Addendum I: Lethal Predator Control and Livestock

SUPPLEMENTAL TO SPECIAL REVIEW REQUESTS

I. Summary

There are three poisons used in Canada to kill large carnivores to ostensibly manage predation on livestock: strychnine, Compound 1080, and sodium cyanide. The Alberta government holds four permits for the use of these poisons and Saskatchewan holds two. The six permits for poisoning carnivores for agricultural purposes are as follows:

Alberta	Saskatchewan
Compound 1080 permit 18300	Compound 1080 permit 28865
Compound 1080 permit 24512	Compound 1080 permit 25857
Sodium Cyanide permit 25108	
Strychnine permit 20410	

Despite the controversial use of strychnine, Compound 1080, and sodium cyanide, the Pest Management Regulatory Agency ("PMRA") has not required registrants to substantiate the effectiveness of these poisons in terms of their efficacy at reducing predation on livestock. Rather, the PMRA's only consideration assessing the effectiveness of a poison has been in its ability to cause death. However, a growing body of scientific evidence suggests that lethal removal of wolves and large carnivores can exacerbate predation on livestock (Cooley *et al.* 2009a, Cooley *et al.* 2009b, Krofel *et al.* 2011, Peebles *et al.*2013, Wielgus and Peebles 2014, Fernandez-Gil *et al.* 2015, McManus *et al.* 2015, Santiago-Avila *et al.* 2018a, Nattrass *et al.* 2019). In an evaluation of lethal control in the management of human-wildlife conflict, Treves and Naughton-Treves (2005) summarized (pg. 98) that both selective lethal control and culling programs were short-lived in effectiveness and incurred high rates of death of non-target animals. Although the poisons listed above are efficient at killing animals, their value is unacceptable because there is little to no sound evidence to indicate that poison is an effective method for reducing predation on livestock – with the exception of complete carnivore extirpation.

The primary purpose of Canada's *Pest Control Products Act*, SC 2002, c 28 ("PCPA") is to "prevent unacceptable risks to individuals and the environment from the use of pest control products" (s 4). The Act's preamble recognizes that this objective is in the national interest, and the corresponding need to ensure that:

> …the federal regulatory system be designed to minimize health and environmental risks posed by pest control products and to **encourage the development and implementation of innovative, sustainable pest management strategies**, for example by facilitating access to pest control products that pose lower risks, and **encouraging the development and use of alternative, non-toxic, ecological pest control approaches, strategies, and products.** [emphasis added]

This requirement is further reflected in the Minister's duties under section 4(2)(b) of the Act. As such, the Minister should encourage livestock producers, wildlife managers and policy makers to invest resources in developing and implementing ethical and ecologically sound methods to prevent predation on livestock instead of reacting to predation events with dangerous poisons.

Furthermore, the Minister must ensure that only those pest control products that are of acceptable value are approved for use in Canada (s 4(2)(d)). "Value" is defined in the Act as meaning:

> …the product's actual or potential contribution to pest management, taking into account its conditions or proposed conditions of registration, and includes the product's (1) efficacy; (2) effect on host organisms in connection with which it is intended to be used; and (3) health, safety and environmental benefits and social and economic impact. (s 2(1))

There is a lack of evidence to support the efficacy of lethal control when it comes to reducing future predation rates (Treves *et al.* 2019, Lennox *et al.* 2018), yet this is where the focus of management efforts using these products is channeled. Killing wolves following a predation event (or pre-emptively) does not ensure that future livestock predation events will not occur (Musiani *et al.* 2005); livestock predations continue in jurisdictions using poison. Where conflicts occur among wolves or other carnivores and livestock, the response variable that would indicate success of a given treatment or management action is a change (i.e. reduction) in livestock losses.

We provide this information to be included as part of our requests for special review of all pest control products containing strychnine, Compound 1080, and sodium cyanide. Lack of scientific evidence demonstrating the "value" of products containing these poisons with respect to decreased livestock loss to predators is an important rationale when considering current and future use of these poisons. Assessing the value of poisons used to kill wildlife must include assessing the efficacy of these products in reducing the number of livestock killed by target predators, as well as sustainability and social and economic impacts of cancelling these products' registration.

In addition to a lack of scientific evidence to demonstrate that the use of poisons decreases livestock loss to predators, the availability of poisons deters the development of alternative methods that are humane and more ecologically responsible.

We assert that questions surrounding the functional efficiency of these poisons, in addition to concerns surrounding morality and ecological impacts, deem their continued use unacceptable. There are more dangers associated with these poisons than there are benefits. They should be removed from the toolbox of allowable management practices in Canada.

II. Value Assessments under the PCPA

Despite continuation of the controversial practice of using poison in an effort to decrease predation on livestock, there is scant evidence to indicate that poisons are effective for this purpose, unless the predator guild is removed in entirety. The only study that we could find that has claimed effectiveness of poison (Bjorge and Gunson 1985) is more than 30 years old and was strongly refuted and rebutted on the grounds that the testing involved a flawed design which is inadequate to support reliable inference (Treves *et al.* 2016 - Webpanel 1 of Supporting Information).

In contrast, there is a growing body of scientific evidence which speaks to i) the ineffectiveness of lethal control on reducing predation on livestock (Krofel *et al.* 2011, McManus *et al.* 2015, Fernandez-Gil *et al.* 2016, Lennox *et al.* 2018); and ii) the counterintuitive effects that lethal control of predators can have on livestock predation (Peebles *et al.* 2013, Wielgus and Peebles 2014, Santiago-Avila 2018, Natrass *et al.* 2019).

