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Point to Ponder

Maintaining Ethical Standards during Conservation Crises

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Note from the Editorial Office: *An earlier version of this manuscript was originally submitted for publication in Canadian Journal of Zoology (CJZ) on January 8, 2015. However, on January 27, the CJZ editorial office communicated that the paper was non-receivable, citing concerns with manuscript length and tone of perceived accusation. Meanwhile, the CJZ Editor requested an addendum from Hervieux et al. to justify their activities and individual involvements, especially as they related to animal care approvals. The original manuscript was reformatted and submitted to CWBM on January 28. Because of the controversial content of the manuscript, and because co-author G. Proulx is the Editor-in-Chief of CWBM, Guest Editor Emmanuel Do Linh San, Fort Hare University, and Associate Editor Pauline Feldstein supervised the peer review and made the final editorial decision. Six referees from the fields of veterinary medicine, wildlife research, and management evaluated this paper. All recommended that the paper be accepted with moderate revisions, and these have been incorporated into the final published version.*

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Abstract

Many species at risk in Canada and globally are at or approaching a crisis, especially where little or nothing consequential is being done to prevent extirpation. Such is the case of endangered boreal caribou (*Rangifer tarandus caribou*) in southern Alberta, Canada. Expedient but inadequate emergency ‘fixes’ have been experimentally implemented to arrest their decline and potential extirpation, but use of these measures raises important ethical problems. In their study of the effects of killing wolves (*Canis lupus*) on the Little Smoky woodland caribou population, Hervieux *et al.* (2014a) employed lethal methods that included shooting a firearm from a helicopter and the use of strychnine baits. Both of these methods raise critical questions with regard to animal welfare. When it is necessary to kill an animal, reliable humane procedures must be used to avoid pain or distress, and produce rapid loss of consciousness until death occurs. Also relevant are formal approvals by government and institutional animal ethics committees that adhere to Canadian Council on Animal Care (CCAC) guidelines. Shooting a moving animal from a helicopter is prone to error and not conducive to shots that quickly render animals insensitive to pain or produce a consistently quick kill. Strychnine does not meet the CCAC’s criteria for an acceptable killing method, and is specifically prohibited as an injectable option for euthanizing animals. Its use under uncontrolled conditions at bait sites is likely even less suitable. In addition, the risks of non-lethal and painful injuries from this poison and associated deaths to large numbers of non-target animals clearly contravene the CCAC guidelines for wildlife research. This study did not meet the CCAC’s guidelines and did not adhere to the Canadian Journal of Zoology’s requirement that all research must be approved by an institutional animal care committee. More broadly, and regardless of the failure of formal safeguards and implicit justifications offered by authors, we should be concerned when researchers impose suffering on wild animals and advocate for such programs to continue. Based on an apparent lack of compliance with CCAC’s guidelines, we believe that this controversial study should never have taken place and should not have been published by the Canadian Journal of Zoology. Experiments that involve the intentional inhumane killing of animals violate the fundamental principles of ethical science and rightfully endanger the reputation of science and scientists, as well as the journals willing to publish them. We recommend that CCAC guidelines be further developed to clearly address field methods used in wildlife studies, namely the shooting of animals from a helicopter, and the use of strychnine in baits. Also, independent audits should be conducted to investigate individual researchers and their studies, and the journals that publish this work, to ensure that CCAC guidelines are properly followed, even by researchers who collaborate well after the animal-based procedures have been carried out.

Key Words: Aerial shooting, Animal care, Caribou, Ethics, Guidelines, Inhumane methods, Publishing, Strychnine poisoning, Wolf Control.

