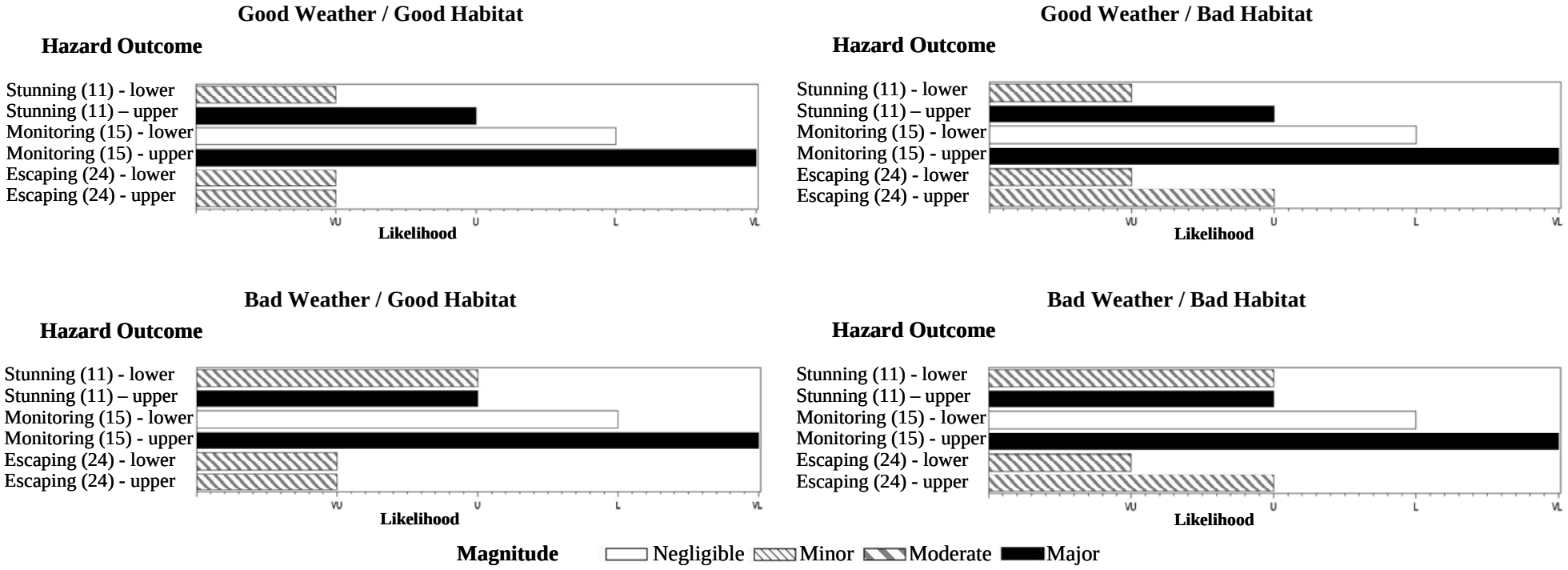


Figure 24. Scenario 8 – Firearms

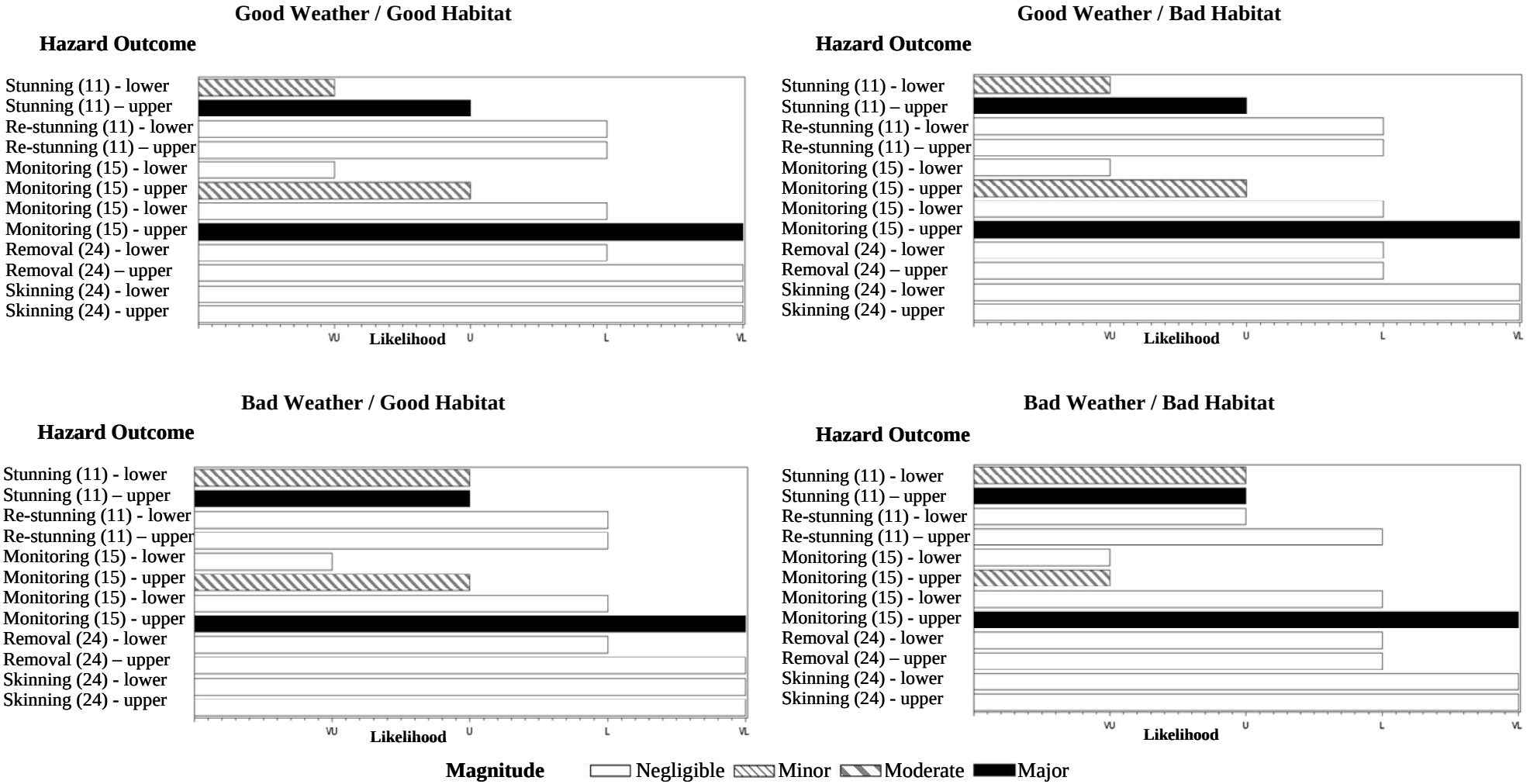


Figure 25. Scenario 9-10-11 – Netting All Weather and Habitat