Strychnine Special Review Request

EVIDENCE AND SUPPORTING INFORMATION

Please accept the following evidence and information in support of our request for a special review of the following pest control products under section 17 of the *Pest Control Product Act*, SC 2002, c 28 ("PCPA"):

Reg. No. 20410 – Strychnine Wolf, Coyote and Black Bear Control Predacide
Reg. No. 24510 – Strychnine Predacide Skunk Control
Reg. No. 31756 – Maxim Technical Strychnine
Reg. No. 30433 – 2% Liquid Strychnine

I. Summary

Pursuant to section 17 of the PCPA, the Minister shall initiate a special review of the registration of a pest control product if the Minister has reasonable grounds to believe that the health or environmental risks of the product are, or its value is, unacceptable. For the reasons outlined below, we believe that the health and environmental risks of strychnine are unacceptable, and that its value with respect to reducing livestock loss and protecting prey, such as at-risk caribou, is also unacceptable. We believe that the above-noted registrations should therefore be cancelled following the Minister's special review.

Environmental Risk

- Registrant records indicate that more non-target animals are poisoned every year than wolves, in both caribou conservation and livestock depredation contexts. Non-target animals include species at risk (e.g. grizzly bear, bald eagle, golden eagle) and domestic animals (e.g. dogs).
- Strychnine baits go missing each year during caribou conservation poisoning. For example, between 2006 and 2009, 1,203 cubes of strychnine were not recovered, either because they could not be found or because wolves, coyotes, weasels and/or unidentified animals had consumed the baits and their bodies were not recovered. Moreover, bait consumption without carcass recovery occurred at 14 of 15 bait sites in 2006, 11 of 15 bait sites in 2007, 22 of 22 bait sites in 2008 and 29 of 30 bait sites in 2009. A large quantity of strychnine is therefore entering the food chain and potentially killing significant numbers of both wolves and non-target animals. Unrecovered carcasses also have the potential to poison a variety of species, including species at risk such as grizzly bears.
- Many occurrence reports from strychnine used at confirmed livestock depredation sites indicate that no carcasses were recovered, but that baits were consumed. For example, between 2005 and 2010, 51 of 93 occurrences of use were associated with no target or non-target carcasses found. A minimum of 800 cubes of strychnine were deployed at these sites, with no recorded information about the number of cubes removed upon termination included on Toxicant Use Records, which are required to be filled out under the Government of Alberta's "Use, Storage and Handling of Vertebrate Toxicants for Problem Wildlife Control and Wildlife Management". Commonly, individual occurrence reports include references to drop baits and laced carcasses being consumed without any carcasses found. This indicates that strychnine is at large in the

food chain, and leading to secondary poisoning elsewhere in addition to likely poisoning non-target animals directly.
- PMRA never calculated risk quotients for strychnine concentrations or use limitations and patterns of Reg. No. 20410 or Reg. No. 24510, and therefore never evaluated the environmental risks associated with its use.

Lack of Value Assessments

- Statistical critique and analysis of data used to justify the value of lethal control of wolves to benefit caribou found that the use of lethal control on wolves — including but not limited to poisoning with strychnine — was never designed appropriately to be able to determine its impact, if there is one. The critique found that the initial analysis relied on insufficient baseline data (e.g. wolf census data), a limited sample size, unbalanced design, unrepresentative use of control scenarios, and irreproducible habitat variability data. Perhaps most glaringly, the critique determined that those involved in the initial analysis failed to publish the null model which argued with equal likelihood that wolf control (and maternal penning) do not explain caribou populations better than habitat variability or random chance (Harding et al. 2020). Such poor design and analysis hamper our ability to corroborate the value of strychnine in the caribou conservation context. For a science-based agency such as the Pest Management Regulatory Agency ("PMRA"), we find it particularly concerning that the value of strychnine has not been evaluated as required under the PCPA. We stress that nowhere in PMRA documentation on maintaining registration for strychnine for the use of killing wolves, coyotes and black bears (Reg. No 20410) or skunks (Reg. No. 24510) has a quantitative value ever been demonstrated.
- Humane and ecologically sustainable alternatives exist to using strychnine (or other poisons) to lethally remove carnivores where conflicts arise between predators and livestock. In addition, contemporary science indicates that lethal and indiscriminate removal of wolves and other large carnivores can backfire and lead to increased levels of conflict, either at the livestock producer's own site, or a neighbouring site.
- Strychnine is not a safe option for targeting wolves which might endanger the safety of people, a rare enough occurrence in itself. Rather, strychnine endangers both the people in the community, and dogs, which are noted by researchers as being the primary driver and strongest correlate of wolf-human conflicts.

Non-Compliance

- Registrant for Reg. No 20410 has not followed the following Product Label directions:
    - Disposal: The registrant failed to incinerate or bury all poisoned carcasses and remaining baits (2018).
    - Use: The registrant set more (average 20 in 2018) than the maximum number of baits (12) at a draw bait site.
    - Use Limitations #5: The registrant failed to check sites at least every seven days (between 2005 and 2019).

Humane Treatment of Vertebrates

- On July 6, 2014 the Canadian Veterinary Medical Association ("CVMA") denounced the use of strychnine in a position statement on pest control due to the severe pain and convulsions it causes. Further, strychnine use is condemned by the American Veterinary Medical Association ("AVMA") and the American Society of Mammalogists ("ASM") and contravenes guidelines set forth by the Canadian Council on Animal Care ("CCAC").
- By hosting a public consultation on "Humane Vertebrate Pest Control" in 2019, the PMRA formally recognized that animal welfare is an important societal concern and responsibility.

II. Background

In Canada, it is legal for registrants to use strychnine to poison several mammalian species.

Alberta Environment and Parks, Fish and Wildlife Policy Division is currently registered to use strychnine as a Wolf, Coyote and Black Bear Control Predacide (Reg. No. 20410) by Health Canada's PMRA until December 31, 2022. This permit has been in place since 1987 (PMRA 2020a).

This permit allows strychnine to be used after confirmed livestock predation events or in response to community safety concerns or declines in prey populations as they relate to wolves, coyotes and/or black bears.

Predacidal strychnine used to poison skunks for rabies control has been registered to Alberta Government's Agriculture & Rural Development Regulatory Services Division since 1996 (Reg. No. 24510). The permit will expire December 31, 2024.

Several low concentration strychnine end products have been in contemporary use for registrants in Alberta and Saskatchewan to kill Richardson's ground squirrels. In 2018, after over a decade of delay, the PMRA proposed a Re-evaluation Decision for rodenticidal strychnine including a plan to cancel its use due to new evidence supporting the findings of unmitigable environmental risk to the wildlife community where it is deployed (PMRA 2018). The only existing permit, for 2% liquid strychnine (Reg. No. 30433), is finally being cancelled by PMRA following a lengthy period of research, re-evaluation and consultations.[1] Since 2005, PMRA has publicized concerns about the environmental risks associated with the use of rodenticidal strychnine, noting in particular that the risks of non-target poisoning are too great and cannot mitigated with label amendments (PMRA 2005, PMRA 2007, PMRA 2018 and PMRA 2020).