The killing of animals in experimental research is a contentious and contemporary issue, including fundamental questions about the need to do so and the associated methods that are used (Vucetich and Nelson 2007). Such conflict can arise when specific research methods (e.g., tagging) or scientific management outcomes (e.g., control of invasive animals, translocations for climate change mitigation) impose harm to individuals within populations (e.g., Minter and Collins 2005; Parris *et al.* 2010; Draper and Bekoff 2013). Although multiple formal and informal protections are in place in Canada and internationally to maintain a common standard of ethical practices in ecological research, ethical safeguards can fall through institutional and scholarly cracks (Minter and Collins 2005). Here we evaluate the compliance of Hervieux *et al.*’s (2014a) study (recently published in the Canadian Journal of Zoology) of the effects of lethal wolf (*Canis lupus*) control on a boreal woodland caribou (*Rangifer tarandus caribou*) population with ethical standards that are widely recognized and applied in Canada and elsewhere. Hervieux *et al.* (2015) have since

published an addendum to their initial study, which we additionally evaluate using the same criteria. We identify ethical breaches at various points from the implementation to the publication of this research. We conclude that the addendum fails to address our concerns because it simply reaffirms and endorses the questionable scientific justifications and methods of the initial publication, while ignoring critical issues of animal welfare.

Hervieux *et al.* (2014a) described 2 methods they used to kill 733 wolves over a period of 7 years in the range of the Little Smoky caribou population in west-central Alberta, Canada, to address an apparent conservation crisis. Five-hundred-and-seventy-nine wolves were killed by gunshot from a helicopter (aerial shooting). With this method, individual wolves drawn from different packs were first located by helicopter, captured by net-gun, fit with a VHF radio-collar, and released. These marked individuals were then used to locate and kill additional pack members by aerial shooting. After all pack members were killed, the radio-collared wolves were shot.

The humane killing of wild animals requires that they die quickly, if not instantly, and with minimal pain (AAZV 2006; AVMA 2013). A gunshot to the brain can be used to humanely kill restrained or anesthetised animals (AAZV 2006). With free-ranging animals, gunshot to the chest (heart and lungs), a target area larger than the brain, is recommended instead to reduce the likelihood of wounding and escape (CCAC 2003; AAZV 2006). The humaneness of gunshot in the free-ranging situation depends largely on the nature of the local vegetation cover (e.g., open meadow versus dense forest), the proficiency of the shooter, and the type of firearm and ammunition used (Daoust and Cattet 2004; Hampton *et al.* 2014). We presume that the aerial shooting of wolves, as described in Hervieux *et al.* (2014a), is one of the most difficult situations to kill animals humanely with consistency. The effectiveness of the method as a humane method of killing is not satisfactorily documented in the scientific literature. Obvious problems include trying to accurately target, shoot and rapidly kill an agile, fleeing animal from a platform that is moving irregularly through the boreal forest where open spaces are few, small, and intermittent. Thus, the ability of even the very best pilot to position the shooter correctly under these circumstances every time also has a strong bearing on the efficacy and humaneness of euthanasia by aerial shooting. Painful injuries and inhumane kills will inevitably occur, even with the hiring of skilled helicopter pilots and proficient shooters. Despite these difficulties and the clear likelihood that animals will be wounded and lost, the authors provided no data regarding animal welfare outcomes, including average time to death, wounding rate, escape rate, instantaneous death rate, and location of bullet wound tracts. They also failed to provide basic details on the type of helicopter, firearm, and ammunition that were used, as well as the proficiency of the shooter(s). This lack of information strongly suggests that wolves were killed by gunshot without adequate consideration or effort to examine whether, or ensure that, their deaths were consistently humane.

