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COMMENT

Poisoning wolves with strychnine is unacceptable in experimental studies and conservation programmes

In an experimental attempt to reduce predation on caribou (*Rangifer tarandus caribou*) populations threatened by industrial disturbance in western Alberta, Canada, Hervieux *et al.* (2014*a*) used strychnine baits to kill wolves (*Canis lupus*). Strychnine poisoning was once used in attempts to reduce livestock depredation, increase abundance of game species, and remove invasive species (see for example Denney 1972; Reynolds & Tapper 1996; Lorvelec & Pascal 2005). However, its use has been largely abandoned because it causes suffering in animals; its use was banned in the USA in 1972 (Wade 1980), and by the European Union in 2006 (Davies 2006). In this paper, we do not address Hervieux *et al.*'s claim that wolf populations need to be reduced to promote woodland caribou recovery. Our intention is to show that use of strychnine in wildlife research and management programmes is biologically and ethically unacceptable. We believe that accepting strychnine poisoning as a relatively low cost and putatively expedient conservation strategy should alarm wildlife biologists, veterinarians, and environmental authorities. Herein, we reject strychnine as a means to control wolves because it is: (1) inhumane; (2) in contravention of animal welfare guidelines; and (3) non-selective.

According to the Canadian Council on Animal Care (CCAC 2003), a killing method is humane if it causes rapid (immediate) unconsciousness and subsequent death without pain or distress. Death by strychnine ingestion is inhumane, as it causes frequent periods of tetanic seizures, occasional cessation of breathing, hyperthermia, extreme suffering, and death from exhaustion or asphyxiation, which typically occurs within 1–2 hours of the onset of clinical signs (Khan 2010). However, death can take up to 24 hours or longer if the dose is low (Eason & Wickstrom 2001).

The use of strychnine to kill wolves is in contravention of CCAC guidelines (CCAC 2003), the American Veterinary Medical Association (AVMA 2013), the Canadian Veterinary Medical Association (2014), and the American Society of Mammalogists (Sikes *et al.* 2011).

Although the use of strychnine baits to kill predators has a well-documented history (see Young 1942; Greenwood *et al.* 1990), this practice is indiscriminate and kills many non-target species via ingestion of bait and secondary poisoning (Cain 1972; Allan 1989). Notably, its use does not meet the International Union for Conservation of Nature (IUCN) guidelines for wolf management, which advise that when wolf reduction measures are necessary, 'the methods must be selective, specific to the problem, highly discriminatory, and have minimal adverse side effects on the ecosystem'. In Canada, predator control programmes employing strychnine baits have contributed to the extirpation of fisher (*Pekania pennanti*) in central Alberta (Douglas & Strickland 1987), and the decline of wolverine (*Gulo gulo*) in northern regions (Kelsall 1981). In the Canadian Prairies, strychnine poisoning caused the decimation of the now endangered swift fox (*Vulpes velox*) (Sovada *et al.* 2009) and the local extirpation of American badgers (*Taxidea taxus*) (Proulx & MacKenzie 2012), now a 'species of special concern' (COSEWIC [Committee on the Status of Endangered Wildlife in Canada] 2012).

Hervieux *et al.* (2014*b*) reported the non-target poisoning of 91 ravens (*Corvus corax*) and 78 terrestrial carnivores, mostly mustelids and canids. This is a minimum number of non-target mortalities because poisoned animals often die in concealed places, sometimes far from bait sites, are buried in snow, and are otherwise not retrieved. Carcasses can be moved further away by scavengers. Strychnine is highly persistent in poisoned carcasses (Eason & Wickstrom 2001), which can kill more non-target scavengers (Wobeser & Wobeser 1992; Vyas 1999).

The haphazard and indiscriminate poisoning of individual animals can potentially manifest in population-level impacts. For example, because fishers and wolverines have relatively low reproductive rates and large home ranges that can exceed 100 km^2 (Carroll *et al.* 2001; Weir & Corbould 2006), the poisoning of just a few animals might jeopardize their populations. In or near the western Alberta study area, local trappers have reported a significant reduction in carnivores on their traplines (Handy 2013; Kranjec 2015). Hunters observed fewer scavengers, and found carcasses of weasels and bears (*Ursus* spp.) at or near wolf-baiting stations (Alberta Fish & Game Association 2015).

In summary, the use of strychnine in scientific investigations is unethical according to contemporary animal care guidelines, and adversely affects sympatric predators and scavengers. Accordingly, we believe that the use of strychnine poisoning in wildlife conservation should be prohibited and condemned by the scientific community, governments, and conservation groups.

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