In the PMRA's 2005 Proposed Acceptability for Continuing Registration (PACR2005-08) for strychnine, the Agency reported concern for the environmental risks associated with farmers using registered strychnine products to poison rodents, including the inability to detect what is likely a large number of non-target deaths from both primary and secondary poisoning (PMRA 20005). However, the PMRA noted that "the use patterns for predator and skunk control are severely restricted and are only for use by trained provincial or municipal employees in the province of Alberta; these control measures are used very infrequently". The PMRA apparently determined that the aforementioned restrictions and "very infrequent" use precluded predacidal strychnine from an environment risk assessment

[1] Note that Animal Justice, Wolf Awareness, Coyote Watch Canada, Cochrane Ecological Institute, Humane Society International Canada, and International Fund for Animal Welfare Canada filed a notice of objection regarding the three-year phase in period for this ban. The organizations' notice of objection asks that the products' registration be cancelled immediately.

(PACR2005-08; PMRA 2005). In addition to lacking an environmental risk assessment, an assessment of the value of predacidal strychnine was also absent.

Several months after the PMRA drew this conclusion, the Alberta government began using strychnine in a highly controversial program that targets wolves in an attempt to boost declining caribou populations (Government of Alberta E18-G-1236). Under the predacidal strychnine registration, authorized personnel in the Alberta government have been placing this broad-spectrum poison in meat baits intended to kill wolves on public lands in the A La Peche and Little Smoky caribou herd ranges. Occurring almost every winter since 2005, the government-led wolf poisoning program has substantially increased the amount of strychnine being used on the Canadian landscape, and raises serious concerns about impacts on human safety and non-target organisms, including species at risk, in addition to concerns surrounding strychnine's inhumane nature.

Predacidal skunk strychnine continues to be registered for use in Alberta.

Below we outline the new evidence and concerns which we believe are sufficient to warrant the special review of all strychnine end products in Canada, including the technical grade concentrations. Given the lengthy delay of PMRA's recent decision to cancel liquid strychnine used to poison ground squirrels (RVD2020-06), we believe the information summarized below warrants the immediate ban of all strychnine end-use products until such a time when a comprehensive review and value assessment is completed for each. With regard to rodenticidal strychnine, we ask that the 3-year phase out plan be replaced with an immediate moratorium on use and deregistration of Reg. No 30433.

A. Humane Treatment of Vertebrates

It is well known that the use of strychnine is inhumane, given that it causes prolonged pain and suffering prior to death. According to the Canadian Council on Animal Care ("CCAC"), a killing method is "humane" if it causes rapid (immediate) unconsciousness and subsequent death without pain or distress (CCAC 2003). In contrast, death by strychnine ingestion causes frequent periods of tetanic seizures, occasional cessation of breathing, hyperthermia, and extreme suffering (Khan 2010). The list of strychnine poisoning symptoms from the original product label for predacidal strychnine dating back to 1987 (p. 4 Government of Canada ATIA A-2018-001455/NM) lists the following symptoms:

> convulsions, hyperflexia, heightened acuity to prehension, body aches, fists tightly clenched, jaw ([sic] lockjaw; trismus), protruding eyes, fixed stare, cessation of breathing, deep cyanosis, and perspiration, followed by relaxation of symptoms. (One to 10 attacks usually occur before death or recovery.)

The sawhorse stance (Fig 1) and facial rictus (Fig 2) on animals that have died due to strychnine poisoning illustrate the severe pain and suffering experienced by animals prior to their ultimate death.

Figure 1 A lactating dog dead due to strychnine consumption characterized by extensor rigidity. Photo provided by J. Smits courtesy of Western College of Veterinary Medicine, Department of Pathology, University of Saskatchewan

Figure 2 The same lactating dog, close up of facial rictus. Photo provided by J. Smits courtesy of Western College of Veterinary Medicine, Department of Pathology, University of Saskatchewan

Tucker and Crabtree (1970) report apparent painful sensitivity to sound in animals poisoned by strychnine. Death from exhaustion or asphyxiation, which typically occurs within one to two hours of the onset of clinical signs (Khan 2010), can take up to 24 hours or longer if the dose is low (Eason & Wickstrom 2001). Human victims who recover from strychnine poisoning have reported being conscious throughout these agonizing symptoms (Smits 2020 pers. comm).

In an open letter to the PMRA, 50 scientists and organizations requested that strychnine and other predacides be banned across Canada, expressing concern that the use of strychnine violates several established professional standards (2018). The CVMA specifically lists strychnine as an inhumane poison (2014). Furthermore, strychnine use is in contravention of the American Veterinary Medical Association, the American Society of Mammalogists (Sikes et al. 2011) and the International Union for Conservation of Nature regarding management of wolves specifically (IUCN 2000).

It is inappropriate for the federal government to support wildlife management practices that cause significant and prolonged suffering, and are not supported by Canadian and international expert bodies. We are supportive of the PMRA's public consultation on Humane Vertebrate Pest Control and encourage the Agency to revisit the concerns and arguments listed in our submission, and the thousands of comments submitted by members of the public. Given the urgency of this issue, and the thousands of animals impacted each year by pest control practices that cause significant pain and distress, it is our expectation that the PMRA will move quickly to adopt humane use criteria in pest control product evaluations and re-evaluations. We urge the PMRA to adopt such criteria by the end of 2020.

B. Environmental Risk: Threats to non-target organisms including species at risk

As explained below, the use of pest control products containing strychnine poses significant and widespread risks to the environment.

In the 2005 re-evaluation of strychnine (PMRA 2005), risk quotients were only calculated for birds and mammals hypothetically consuming rodenticidal strychnine (0.4% end use concentration) either via eating the end-product (e.g. seed) or poisoned carcasses or prey items. Nowhere in the re-evaluation did the PMRA calculate risk quotients for predacidal strychnine (currently 38.6%, previously 50%), which is currently over 25 times more concentrated than rodenticidal strychnine. Given the significant and widespread environmental risks posed by predacidal baits and their much higher concentration of strychnine, these risks should be considered by the PMRA; we believe they would demonstrate that the environmental risks of these products are unacceptable. The PMRA itself noted that "there is an acute risk to mammalian predators or scavengers" consuming animals poisoned by low concentration strychnine. This risk is even higher for mammalian predators or scavengers, as well as birds, consuming animals poisoned by even higher concentration strychnine.

Existing weekly site check requirements for predacidal strychnine make it impossible to accurately monitor the effects of strychnine once it is placed in an ecosystem. This precludes any accurate assessment of the products' adverse environmental effects, making it impossible to assess the

acceptability of these risks for the purposes of section 17(1) of the PCPA. Nonetheless, there is sufficient evidence that the use of strychnine poses significant risks to non-target animals, including species at risks, and restrictions on products' use are not enough to reduce or mitigate the environmental risks of strychnine. Given the risks of serious and irreversible damage posed by the use of pest control products containing strychnine, the precautionary principle of international law, as enshrined in the PCPA, requires that the registration of these be cancelled in order to protect the environment.

The use of strychnine to kill predators has been prohibited in the US since an executive order signed in 1972. Multiple attempts to revisit this decision by different agencies have been unsuccessful at having this prohibition overturned, due to the well-documented poisoning of non-target and endangered species (US EPA Case 3133). The Environmental Protection Agency ("EPA") further notes that "until such a time that the species may be removed from the endangered species list, any losses due to pesticides are of significant concern" (US EPA 1980).

Strychnine has been most commonly used in rodenticidal end products in Canada. Such end products result in strychnine poisoning of domestic animals, especially dogs, where it has been described as a "common toxicosis" in western Canada (Cowan and Blakley 2015, Addendum II). As noted above, on March 4, 2020, the PMRA announced its decision to cancel the registration of strychnine, and all associated end-use products, used to kill Richardson's ground squirrels, for sale and use in Canada due to environmental risks of concern for non-target organisms, including species at risk (PMRA 2020b). This re-evaluation decision stated that "based on evaluation of currently available scientific information, Health Canada has concluded that the environmental risks…were not shown to be acceptable when this product is used according to the label directions and required mitigation measures". We argue that the evidence we present in this request for a special review of all products containing strychnine warrants a similar cancellation.