An additional 154 wolves – likely a minimum estimate, given that some poisoned animals would surely go undetected by researchers – were killed by ingesting bait laced with strychnine (strychnine poisoning). With this method, bait of an unspecified type was mixed with strychnine, distributed at 15-20 locations throughout the winters, and checked every 8 days on average to recover the carcasses of wolves that had died in the vicinity. In addition to wolves, 91 ravens (*Corvus corax*), 36 coyotes (*C. latrans*), 31 red foxes (*Vulpes vulpes*), 4 American martens (*Martes americana*), 3 lynx (*Lynx canadensis*), 2 weasels (*Mustela* spp.), and 2 fishers (*Pekania pennanti*) were also presumed to have died by strychnine poisoning (Hervieux *et al.* 2014b). This is also a minimum estimate, however, as it is unlikely that all poisoned animals were located given animal movement and long periods between checks of poison baits for carcasses (Vyas 1999). Studies on the impact of strychnine baits on wildlife have shown repeatedly that scavengers

and predators are killed in large numbers by secondary poisoning and often die at considerable distances from bait sites (Dobbs and Beason 1986; Proulx and MacKenzie 2012), resulting in many undocumented mortalities. Furthermore, scavengers commonly pick up the carcasses of poisoned animals and leave the area, feed on them, and die from secondary poisoning (Montaz *et al.* 2014; Proulx, unpublished observations).

Hervieux *et al.* (2014a) failed to provide details on what type of baits were used or how wolves were attracted to strychnine baits. Via the Freedom of Information Process (the FOIP Act provides individuals with the right to request access to information in the custody or control of public bodies while providing public bodies with a framework within which they must conduct the collection, use, and disclosure of personal information; Office of the Information Privacy Commissioner of Alberta 2015) in Canada, Stewart (2014) reported that, in the Little Smoky caribou population range, since 2005, 177 moose (*Alces alces*), 16 elk (*Cervus canadensis*), and 3 mule deer (*Odocoileus hemionus*) were used as baits to attract and/or deliver poison to wolves. Of these, 93 moose, 8 elk, and 2 mule deer were killed during 2010-2012. Before 2010, road kills were apparently used as draw baits (FOIP to B. Stewart, personal communication with G. Proulx). The authors provided no information relative to these draw baits.

Strong evidence suggests that strychnine causes suffering. The poison is a highly-toxic alkaloid registered for restricted use in Canada as a pesticide, particularly for killing small vertebrates such as rodents and birds (Blakely 2009). Through competitive inhibition of glycine, a neurotransmitter, strychnine causes unimpeded stimulation of motor neurons affecting all the striated muscles of the body to produce generalized rigidity and tetanic seizures (Khan 2010). Clinical signs usually develop within 30-60 minutes after ingestion, but onset can be delayed by the presence of food in the stomach. Clinical signs include frequent periods of maximal muscle contraction (tetanic seizures), occasional cessation of breathing, and hyperthermia (body temperature $\geq 40^{\circ}\text{C}$) (Khan 2010). Sudden movement, sounds, or changes in light intensity can induce tetanic seizures. The seizures involve most of the body's musculature and affected animals often assume a 'sawhorse stance' due to spasms of the neck and back muscles causing extension of the head and neck, while spasms of the leg muscles cause the legs to become rigid and wide-stanced. Tetanic seizures can last from a few seconds to a minute and become more frequent over time. Death from exhaustion or asphyxiation during seizures typically occurs within 1-2 hours of the onset of clinical signs (Kahn 2010). Consequently, death by strychnine poisoning is inhumane because affected animals remain conscious and appear to suffer pain and anxiety from the onset of clinical signs until death. Importantly, humans who have been poisoned with strychnine report feeling intense pain (Wood *et al.* 2002; Parker *et al.* 2011). Accordingly, the use of strychnine for euthanasia is considered unacceptable under

any circumstances by both government agencies and veterinary organizations (CCAC 2003; AVMA 2013). Notably, Hervieux *et al.* (2014a) ignored the CCAC guidelines and used standards developed by Alberta government agencies, which allow the use of strychnine for the purpose of predator control in Alberta.

We believe that the formal safeguards designed to prevent the approval, execution, and publication of unethical animal research in Canada either failed, were subverted, or both. The Canadian Council on Animal Care (CCAC) states that: “the keystone of the Canadian system of oversight of the care and use of animals in science is the local institutional animal care committee (ACC) set up by each participating institution according to the CCAC policy statement on terms of reference for animal care committees. Institutional ACCs are responsible for overseeing all aspects of animal care and use and for working with animal users, animal care personnel and the institutional administration” (CCAC 2014). All professors, students, technicians, and post-doc researchers in Canada must learn about this by passing a course before being allowed to do research that involves animals (e.g., University of British Columbia 2015; University of Alberta 2015; University of Saskatchewan 2015; University of Victoria 2015). Universities and colleges in Canada take this education very seriously and normally ensure compliance with CCAC guidelines by only releasing research funds once a detailed animal care protocol is approved by the institutional ACC.

Although ACC oversight is mandatory at all Canadian universities and colleges, most provincial governments including the Province of Alberta have also committed to adopting CCAC standards and guidelines (Alberta Animal Protection Act 2005). For some agencies, however, ACC oversight is applied to their research activities, but not their management activities. Nonetheless, the actions of the authors were clearly research-related as substantiated by their designation of treatment and control populations, their generous use of terms such as “study” and “experiment” throughout the report, and their submission of the report for publication in a primary research journal. Thus, the Alberta Wildlife ACC should have reviewed and approved a detailed animal care protocol covering all aspects of this study before it was conducted.

Hervieux *et al.* (2014a) did not seek CCAC approval as confirmed in their 2015 addendum by indicating that CCAC approval was unnecessary, and no specific animal care protocol number has been provided by the Alberta Wildlife ACC. However, this is contrary to the Alberta Animal Protection Act (2005) which states that “A person who owns or has custody, care or control of an animal for research activities must comply with the following Canadian Council on Animal Care documents”, which follows with a list of 22 CCAC documents that must be considered. Research activities include the use of animals in scientific investigation (i.e., experiments). This is a clear and

important oversight, despite the vague assertions by Hervieux *et al.* (2015) that appropriate policies were followed. We argue that, while CCAC guidelines may be interpreted differently by some professionals, review and approval of an animal care protocol were also likely required for 2 co-authors by ACCs at the respective academic institutions where they are employed. For 1 co-author at the University of Alberta, the employer states, “All research, teaching or testing using animals conducted by staff or students affiliated with the University of Alberta, or involving University resources/ facilities, must be reviewed and approved by one of the University’s Animal Care and Use Committees (ACUC) before the research starts” and “Investigators wishing to conduct research involving animal use across two or more institutions should contact their ACUC coordinator for advice on how to proceed” (University of Alberta 2015). For the other co-author at the University of Montana-Missoula, the employer states that “The Institutional Animal Care and Use Committee (IACUC) is responsible for the review and approval of all animal care and use associated with The University of Montana-Missoula or conducted by its faculty, staff, students, visitors, or affiliates” and “The University of Montana (UM) Institutional Animal Care and Use Committee (IACUC) requires that a Wildlife Animal Use Protocol be submitted for any study conducted on free-living wild animals in their natural habitat that involves procedures that may harm or materially alter the behavior of the animals under study (i.e., trapping/capture, physical/chemical restraint, and/or invasive procedures causing stress, including removal from nest and habitat for short durations)” (University of Montana 2015). Hervieux *et al.* (2015) argued that “no university animal care protocol was required because the university scientists were never involved in the capture or handling of any wildlife”, however, the issue is much more complex than that. The CCAC indeed has specific policies with respect to this issue: “Where more than one ACC is involved in the review of a protocol (e.g., when research is conducted outside of the jurisdiction of the home institution), a well-defined arrangement between the ACC of the home institution and the host organization, for monitoring the proposed project and the welfare of the animals, should be agreed upon before the project begins. ACCs need to be aware of the protocols and progress of projects which are being carried out locally. The local ACC is often the point of contact for the public and should be able to answer questions concerning wildlife studies in their area.” Collaborative research projects and those ostensibly based on using existing datasets are not free from CCAC oversight.