The use of strychnine to kill wolves, coyotes and bears in Canada causes environmental risk to non-target species. These risks are known to occur, but are unquantifiable under the existing use limitations set out in Reg. No. 20410.

As noted by the PMRA, strychnine is water soluble, expected to be persistent in soil, and has the potential for bioaccumulation (PMRA 2005). Despite these concerning characteristics, strychnine's persistence and spread in the environment in its current use pattern has not been assessed, giving little confidence that its inhumane impacts can be mitigated. In Alberta's wolf kill program, where Reg. No. 20410 is most used, bait sites are located near or on frozen water bodies (Government of Alberta E18-G-1236 2018). Indeed, seven strychnine bait sites used in 2020 were not inspected as of June 5th, months after poisoning ended, due to the locations being flooded (Hervieux pers. comm. 2020). Given evidence that baits and/or poisoned carcasses with residual strychnine are not being properly cleaned up (see Handy statement, p.2 Government of Alberta E19-G-2041 and S. Fink pers. comm.), and given that strychnine victims leave the area and are not recovered (Government of Alberta 2010-G-0057 and see US Fish and Wildlife Services 1989), strychnine has the potential to enter water bodies and the soil in unknown quantities, where it will dissolve or persist, respectively. Extant quantities of strychnine are thus expected to remain in the ecosystems and continue to impact target and non-target organisms, such as the endangered Athabasca Rainbow Trout (Fisheries and Oceans Canada 2020). Therefore, the PMRA's conclusion that "[a]s strychnine is used as a bait in localized areas, it is unlikely that aquatic organisms will be exposed to substantial quantities of strychnine when these products are used

according to the label directions", contained in its most recent re-evaluation of strychnine, is not scientifically sound (PMRA 2005).

Since 2005, the strychnine program taking place in Alberta targeting wolves in response to caribou declines has killed more non-target species (at least 13 different species in total) and individual animals (~269 total) every year than wolves (~203 total), according to data provided by the predacidal strychnine registrant upon request (see Government of Alberta E18-G-1236 and Hervieux pers. comm. 9 April 2020). Non-target strychnine deaths recorded by government staff include members of the following species: bald eagle, coyote, fisher, fox, golden eagle, grey jay, grizzly bear, lynx, marten, mink, raven, skunk, and weasel (species not identified). Note that strychnine was not used during two winters of this otherwise annual program: 2009/10 and 2018/19.

Similarly, detailed government use records show that between 2005 and 2010, more non-target animals (91) were killed than wolves (79) when strychnine was used in response to livestock depredation (Government of Alberta 2010-G-0057). These numbers are artificially low, given the difficulty of tracking the precise number of non-target animals killed. Indeed, between 2005 and 2009, the same government records show that almost every single strychnine bait site in caribou ranges had strychnine cubes scavenged without carcasses ever being recovered, which would therefore spread strychnine beyond species consuming the cubes and dying at some distance from bait sites and into scavengers feeding on those carcasses.

Registered product No. 20410 has a use limitation which prevents the use of strychnine in areas where species at risk range, with the label stating: "do not apply this product if species at risk that may feed on strychnine bait or on poisoned carcasses are present in your area". To determine whether strychnine has been used in areas where species at risk are known to occur, we asked the Government of Alberta for maps more accurate than those typically included in recovery planning documents (e.g. Assessment reports completed by the Committee on the Status of Endangered Wildlife in Canada). Unfortunately, we were told that "I don't think anyone has invested time in finer scale maps" for species at risk (Court pers. comm. 2017). Such maps would be necessary for local Ministry contacts to direct use patterns on the landscape.

Point data for species at risk occurrences do exist, and despite the use limitation, strychnine is currently being used in Little Smoky and A La Peche caribou ranges where several species at risk, as well as sensitive and rare mammal species, are known to occur. These include the following:

a. **Grizzly bear**: The grizzly bear occurs in these ranges and is a listed as a species of special concern on Schedule 1 under the *Species at Risk Act* , SC 2002 c 29 ("SARA"). The species is classified as threatened by the Government of Alberta (Government of Alberta 2015). Government records indicate that at least one grizzly bear has been killed by strychnine in this program (E18-G-1236), and signs of grizzly activity as well as past carcass remnants have been found at more than one strychnine bait site (Handy 2018). Grizzly bears generally hibernate from approximately late October to late April, although this can vary either later or earlier (McCrory, W.P. pers. comm.). However, grizzly bears can become readily aroused from their state of dormancy during winter sleep (Craighead and Craighead 1972). Some grizzly bears have been known to leave their winter dens for short periods of time, which would make them susceptible during the winter season to having access to strychnine bait sites (McCrory, W.P. pers. comm.). As noted in the

introductory letter of this request for review, killing species at risk such as a grizzly bear is a violation of Alberta's *Wildlife Act*, RSA 2000, c W-10 (s25) and *Agricultural Pests Act*, RSA 2000, c A-8 (s2(2)).

b. **Wolverine:** Wolverines (*Gulo gulo)* are listed as a species of special concern under SARA, and are another species at risk occupying the area where strychnine is used. At least one local trapper has commented that wolverine abundance has declined in an area where strychnine has been deployed (see p. 2 E19-G-2041). Wolverines are scavengers, and are therefore at risk of strychnine poisoning. Indeed, wolverine population declines have resulted from wolf poisoning programs (COSEWIC 2003).

c. **Canada Lynx**: The Canada lynx (*Lynx canadensis)* is classified as a sensitive species in Alberta (Government of Alberta 2015). Between 2005 – 2012, there were three lynx deaths recorded from strychnine poisoning in Alberta's strychnine program for caribou recovery (FOIP E18-G-1236). Another lynx was recorded killed by strychnine in the 2019/20 program (Hervieux via Parr pers. comm. 2020). As with all non-target poisonings, these numbers are likely to be artificially low, with the bodies of most non-target poisoning victims going unrecovered.

d. **Fisher:** Another animal residing in the strychnine zone that is considered uncommon or rare in Alberta is the fisher (*Pekania pennanti),* listed as sensitive in the province (Government of Alberta 2015). A minimum of three fishers have been accidentally killed by strychnine since the program began (FOIP E18-G-1236). Fishers have previously been extirpated due to predator control programmes involving strychnine in central Alberta (Douglas and Strickland 1987).

e. **Weasels**: At least two weasels have been recorded as non-target strychnine deaths (FOIP E18-G-1236). Long-Tailed weasels (*Mustela frenata),* are provincially listed as sensitive in Alberta (Government of Alberta 2015). In 2006, 69 baits disappeared at a single bait site where weasels and coyotes had visited the site, consumed baits, but not recovered. These animals likely died, given that a single cube of strychnine contains more poison than is required for a lethal dose for a weasel.

There is no way to quantify how many small animals were poisoned but became buried by snow and were never retrieved or were consumed by other scavengers before they could be recovered. It is therefore impossible to quantify the environmental risk to their populations at the local or regional scale.