We appreciate that the authors in this paper had different roles in designing, conducting, analyzing, and writing Hervieux *et al.*’s (2014a) research study. Our major criticism is aimed specifically at the methods of the study, in which authors might have different levels of involvement. We believe, however, that by publishing this work in a peer-reviewed journal and presenting these results as

scientific research (as opposed to a government technical report) and using the collective 'we' throughout the paper that all authors have a shared responsibility for the methods described, including their design and execution (see Merrill 2015). Moreover, the authors' collective advocacy in the Discussion that lethal predator control should continue implies that their methods are appropriate, and there are no statements in the paper or the associated addendum to the contrary. Importantly, in Hervieux *et al.* (2015), all the authors reaffirmed their endorsement of the problematic methods by implicitly arguing that resolving the scientific questions addressed in the research trumped the welfare of the animals that were inhumanely killed during the study. This is especially important in this case because academic university-based researchers who are responsible for adhering to the highest ethical standards and following CCAC guidelines are clearly advocating for continuing the use of methods that violate those standards and guidelines. We also recognize that the management goal driving this study was to ensure persistence of woodland caribou populations that are threatened by habitat loss due to industrial activities. However, there are no provisions within CCAC standards allowing ethical standards to be avoided in order to accommodate this apparent conservation crisis or any other management scenario.

Beyond questions of compliance with existing laws and standards of animal welfare and necessary approval by several ACCs, we also ask how the publication of Hervieux *et al.* (2014a) can be reconciled with the published ethical standards of the Canadian Journal of Zoology and the policies of its publisher NRC Research Press. The journal's instructions to authors clearly state that, "All authors, regardless of their country of origin, who describe experiments on animals are required to give assurance in the Materials and Methods that the animals were cared for in accordance with guidelines such as the Guide to the Care and Use of Experimental Animals (Vol. 1, 2nd ed., 1993, and Vol. 2, 1984, available from the Canadian Council on Animal Care, Constitution Square, Tower 2, Suite 315, 350 Albert St., Ottawa, ON K1R 1B1, Canada, or on their Web site at <http://ccac.ca>) or the Guide for the Care and Use of Laboratory Animals (1996, published by National Academy Press, 2101 Constitution Ave. NW, Washington, DC 20055, USA), and that their use of animals was reviewed and approved by the appropriate animal care review committee at the institution(s) where the experiments were carried out" (Canadian Science Publishing 2014). In addition, we note that the NRC Research Press' publishing policy states, "Authors should describe the safeguards used to meet both formal and informal standards of ethical conduct of research (approval of a research protocol by an institutional committee, procurement of informed consent, adherence to codes of ethical conduct for the treatment of human or animal subjects, and maintenance of confidentiality of personal data on patients, etc.)" The addendum by Hervieux *et al.* (2015) confirmed that no attempt was made to adhere to CCAC

guidelines or seek approval from any ACC, as required by the Canadian Journal of Zoology.

In conclusion, the publication of Hervieux *et al.* (2014a) appears to have proceeded through a comprehensive Canadian system of formal and informal checks and balances that would normally prevent the approval, execution, and publication of unethical animal research. Importantly, commentary regarding this research has already been invoked to suggest that similar approaches to killing wolves will likely occur in other areas of Alberta (Ellis 2015). Further, we are appalled to learn that the methods of aerial shooting and strychnine poisoning used in this study could be deemed acceptable and recommended to continue in the future. From an animal welfare perspective, this controversial study should never have taken place and should not have been published by the Canadian Journal of Zoology. Experiments that involve the intentional inhumane killing of animals violate the fundamental principles of ethical science and rightfully endanger the reputation of science and scientists, as well as the journals willing to publish them.