In addition to the above-noted at risk mammal species present in the Little Smoky and A La Peche caribou ranges, several at-risk birds of prey are further threatened by the Government of Alberta's strychnine program. The following species have been documented non-target mortalities at strychnine bait sites laid in caribou ranges since 2005:

a. **Barred owl** (*Strix varia*): This is classified as a species of special concern in Alberta (Government of Alberta 2005).
b. **Prairie falcon** (*Falco mexicanus)*: The prairie falcon is classified as threatened in Alberta (Government of Alberta 2002).

c. **Golden eagle** (*Aquila chrysaetos)*: This is classified as a sensitive species in Alberta. At least two golden eagles have been recorded as non-target mortalities since 2015. The Government of Alberta estimates that only 100 – 250 breeding pairs reside in the province (Government of Alberta 2015).

d. **Peregrine falcon** (*Falco peregrinus)*: This is a federally listed species of special concern (SARA Schedule 1). There have been reports of Peregrine falcons sighted north, south, east and west of the A La Peche and Little Smoky caribou ranges where the strychnine program is underway (eBird 2020).

e. **Great gray owl** (*Strix nebulosa*): This species is classified as sensitive in Alberta, and requires old-growth habitat, much like caribou (Government of Alberta 2015). At least one great gray owl was recorded as a non-target mortality in 2018, well after the strychnine baits were allegedly cleaned up (see Table 1).

Strychnine results in secondary poisoning deaths when scavengers eat from a poisoned carcass. Depending on the stomach contents of a victim, death may be delayed by several hours, allowing the animal to walk away. Indeed, government briefing notes state that "the exact number of these individual kills could not be confirmed since the distance traveled by those animals prior to death precluded recovery" (Hervieux 2008). For example, a bloodhound accidentally poisoned by strychnine laid according to Reg. No. 20410 "travelled approximately 1.5 to 2.0 miles before digging [sic, dying]." (PMRA PIR 2013-2771). More generally, government use records from the first several seasons of strychnine use in Little Smoky caribou range show that most bait sites are visited by wolves, coyotes, weasels and/or unidentified animals, who consume baits and depart without ever being found. This occurred at 14 of 15 bait sites in 2006, 11 of 15 bait sites in 2007, all 22 bait sites in 2008, and 29 of 30 bait sites in 2009 (Government of Alberta 2010-G-0057). The Government of Alberta chose not to disclose this level of detail in subsequent Freedom of Information ("FOI") requests, instead providing only summary data for seasons after 2009. However, given the prevalence of notes indicating that baits had been consumed without carcasses being discovered, it is reasonable to assume this occurs at virtually every bait site, during each and every season of use.

The body of the bloodhound mentioned above was found because the dog was a domestic animal that someone was searching for specifically. In contrast, wildlife poisoned in these remote locations are likely undetected because no one is aware of the precise composition of the wildlife community prior to poisoning and no one is present to track and monitor the poison as it is ingested by animals throughout the ecosystem.

Birds prove even more difficult to track than mammals, and can disperse strychnine baits directly by flying away with poisoned bait or carrion carried in their beaks or talons (Smits pers. comm. 2020). If they are scavenged by other wildlife, strychnine is moved even further via secondary poisoning. For example, investigators found dead birds ranging from 0m (e.g. Site A, Table 1; Fig 3) to 500m (Site N, Table 1) from draw baits at 5 of 17 bait sites active during the early months of 2018. None of these carcasses were identified or collected by the registrant; all were partially or entirely (except feathers) consumed by other scavengers.

Table 1. Strychnine bait sites investigation findings by International Fund for Animal Welfare and Registered Fur Managers Shane Ramstead and Darcy Handy, 2018.

Site ID	Latitude, Longitude[a]	Date span active[a]	No. site checks missed of total weeks active	Carcasses Reported by registrant	Carcasses observed at site explorations
A	54.18982, -117.4688	Jan 18 – Mar 6	3 of 7	March 6: 1 raven	March 13[b]: 2 ravens
B	54.18126, -117.72201	Feb 28 – Mar 29	0 of 4	none	March 13[b]: none
C	54.18652, -117.73080	Jan 18 – Mar 13	2 of 7	none	March 13[b]: none
D	54.06079, -118.19805	Feb 28 – Mar 29	0 of 4	March 29: 1 coyote	July 28[c]: 1 lynx (legs only) 1 grizzly (hide and hair) 1 coyote (fresh, partially consumed) 6 ravens (piles of feathers) 1 owl (pile of feathers, likely Great Grey)
E	53.90715, -118.45989	Feb 28 – Mar 19	0 of 3	none	March 13[b]: 1 raven, 1 grey jay July 24[c]: 1 raven, 1 fox
F	54.51022, -117.87025	Jan 19 – Mar 6	2 of 6	1 coyote 2 ravens	March 14[b]: none
G	54.48489, -117.92816	Feb 28 – Mar 29	0 of 4	none	March 14[b]: none
H	54.46428, -117.99440	Feb 28 – Mar 19	0 of 3	none	March 14[b]: cougar ran off bait site upon arrival

I	54.32738, -118.20207	Jan 19 – Feb 1 (Feb 26[d])	2 of 5	none	March 14[b]: 1 raven, single wolf near bait site (alive)
J	54.2999, -1118.22285	Feb 28 – Mar 29	0 of 4	none	March 14[b]: none
K	54.30855, -118.03627	Feb 28 – Mar 29	0 of 4	none	March 14[b]: none
L	54.35565, -117.82306	Jan 18 – Mar 6	2 of 6	none	March 14[b]: none
M	54.36056, -117.80318	Feb 28 – Mar 29	0 of 4	1 raven	March 14[b]: none
N	54.37047, -117.44911	Feb 28 – Mar 29	0 of 4	1 wolf 1 coyote	March 14[b]: 2 ravens
O	54.40147, -117.69711	Jan 18 – Feb 26	2 of 5	none	March 14[b]: none
P	54.49353, -117.69370	Jan 18 – Mar 6	2 of 6	none	March 14[b]: none
Q	53.74417, -118.26232	Jan 19 – Feb 26	2 of 5	none	Jun 8[c]: 1 wolf 2 foxes 4 ravens Jun 27[c]: 1 coyote (new) 1 fox (new) 1 raven (new) July 29[c]: 2 ravens (new) 1 fox (new)
TOTAL			**17 missed site checks**	**1 wolf** **3 coyotes** **4 ravens**	**1 wolf** **2 coyotes** **20 ravens** **1 lynx** **1 grizzly bear** **5 foxes**

					1 great grey owl **1 gray jay**

[a] Recorded by registrant, see Government of Alberta, E18-G-0389.

[b] International Fund for Animal Welfare, March 13-14, 2020. Accompanied by Landon Delorme, Andrew Thoma and Stewart Cook.

[c] Darcy Handy and Shane Ramstead, multiple site visits during 2018.

[d] Error in the records provided by registrant. Site allegedly closed Feb 1, but records also indicate site checks completed two and three weeks later.

Figure 3 Bird feathers found at Site A (see Table 1). This non-target was not reported in government files.

Lead staff for the registrant recently refused to provide the latitude and longitude for bait sites used in this past season's strychnine program in Little Smoky caribou range "pending a final inspection of the sites to ensure they are safe**"** (Hervieux via Campbell pers. comm. 2020), emphasizing the dangers these sites can pose to the public. Prior to the 2019/2020 strychnine season, no post-season final inspections were conducted.

We are concerned about significant discrepancies in information provided by the registrant regarding the post-season final inspections in 2020. Firstly, final site inspections did not occur until between two to three months after the sites were closed (the sites closed February 19 to March 18 2020, while final site inspections occurred June 2-3 (Government of Alberta E20-G-0611)). Secondly, as described above, the registrant indicated that seven of the sites were not able to be inspected before June 5, 2020 due to flooding. Nevertheless, the registrant provided information to Mr. Handy, a registered trapper in the strychnine use area, on July 24th indicating that all sites had been checked on either June 2 or 3, 2020 (Hervieux pers. comm. 2020). Lastly, eight bait sites close to Mr. Handy's registered fur area were re-checked by government staff on July 22, 2020, the day after Mr. Handy requested the information from the registrant. The discrepancies and the timing and location of the second "final" checks in July suggest that the registrant is not confident that the bait sites are cleaned up and free of carcasses or strychnine even after the final inspections in June, and that the registrant is refusing to be transparent with members of the public about the strychnine program. Importantly, staff from the Government of Alberta's Freedom of Information and Protection of Privacy ("FOIP") office refused a FOI request for these same data and instead prompted Mr. Handy, but not Wolf Awareness, to contact the registrant directly. The data were not disclosed to Wolf Awareness until October of 2020 (Government of Alberta E20-G-0611).

We note that the registrant's commitment to conduct final site inspections only arose in response to concern expressed regularly by Wolf Awareness and Mr. Handy. While these inspections are a progressive amendment to the poison program, they are not enough to prevent wider transmission of strychnine throughout the landscape mediated by secondary poisoning via undetected carcasses or missing drop baits throughout the entire time the program is active. Moreover, these site inspections are hampered by the site selection process; more than 20% of strychnine bait sites were not able to be inspected, either adequately or at all, for up to three months after sites were deemed closed due to local flooding (Hervieux pers. comm. 2020). Indeed, during the March 13-14, 2018 investigations conducted by staff with the International Fund for Animal Welfare ("IFAW") during the active poisoning season, investigators noted rapid thawing in snow that was exposing blood and other particulate matter in the snow piles where baits are buried. Rapid thawing of large amounts of snow in the back country can occur quickly and be compounded by river thawing (bait sites are commonly and notably placed on or adjacent to frozen rivers (e.g. sites E, J (Fig 4), L (Fig 11), O, P (Fig 5) and Q in 2018; Fink 2020 pers. comm)). Such thawing and flooding would loosen left-over strychnine baits or other small quantities of biological material containing strychnine (e.g. parts of carcasses) into the underbrush or into the water bodies, making it impossible to collect.

Figure 4. Aerial photograph of Site J shows the proximity of bait piles and draw bait to a water body.

Figure 5. Site P shows draw baits and strychnine bait piles are located on a frozen river. Open water patches visible at top of photo, to right of shrubs.

These factors reduce the ability of those conducting the recently-implemented final site inspections to collect any missing baits or carcasses. These visits are not enough to prevent lethal quantities of strychnine in carcasses or baits from persisting in the local environment and within carcasses of scavengers.

C. Inadequate risk mitigation of current use limitations and concomitant non-compliance

We present the following information in this section as a summary of growing concerns based on recent findings which have previously been presented to the PMRA in the form of testimonials (e.g. Handy 2018, Fink 2019); public incident reports (PIR; e.g. PIR 2018-5366); photographs and briefings presented at in-person meetings with PMRA staff; published journal articles (e.g Hervieux et al. 2014); materials obtained from the registrant that should have been requested by the Minister in accordance to PCPA SOR/2006-124 s. 8 when the Reg. No 20410 was renewed in 2017 (e.g. Government of Alberta E18 – G-1236; and internal inspections conducted by PMRA compliance staff (see Government of Alberta E18-G-0389).

i) **Site check and clean-up requirements, and reporting of non-target mortality**

The Product Label requirement for weekly bait site checks appears insufficient to protect non-target animals, including endangered species, from poisoning. We request that PMRA immediately calculate the required risk quotients, and calculate the total number of animals that could be primarily or secondarily poisoned under the current use pattern of Reg. No. 20410 in Alberta, specifically addressing the possibility that all baits could be consumed and moving through the food chain at significant distances from the bait site via secondary poisoning within seven days between site checks. Government of Alberta records obtained in 2010 show that between 2005 and 2009, it was not uncommon for dozens of baits to be added to sites where strychnine baits were being consumed without any carcasses, target or non-target, being recovered (Government of Alberta 2010-G-0057). Indeed, a wolf carcass that had been scavenged was found by recreational snowmobilers in the Little Smoky vicinity, and within two days the carcass was almost completely gone, with only “a few bones on a highly scavenged skeleton” (Fig. 6; Ramstead, S. 2020 pers comm). Scavenging, and therefore the travel of strychnine through the food chain and the natural degradation of poisoning evidence – whether non-target or target -- occurs much faster than the seven day check use limitation could control, even if it were being adhered to.

Figure 6. This wolf carcass discovered at an active bait station in Little Smoky range was entirely consumed 2 days after the animal was detected and photographed by recreators.

Throughout the PMRA's registration evaluations of strychnine, they have relied on the expert conclusions drawn in the U.S. by the EPA. Of particular importance is the difficulty in determining and collecting poisoned wildlife.

Information received in response to an Access to Information and Privacy ("ATIP") request submitted to the PMRA (Government of Canada 2019 A2019001232) indicates that the Agency was aware that the U.S. Fish and Wildlife Service's biological opinion on the use of above-ground strychnine emphasized the difficulty in recovering poisoned grizzly bears "due to the wide ranging habits", acknowledging the distances they regularly travel (1989). Wide ranging behaviour led the EPA to conclude that "the levels of incidental take permitted were "unquantifiable" for certain endangered species and zero for others" when examining non-target mortality (US EPA Case 3133). As such, the PMRA should review with extreme caution the data presented by registrants from weekly site checks, given that this data is likely not representative of actual non-target mortality. It is much more likely that significantly more non-target animals have been accidentally killed and not found or reported due to repeated scavenging events or snow cover.

Indeed, testimony presented to multiple government officials in the Government of Alberta's Fish and Wildlife Enforcement Branch (August 4 and 11 2018, see p. 5 Government of Alberta E18-G-2041) and

Ministry of Environment and Parks (October 18 2018, see p. 6 Government of Alberta E18-G-2041), as well as the PMRA (Public Incident Report 2018-5366 and Handy 2018), from Mr. Handy, who is licensed to a Registered Fur Management Area (RFMA), indicates that it is possible for grizzly bears to be poisoned at strychnine bait sites either following site deactivation, or during active poison days and yet remain unrecorded. Mr. Handy found a strychnine bait site in 2012 (hereafter Site R). Two weeks after initially finding Site R, Mr. Handy and his licenced trapping partner investigated the surrounding meadow and found raven feathers at the base of a tree 75 yards from the bait site, and fox tracks leading from the feathers into the nearby forest, indicating that the raven had fallen from the tree and been scavenged by a fox. Several months later, when the site was explored for a third time during a hunting trip, the carcass of a coyote was found, along with the grizzly bear remains approximately 200m from the draw bait. The bear's death most likely occurred after the site was closed, given that no bear was recorded by the registrant as a non-target victim in 2012, not at Site R or any other site (Government of Alberta E18-G-1236), and that the bear skull and hair were not found until Mr. Handy's third site visit (Handy 2018, see p.2 of Government of Alberta E18-G-2041). It seems unlikely that the carcass of a grizzly bear could be missed during required site checks.

Many large mammals are capable of traveling long distances, and therefore moving strychnine around on the landscape, without being collected or even identified to be counted as non-target deaths. In June 2018, site Q (Table 1) was located by Mr. Handy while he was exploring the area in and around his RFMA. There he found a dead, partially scavenged wolf near a poison warning sign. The deceased animal was laying on its side in the shrubs. Despite records obtained later through a FOIP request indicating that the site had been closed for months, two foxes and four ravens were found around the bait site. Signs of a grizzly bear were observed in the adjacent meadow.