Although we recognize that the CCAC guidelines (2003) are outdated (however, see its website devoted to wildlife research – <http://3rs.ccac.ca/en/research/wildlife-research.html> – which is considerably more current than their guidelines), we believe that the guidelines need to be further developed to clearly address field methods used in wildlife studies, namely the shooting of animals from a helicopter, and the use of strychnine in field baits. In this respect, we take comfort in knowing that AVMA (2013) considers that a gunshot to the head causing destruction of brain tissue should be the objective of the shooter, and that a shot to the heart or neck does not immediately render animals unconscious. Likewise, AVMA (2013) clearly stipulates that strychnine is an unacceptable euthanasia agent under any circumstances.

Hervieux *et al.* (2014a, 2015) dismissed ethical considerations in favour of 'policy frameworks for recovering species' and the ability of wolves to 'absorb' mortality. These management phrases disregard the suffering of individuals. Such dismissal is alarming given that biologists – by virtue of their training – are well aware of the physiological dimension of suffering (Paquet and Darimont 2010; Ramp and Bekoff 2015).

The CCAC certifies institutional animal care and use programs, and not individual researchers or studies. Without an audit system, CCAC guidelines can be overlooked, side-stepped, or interpreted improperly. Accordingly, there is an obvious need for independent audits where individual researchers and their studies must be investigated to ensure that CCAC guidelines were properly followed, even by researchers who collaborate well after the animal-based procedures have been carried out. Furthermore, audit of peer-reviewed research journals that purport to adhere to CCAC standards is also clearly necessary. Finally, CCAC guidelines should apply to all wildlife-related programs,

including research and management. When it comes to animal care, CCAC guidelines should have precedence over provincial standards, which may not have been developed with the purpose of assuring the wellbeing of animals. Hervieux *et al.* (2015) asked: “should university researchers be prevented from conducting and publishing research on controversial management areas?” We believe that collaborations among government and academic researchers, as well as reuse and analysis of existing datasets can be highly successful and important in conservation science. We also believe, however, that the highest standards of animal care must be met in all studies and programs, regardless of their objectives.