Three weeks later, when Mr. Handy returned to Site Q to explore the nearby timber stands, he found the remains of a dead fox, a coyote and a raven. In July 2018, Mr. Handy once again revisited the site and found two dead ravens and one freshly scavenged fox.

Government records indicate that no target or non-target species were reported as killed at this site (p. 28 Government of Alberta E18-G-0389), and that the site was closed on February 26, 2018 "following heavy snow accumulation". Registrants later claimed in multiple internal communications that they had missed "a single dead wolf" which resulted in several more non-target mortalities via secondary poisoning (p. 36-39 Government of Alberta E18-G-0389).

The results of this missed carcass, assuming that it was a single dead wolf and not several carcasses, axiomatically demonstrates the significant environmental risk associated with a single carcass causing strychnine to persist in the food chain. Moreover, given that many scavenging species are by their nature cursorial, the impacts from a single site are undoubtedly far larger than has been reported.

We note that the registrant did not even pick up the poison signs at the final check at Site Q, perhaps because it was buried in snow which may or may not have also been covering the wolf and/or other carcasses if they were poisoned prior to site deactivation.

Smaller animals have also failed to be recorded by the registrant, as noted by investigators visiting bait sites in March, midway through the 2018 poison season (Table 1). Aerial and ground-based investigations located two active sites where non-target animal carcasses failed to be recorded by the registrant (Sites E and N), indicating either failed detection events or complete scavenging of the

poisoned carcasses before the subsequent site check. At two deactivated sites, ravens were located at Sites A and I. It is unknown whether these animals were not detected during site deactivation, or occurred following deactivation from either remaining baits or poisoned carcasses.

Given the large number of wildlife tracks leading to and from many of the sites, it is impossible to determine how many animals scavenged at each bait site before dispersing, and possibly dispersing strychnine as well.

The fur manager's findings were provided to the Government of Alberta, among others, repeatedly (August 4 2018, August 11 2018 and October 8 2018 (see p. a E18-G-2041)). However, the registrant did not conduct their own site investigation until December 5, 2018, after having these findings publicized on CBC (Snowdon and Cummings 2018). We believe this lack of action is symptomatic of the normal winter weather conditions which often preclude safe site checks at least once every seven days as required under Reg. No. 20410.

Regular snowfall events also reduce carcass detection at site checks when they do occur. For example, Government of Alberta staff noted that they were unable to find any other biological material in the meadow other than the wolf carcass after searching for two hours because there was 10cm of snow on the ground (E18-G-2041).

If 10cm of snow precludes finding carcass remains, then baits cannot be fully recovered during bait site deactivation. This applies especially if the piles have been disturbed by wildlife, and if there has been any snowfall between site checks. For example, an intact bait (Fig 7) was located in a bait snow pile that had been partially dug out by a large canid at Site I in 2018 (Fig 8). The bait was later confirmed to contain high levels of strychnine (University of Guelph Animal Health Laboratory 2018). FOIP data alleged that Site I was deactivated on February 1 or February 26, 2018 (Government of Alberta E19-G-0389).

Figure 7. Strychnine bait discovered in a partially disturbed snow pile at a deactivated site.

Figure 8. Canid tracks show where snow pile has been partially dug out after not being cleaned up in February as claimed.

Furthermore, if 10cm of snow precludes finding carcass remains, then non-target and target mortalities cannot be accurately located and recorded with weekly site checks if there has been snow between checks. For example, the remains of scavenged birds are often feather and small quantities of tissue, which can easily be covered by a light snowfall (e.g. Fig 9 taken at Site I).

Figure 9. Feathers, and very little tissue and bones remain after birds are scavenged. This can easily be obscured by snowfall and be undocumented.

These conclusions are corroborated by a statement made by Government of Alberta staff about site investigations that occurred in December 2018 at sites A, L, and Q and 18-15 (see registrant site ID in records), which were chosen "due to the notes from bait site investigations from winter 2018 which indicated there could be carcasses missed due to high snowfall" (p. 18 of 50 Government of Alberta E18-G-2041). These notes regarding snowfall were not produced in FOIP records, therefore we are unable to determine how often this happens.

If snowfall prevents proper site checks, deactivations and final inspections, then strychnine should not be deployed.

We are further concerned that site checks and deactivations that are being conducted are not thorough enough to locate baits and carcasses, given the large number of checks and closure events that government records show happen on single days. For example, data provided to the PMRA during a compliance inspection instigated by concerns from the public (Government of Alberta E18-G-2041) indicate the following:

- February 1st, 2018: seven bait sites were checked and 1 bait site was closed.
- February 6th, 2018: 10 site checks occurred.
- February 15th, 2018 17 sites were checked.
- February 26th, 2018: nine sites were checked and eight sites were closed.

- March 6th, 2018: six sites were closed and 13 sites were checked. Site A was supposed to be closed, but either they did not discover the raven remains, directly visible on the draw bait, or they did not collect them for incineration. Only one of the two ravens present were documented.
- March 13th, 2018: one site was closed and 12 sites were checked, including Site D where the registrant did not notice/record a dead grey jay or a dead raven near the draw bait that IFAW discovered on March 14th.
- March 19th, 2018: four sites were closed and eight sites checked.
- March 8th, 2018: eight sites closed.

It is unlikely that so many site checks and/or closures can occur on a single day and result in adequate site clean up. Indeed, it requires a significant period of time to ensure that baits are no longer in place below snow piles (S. Fink pers. comm 2020). Upon review of photographs taken of several sites investigated by IFAW staff, it is apparent that site deactivation was not completed at every site as marked in the registrant's records.

At Site P (Fig 5), where the site was deactivated one week prior to IFAW's aerial and ground investigation, photographs show clearly that the snow piles where baits are hidden had been dug out by people and the baits removed (Fig 10).

Figure 10 Shovel marks and relative fresh human tracks leading to a dug out bait pile at Site P. Detail of Fig 5.

Several sites that FOIP records showed as deactivated when site visits were made by IFAW can be seen to have intact snow piles, indicating that baits were not removed in some areas (e.g. Site I, above; Site L see Figs. 11 and 12).

Figure 11. Aerial photograph of Site L, apparently deactivated on March 6th, had 8 of 10 bait piles still intact on March 14th 2020. Note the sections of open water at centre, top of photo, indicating the bait site is located on a frozen river.

Figure 12. Site L, detail. Of ten strychnine bait piles, only the bottom two have been dug out (see shovel marks and relatively fresh human snowshoe tracks). Note also very fresh canid tracks visible between helicopter landing pads.

Additionally, despite the PMRA compliance inspector asking the lead staff of this Government of Alberta program for "records of bait collection for bait sites listed below from September 2017 – July 2018, showing dates bait sites were collected, who collected the baits, and how much bait was recovered", most of this information was not provided other than the staff person saying "we remove all of the drop baits" (p. 36 Government of Alberta E18-G-0389) and providing site closure dates for all bait sites, one of which was erroneous.

If no records were provided, the PMRA simply cannot be sure that strychnine is being removed from the landscape and that baits and carcasses are incinerated or buried as per the Use Limitation 7 in Registration No. 20410 for predacidal strychnine. Furthermore, it is concerning that this question was not further investigated by the compliance inspector, based on the records obtained in the FOIP request.