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LITERATURE CITED

- Alberta Animal Protection Act. 2005.** Animal Protection Act. Animal Protection Regulation. 203/2005. Alberta Queen's Printer, Edmonton, Alberta, Canada. Available at: http://www.qp.alberta.ca/1266.cfm?page=2005_203.cfm&leg_type=REGS&isbnIn=9780779779956. Accessed 9 February 2015.
- American Association of Zoo Veterinarians (AAZV). 2006.** Guidelines for euthanasia of nondomestic animals. American Association of Zoo Veterinarians. 111 pages.
- American Veterinary Medical Association (AVMA). 2013.** AVMA guidelines for the euthanasia of animals: 2013 edition. American Veterinary Medical Association. 102 pages.
- Blakely, B. R. 2009.** The association of bait formulation of strychnine with poisonings in nontarget species in Saskatchewan from 1975 to 2007. *Canadian Veterinary Journal* 50: 1186-1188.
- Canadian Council on Animal Care (CCAC). 2003.** CCAC guidelines on: the care and use of wildlife. Canadian Council on Animal Care, Ottawa, Ontario, Canada. 66 pages.
- Canadian Council on Animal Care (CCAC). 2014.** Animal Care Committees. Available at: http://www.ccac.ca/en_/assessment/acc Accessed 19 December 2014.
- Canadian Science Publishing. 2014.** *Canadian Journal of Zoology Ethics – Experiments involving animals.* Available at: <http://www.nrcresearchpress.com/page/cjz/authors#Typesofpapers> Accessed 02 January 2015.
- Daoust, P.-Y., and M. Cattet. 2004.** Consideration of the use of the .22 caliber rimfire Winchester magnum cartridge for instant killing of young harp seals (*Pagophilus groenlandicus*). Canadian Science Advisory Secretariat Research Document 2004/072. 37 pages.
- Dobbs, J. C., and P. C. Benson. 1986.** Strychnine poisoning and the effect on wildlife. Pages 28-39 in *Colloquium on the use/abuse of strychnine*, June 1986, Onderstepoort, South Africa, South African Veterinary Association, Wildlife Group.
- Draper, C., and M. Bekoff. 2013.** Animal welfare and the importance of passionate conservation – A comment on McMahon *et al.* (2012). *Biological Conservation* 158: 422-423.
- Ellis, C. 2015.** Hundreds of wolves killed to save caribou Rocky Mountain Outlook (online, February 05, 2015). <http://www.rmoutlook.com/article/20150205/RMO0801/302059988/hundreds-of-wolves-killed-to-save-caribou>
- Hampton, J. O., B. D. Cowled, A. L. Perry, C. J. Miller, B. Jones, and Q. Hart. 2014.** Quantitative analysis of animal-welfare outcomes in helicopter shooting: a case study with feral dromedary camels (*Camelus dromedarius*). *Wildlife Research* 41(2): 127-135.
- Hervieux, D., M. Hebblewhite, D. Stepnisky, M. Bacon, and S. Boutin. 2014a.** Managing wolves (*Canis lupus*) to recover threatened woodland caribou (*Rangifer tarandus caribou*) in Alberta. *Canadian Journal of Zoology* 92: 1029-1037.
- Hervieux, D., M. Hebblewhite, D. Stepnisky, M. Bacon, and S. Boutin. 2014b.** Supplementary material. *Canadian Journal of Zoology*. Available at: <http://www.nrcresearchpress.com/doi/suppl/10.1139/cjz-2014-0142#VKbKdSvF-So> Accessed 07 December 2014.
- Hervieux, D., M. Hebblewhite, D. Stepnisky, M. Bacon, and S. Boutin. 2015.** Addendum to “Managing wolves (*Canis lupus*) to recover threatened woodland caribou (*Rangifer tarandus caribou*) in Alberta”. *Canadian Journal of Zoology*, 10.1139/cjz-2015-0012.
- Khan, S. A. 2010.** Overview of strychnine poisoning. In *The Merck Veterinary Manual, Tenth Edition. Edited by C. M. Kahn and S. Line.* Merck & Co., Whitehouse Station, New Jersey, USA.
- Merrill, E. 2015.** Sensitivity and integrity of authorship. *Journal of Wildlife Management* 80:4:1-3.
- Minteer, B. A., and J. P. Collins. 2005.** Why we need an “ecological ethics”. *Frontiers in Ecology and the Environment* 3: 332-337.
- Montaz, J., M. Jacquot, and M. Coeurdassier. 2014.** Scavenging of rodent carcasses following simulated mortality due to field applications of anticoagulant rodenticide. *Ecotoxicology* 23: 1671-1680.
- Office of the Information Privacy Commissioner of Alberta. 2015.** Freedom of Information and Protection of Privacy Act