Concerned that this improper clean-up of a strychnine bait site was related to anecdotal observations of significant reduction in scavenging species — including wolverines, ravens and coyotes — Mr. Handy decided to visit additional bait sites in July 2018 that were identified in FOIP records (Government of Alberta E18 – G-1236). Only one site was reachable during snow-free months in addition to Sites D and Q, which he visited in June. Nonetheless, animal remains found at all three sites that he visited that

summer corroborate our concerns; concerns which were in no way addressed by the compliance inspection that occurred in late 2018 by PMRA.

Carcasses of non-target animals that were not listed in the Government of Alberta records from Site D include:

- one raven and one grey jay,
- feathers from at least five ravens,
- one fresh coyote carcass (skull only),
- legs of a lynx,
- feathers from at least one owl (likely great grey owl),
- fur and hide from at least one grizzly bear, and
- fox scats around all consumed ravens (but no fox carcasses).

Echoing the US EPA, we agree that "although no chemical analyses for strychnine were conducted, it would be unreasonable to assume that the observed mortality was somehow independent of the baiting operation" (US EPA 1980). The EPA stresses that without radio telemetry, researchers studying non-target mortality from convulsant ingestion would not have been able to locate accidentally poisoned animals, either because detectability is low, or because species are wide-ranging and die at significant distances from bait sites. They refer to two studies; one including mammals (Hegdal et al 1979) and one including birds (Hedgal and Gatz 1976), which we bring to your attention.

Any unabsorbed residues in the gastrointestinal tract of animals that ingested a lethal dose and quickly died "could be sufficient to poison a raptor or carnivore ingesting it" (US EPA 1980). The PMRA is aware of a study summarized by McKinnon et al. which found that 34% of coyotes, 30% of ferruginous hawks and 45% of Swainson's hawks did not eviscerate strychnine killed prey before consuming them, putting them at risk of secondary poisoning (McKinnon et al. 2002). Evidence of scavenging on all of the carcasses found at the sites visited by Mr. Handy indicate that secondary strychnine poisoning is likely happening at significant distances from the bait sites; such mortalities would not likely be identified by helicopter scouting or ground investigation of the bait site itself.

Use limitations set by the PMRA for predacidal strychnine are unrealistic and inadequate. For instance, Use Limitation 5 requires that "Baits shall be checked at least every 7 days". Using strychnine in winter in a remote area such as the Little Smoky caribou range precludes compliance with this limitation. As noted by the lead staff for the registrant, there were no checks the week after the baits were laid at 19 sites in (2018). The following week, only eight of the 19 sites were visited. Similarly, site visits were limited the following week – the other 11 of the 19 total sites were checked, but none that were checked the week before (p. 28 Government of Alberta E19-G-0389). In fact, the methods of this program described in a 2014 publication in the Canadian Journal of Zoology (Hervieux et al 2014) state:

> Beginning in the winter of 2005–2006 and continuing to 2011–2012 (with the exception of winter 2009–2010), on average, 15–20 toxicant [strychnine] bait stations were active within the LSM caribou range at any given time during midwinter to late winter only...**Bait stations were checked, on average, every 8 days**; at which time, any wolf carcasses were promptly removed and incinerated. All baiting stations were removed prior to the onset of spring thaw.

It is unclear whether this publication was provided to the PMRA when it was published by the registrant. In any event, the PMRA appears to have failed to identify this widespread non-compliance with site check requirements. In 2018, the time between bait site check days were as follows:

- 14 days (Jan 18 – Feb 1)
- 5 days (Feb 1 – Feb 6)
- 9 days (Feb 6 – Feb 15)
- 11 days (Feb 15 – Feb 26)
- 8 days (Feb 26 – Mar 6)
- 7 days (Mar 6 – Mar 13)
- 6 days (Mar 13 – Mar 19)
- 10 days (Mar 19 – Mar 29)

Therefore, even if the registrant had the time to adequately check and/or close all sites on each check day, the amount of time between said checks still violated the Use Limitation, exacerbating detection failures and negatively impacting the legally required environmental risk monitoring.

Label requirements cannot prevent public safety incidents if they are not heeded. In addition, human error and accidents occur (e.g. Public Incident Report 2011-2114) and are under-reported (PMRA pers. Comm. 2018), likely because "citizen apathy and lack of knowledge that the incident should be reported and to whom can hamper the notification of incidents to authorities" (Vyas 2017). It is worth repeating that Mr. Handy notified authorities at PMRA directly on October 25, 2018, and at the provincial level (August 4 and 11, 2018) of his findings of a partially consumed wolf carcass and non-target strychnine victims after the winter program had ended. We are concerned that the PMRA has not responded to Mr. Handy to investigate this incident, given the evidence of non-compliance with label requirements and resulting environmental risks. Our understanding is that following Mr. Handy's complaint, the PMRA's only action was to make inquiries with the registrant who is responsible for meeting label requirements and abiding by use limitations.

ii) Maximum quantity of strychnine used at bait sites

The Government of Alberta placed 576 strychnine baits in 29 locations in 2018 (E19-G-0389). In addition to this being a startling amount of strychnine being laid on the landscape with the limited "success" of having killed only seven wolves, we note that these baits were placed in violation of the Product Label. The Product Label sets out the maximum number of baits that can be placed around an unpoisoned draw bait at 12 (Reg. No. 20410), a maximum which has been in place since at least 2004 (Xie 2004, see p. 563 Government of Canada A2019001232), before the strychnine program began in Little Smoky. In 2018, the registrant laid 20 baits at the vast majority of bait sites (28 of 29 total sites; 2 baits per pile, 10 piles per site), and laid 16 baits at the 29th site (2 baits per pile, 8 piles, see p. 32 Government of Alberta E19-G-0389 2019).

Based on government records of the compliance inspection, it appears that the inspector failed to note that the registrant was deploying far more baits at each site than is allowed. It is difficult to have confidence in inspections conducted by the PMRA given this knowledge.

The max rate/site is listed as 0.465g for wolf poisoning (Xie 2004, see p. 572 Government of Canada A2019001232). The EPA estimates that 1.1-1.8mg/kg of strychnine is in the potentially lethal range for humans (EPA 1996, and see p. 564 Government of Canada A2019001232). Therefore, each bait site could theoretically contain enough strychnine to kill three to five 80kg adults and should be carefully monitored to protect human health and safety. These significant risks to human health further demonstrate that the risks of strychnine are unacceptable and the PMRA should immediately cancel the registration of all products containing this dangerous poison.

iii) Signage

Warning signs required to be placed directly at bait sites, as well as at access points leading to predacidal strychnine bait sites (Reg. No. 20410, Use Limitation 4), could become buried during snowfall (Fink 2018). One warning sign was left at a site despite records indicating that the site was closed (Handy 2018), leading to confusion on the part of members of the public.

Significant snowfall events regularly hamper aerial site monitoring, and may also bury signs. Land users who travel at ground level are therefore not adequately protected by signage requirements. Indeed, two bait sites active in 2018 were adjacent to snowmobile trails (Fink 2018).

Where an animal that is the victim of primary or secondary strychnine poisoning travels a significant distance from a bait site before dying, the animal will nonetheless have residual strychnine in its gastrointestinal tract and other carcass tissue. The presence of this poison will be unknown to any members of the public who come across the animal's carcass and investigate the cause of death. The danger is especially alarming given that not all registered fur managers have been notified of the poison program occurring in their area (p. 2 Government of Alberta E18-G-2041) despite the insistence by the registrant that "discussions have occurred with individual Registered Fur Management Areas" (p. 34 Government of Alberta E18-G-0389) as per provincial procedures (Alberta Sustainable Resources Development 2009).

Given the high toxicity of this poison, even sporadic non-compliance with Health Canada's conditions for use should indicate that the risks to human health outweigh any perceived benefit of strychnine use.

D. Human health

Strychnine is a broad-spectrum poison that poses a threat to the health and safety of Canadians**.** The Minister has a statutory duty under the PCPA to prevent unacceptable risks to human health. This includes initiating a special review of the registration of a pest control product where she has reason to believe that the health risks posed by the product are unacceptable (s 17(1)). As a matter of global security, strychnine has been listed as a potential biological warfare agent (Hickman 1999). The US EPA rates strychnine as a Category 1A toxicant, the most acute class (US EPA 1996). Strychnine is highly toxic to many animals, and in 2005, Health Canada emphasized "the primary health concern with any strychnine formulation is its acute toxicity to humans".

E. Value

The value of strychnine for the purpose of Permit No. 20410 for Strychnine for Wolf, Coyote and Black Bear Control is purported for three use scenarios, which we address independently. As explained below, the serious health and safety risks and environmental risks posed by strychnine far outweigh any potential benefits. Since the PMRA's 2005 re-evaluation, there has been increasing scientific evidence of the unacceptably low value of strychnine.

i) Where property damage due to predation has occurred and where adequate protection is being provided to other domestic animals

There is no sound evidence to support claims that strychnine reduces predation on livestock, unless predators are extirpated. Thus, the value of strychnine in this regard is unacceptable given that it is not effective at reducing loss of livestock and there are other methods to achieve this objective that are safer, more effective, and better for the environment and the welfare of animals. See Addendum I *Lethal Predator Control and Livestock Loss* for further detail.

ii) To ensure the safety of people particularly in and around remote northern communities.

Humans determine where and how wolves can exist, yet wolves will exploit niches near or in communities at times (Thiel et al. 1998), especially if they are diseased, injured or have learned to associate people with food rewards, whether or not this was done intentionally. Ultimately, wolves will react to people based on their past experiences. Conversely, on our part, irrational cultural perceptions dominate our understanding of, and behaviour toward, them (Fritts et al. 2003).

Conflicts between wolves and humans are very rare in Canada (Fritts et al. 2003). Increases in encounters documented in recent decades may be due to increased media coverage, and increases in the number of people visiting wolf and other carnivore habitat (Penteriani et al. 2017). Direct human-wolf conflicts are typically limited to charging, biting, and displays (McNay 2002a and 2002b). The vast majority of incidents characterised as "aggressive" that led to a wolf biting a person (11 of 13 cases known during the 1900s) occurred with wolves that had a high proximity tolerance to humans. In order to reduce and prevent conflicts, it is therefore essential to educate people on how to prevent wolves from becoming too close, by managing human attractants, behaviour, and pets while displaying responsible etiquette in areas where wolves live. Aversion conditioning, dog leashing, public education, and bylaw enforcement are the most effective tools to prevent and resolve conflict scenarios (Sampson and Van Patter 2020). The use of poison in communities where wolves are developing an increased proximity tolerance to people and human infrastructure will not only fail to solve the root cause of conflicts, but also endanger people, pets, and wildlife. Dogs are commonly off-leash in remote and northern communities, putting them in direct danger of being poisoned. The use of strychnine for reasons of public safety is not scientifically justified and poses significant risks to humans, as well as wild and domestic animals.

iii) When predation has been shown to be one of the primary mortality factors which is limiting a specific wildlife population density, and where the wildlife population is threatened with extirpation, or where the wildlife population is economically or ecologically important

The effect of strychnine on population trend changes in Alberta's caribou herds has never been analyzed. Indeed, the conclusions drawn from weak statistical analysis of the effect of all lethal control of wolves on caribou in western Canada (Serrouya et al. 2019), including the use of aerial gunning and strychnine poisoning, have recently drawn peer-reviewed criticism (Harding et al. 2020). Stated simply, the use of lethal control on wolves was never designed appropriately to be able to determine its impact, if there is one. Harding et al. found that Serrouya et al.'s analysis relied on insufficient baseline data (e.g. wolf census data), a limited sample size, unbalanced design, unrepresentative use of control scenarios, and irreproducible habitat variability data. Perhaps most glaringly, the authors found that Serrouya et al failed to publish the null model which argued with equal likelihood that wolf control (and maternal penning) do not explain caribou populations better than habitat variability or random chance (Harding et al. 2020). Such poor design and analysis hamper our ability to corroborate the value of strychnine in the caribou conservation context. For a science-based agency such as the PMRA, we find it particularly concerning that the value of products containing strychnine has not been evaluated, despite clear legislative requirements to evaluate products' value prior to their registration.

With respect to lethal control of wolves using strychnine, during the last two seasons in which strychnine was laid in Little Smoky, 29 and 32 bait sites killed only five and seven wolves, respectively. While we recognize that more wolves were likely killed without being noticed due to the issues we have detailed in our request above, the fact that so few wolves were allegedly poisoned does not substantiate Hervieux's argument that "a reversion to negative population growth for Little Smoky caribou was observed in the year with no toxicant program delivery" (E19-G-0389). This single instance provides no statistical power to detect that the value of strychnine's effect on caribou population trend change and is therefore an inappropriate basis for a value assessment.

Moreover, wolf kill programs fail to consider the immediate and long-term effects that this type of "management" has on wolf populations, other wildlife, and biotic-abiotic interactions at the ecosystem level. Such programs can create an ecological debt that falls on future generations to recover, if they can. Strychnine use and any other management practices aimed at wide-scale reduction of wolf populations are contrary to the precautionary principle and the principle of intergenerational equity, and violate the government's duty to protect and conserve Canada's wildlife as a public trust for current and future generations of Canadians.

The Minister should initiate a special review and cancel the registration of products containing strychnine given the significant health and environmental risks posed by these products and our corresponding lack of scientific evidence demonstrating how killing wolves may impede essential behavioural adaptation in caribou, or impact predation of caribou by other large carnivores which may increase or decrease in complex ways due to the presence of poison, and also fewer wolves, on the broader landscape. Moreover, given the caribou's poor defence mechanisms against predation (i.e. they avoid predation risk better than they are able to escape direct predation or defend against a predatory attack), per capita predation rate by wolves might be increased in areas where strychnine or other wolf killing methods are used because the hunting unit (pack) of wolves is likely affected when their social structure breaks down after some wolves survive. It is likely easier for a lone or small wolf pack to kill a caribou than it is to kill a moose or an elk, which defend themselves. Because habitat destruction and fragmentation has led to more caribou-wolf encounters, it stands to reason that this possibility must be

explored before continuing to kill members of a predatory species without adequate evidence to support the success of this program at meeting the population objectives for caribou.

III. Conclusion

Compelling and comprehensive scientific evidence demonstrates that risks to human safety and the environment are unacceptable when strychnine is used according to the current conditions of registration, and that no additional or stricter limitations are not a sufficient means to mitigate these risks. Moreover, there is little evidence in support of the purported value of predacidal strychnine. This is the reality despite PMRA's assurance that a highly regulated government registrant controls the deployment, monitoring and reporting on its use. These concerns also apply to the use of strychnine to kill skunks (Reg. No. 24510). As such, we request that the Minister initiate a special review and cancel the registration of all strychnine-containing products. Canada should promptly enact a nationwide ban on the use of strychnine as a pesticide under the PCPA.

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