- (the FOIP Act) of the Alberta Legislature. Available at: <http://oipc.ab.ca/pages/FOIP/default.aspx> Accessed 09 January 2015.
- Paquet, P. C., and C. T. Darimont. 2010.** Wildlife conservation and animal welfare: two sides of the same coin? *Animal Welfare* 19(2): 177-190
- Parker, A. J., J. B. Lee, J. Redman, and L. Jolliffe. 2011.** Strychnine poisoning: gone but not forgotten. *Emergency Medicine Journal*, 28: 84.
- Parris, K. M., S. C. McCall, M. A. McCarthy, B. A. Minter, K. Steele, S. Bekesy, and F. Medvecky. 2010.** Assessing ethical trade-offs in ecological field studies. *Journal of Applied Ecology* 47: 227-234. doi: 10.1111/j.1365-2664.2009.01755.x
- Proulx, G., and N. MacKenzie. 2012.** Relative abundance of American badger (*Taxidea taxus*) and red fox (*Vulpes vulpes*) in two landscapes with high and low rodenticide poisoning levels. *Integrative Zoology* 7: 41-47.
- Ramp, D., and M. Bekoff. 2015.** Compassion as a practical and evolved ethic for conservation. *BioScienc*. doi: 10.1093/biosci/biu223
- Stewart, B. R. 2014.** How many dead wolves, moose and elk justify the lives of two woodland caribou? *Alberta Outdoorsmen* 16 (7): 50-53.
- University of Alberta. 2015.** Animal Research Ethics. Available at: <http://www.reo.ualberta.ca/Animal-Research-Ethics.aspx> Accessed 02 January 2015.
- University of British Columbia. 2015.** Animal care training resources. Available at: <http://www.animalcare.ubc.ca/training.html>. Accessed 7 February 2015.
- University of Montana. 2015.** Institutional Animal Care and Use Committee (IACUC). Available at: <http://www.umt.edu/research/compliance/IACUC/default.php> Accessed 02 January 2015.
- University of Saskatchewan. 2015.** UCACS animal care course. Available at: <http://research.usask.ca/for-researchers/ethics/ucacs-animal-care-course.php>. Accessed 7 February 2015.
- University of Victoria. 2015.** Research or teaching involving animals. Available at: http://www.uvic.ca/universitysecretary/assets/docs/policies/RH8110_1260_.pdf. Accessed 7 February 2015.
- Vucetich, J. and M. P. Nelson. 2007.** What are 60 warblers worth? Killing in the name of conservation, *Oikos* 116: 1267-1278.
- Vyas, N. B. 1999.** Factors influencing estimation of pesticide-related wildlife mortality. *Toxicology and Industrial Health* 15: 187-192.
- Wood, D. M., E. Webster, D. Martinez, P. I. Dargan, and A. L. Jones. 2002.** Case report: Survival after deliberate strychnine self-poisoning, with toxicokinetic data. *Critical Care*, 6: 456-459.

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Marc Cattet, DVM, PhD, is a senior research scientist and a wildlife veterinarian with the Canadian Wildlife Health Cooperative at the Western College of Veterinary Medicine, University of Saskatchewan. He provides technical expertise in the areas of wildlife capture and handling to government wildlife agencies in Canada, and serves as project veterinarian for the Foothills Research Institute Grizzly Bear Research Program. His research is focused toward detecting, understanding, and reducing the effects of a range of human activities on the health of wild species.



Chris Darimont, PhD, is the Hakai-Raincoast Professor in the Department of Geography at the University of Victoria and the Science Director for the Raincoast Conservation Foundation. As a conservation scientist, his interests are broad but typically draw on ecology, evolution and - increasingly - social sciences approaches to confront acute conservation problems and opportunities. Animal welfare figures prominently in his personal and professional life.

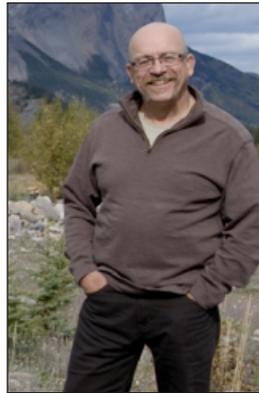


Paul C. Paquet, PhD, is an internationally recognized wildlife biologist who specializes in the ecology, conservation, behavior, and management of wolves, other large wild carnivores, and their prey. He is an Adjunct Professor at the University of Victoria, Department of Geography, and a Senior Scientist with the Raincoast Conservation Foundation. He previously held academic appointments



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Gilbert Proulx, PhD, is Director of Science at Alpha Wildlife Research & Management, Editor-in Chief of the Canadian Wildlife Biology & Management journal, and Chair of the Martes Working Group. Gilbert has 39 years of field experience as a wildlife biologist. He has published more than 120 scientific articles, 5 textbooks, and 8 field guides (species at risk). His main research interest focuses on mammals, particularly in forest and agriculture ecosystems, and on technology development, mainly on mammal trapping and detection methods.



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