Treves *et al.* (2019) summarize as follows:

> Since at least 1983, scientists have questioned whether predators that survive control operations pose fewer, the same, or more threats after removal of their conspecifics (Tompa, 1983; Haber, 1996). Related to this, the literature is unclear whether and how the response of survivors might differ from response to other mortality causes. In some cases, newcomers might kill more domestic animals than previous residents had killed because social networks might be disrupted, as reported in cougars (Cooley *et al.*, 2009a,b; Peebles *et al.*, 2013); or survivors might turn to domestic animals when their conspecifics have been removed (Imbert *et al.*, 2016; Santiago-Avila *et al.*, 2018a), and other "spill-over" effects (Santiago-Avila *et al.*, 2018a).

Concurrently, knowledge continues to grow surrounding non-lethal alternatives aimed at preventing future conflicts among carnivores and livestock (Musiani *et al.* 2003, Shivik, *et al.* 2003, Shivik 2004, Treves and Naughton-Treves 2005, Shivik 2006, Barnes 2015a, Miller *et al.* 2016, Treves *et al.* 2016, Eklund *et al.* 2017, Stone *et al.* 2017, Moreira-Arce *et al.* 2018, van Eeden *et al.* 2018, Treves *et al.* 2019).

Other questions worthy of consideration when it comes to using poison to ostensibly prevent future predation of livestock include: how long the use of the poison will work, what the best approach to use is in a given ecological context, and what the long term costs of using the poison may be (Breck *et al.* 2012).

In light of the seriousness of the dangers presented by these poisons, it is highly disconcerting that no assessment has ever been made to evaluate whether these poisons are effective at reducing predation on livestock, the intended purpose of what these products are registered under, and that PMRA has avoided seeking or referencing alternative non-lethal methods as permits are renewed.

A. Counterintuitive effects of lethal control

Although lethal removal of large carnivores blamed for livestock predation is widely practiced across North America (Musiani and Paquet 2004), an increasing amount of scientific evidence demonstrates that lethal control of wolves and other large carnivores has no effect on reducing predation (Krofel *et al.* 2011, Fernandez-Gil *et al.* 2015, McManus *et al.* 2015, Lennox *et al.* 2018; Peebles *et al.*, 2013, Lennox *et al.* 2018, Santiago-Avila *et al.* 2018a) and may even contribute to increased levels of conflict (Connor *et al.* 1998, Musiani *et al.* 2005, Wallach *et al.* 2009, Allen 2014, Peebles *et al.* 2013; Wielgus and Peebles 2014, Treves *et al.* 2016, van Eeden *et al.* 2018, Santiago-Avila 2018a, Nattrass *et al.* 2019). Recent studies are beginning to shed light on why this happens.

For example, livestock predation may be exacerbated by a loss of social structure and stability, which can result from lethal removal (Cooley *et al.* 2009a, Cooley *et al.*, 2009b, Wallach *et al.* 2009, Rutledge *et al.* 2010, Peebles *et al.* 2013, Santiago-Avila *et al.* 2018a). This can result in increased reproduction and/or immigration, which results in higher energy (i.e. food) demands, and changes in population demographics (Knowlton *et al.* 1999, Cooley *et al.*, 2009a, Cooley *et al.*, 2009b, Rutledge *et al.* 2010, Wielgus and Peebles 2014, Minnie *et al.* 2016, Treves *et al.* 2019).

Selectively removing the targeted individual(s) which predated on livestock is difficult and unlikely. Biologist Adrian Treves (2009) explains further, “even if the culprits are targeted selectively, property damage may increase if hunting disrupts carnivore social organization and promotes new individuals or new denser populations of different species of carnivores that, in turn, may have greater impacts on property".

B. Low-risk alternatives – minimizing predation on livestock using non-lethal measures

Scientific studies and reviews have indicated that non-lethal, prevention-based practices and husbandry techniques can be equally or more effective at reducing conflicts among wolves and livestock when compared to lethal removal (Shivik *et al.* 2003, Musiani *et al.* 2003,Muhly *et al.* 2010; Breck *et al.* 2011, Krofel *et al.* 2011, Western Wildlife Outreach 2014, McManus *et al.* 2015; Stone *et al.* 2017, van Eeden *et al.* 2018).

Previous PMRA reviews of predator poisons and renewed permits have avoided or deliberately ignored and neglected to consider low-risk alternatives for managing conflicts among carnivores and livestock. Management techniques should address resolving conflicts. Response variables and ethical actions geared towards carnivore-livestock conflicts can and should be measured and reflected by a reduction in livestock losses and fewer predation events or attempts (van Eeden *et al.* 2017)).

Various management and husbandry techniques have shown promise at reducing predation of livestock (Landry *et al.* 2005; Shivik 2004; Shivik *et al.* 2003; Smith *et al.* 2000, Musiani *et al.* 2003, Haswell *et al.* 2019).[1] Some of the more commonly used techniques for preventing predation on livestock that have shown success include: concentrating and/or confining flocks and herds at night (night corrals) during periods of vulnerability; establishing a human presence (Barnes 2015a and b, Stone *et al.* 2017); the use of livestock guardian dogs or other guarding animals (Stone *et al.* 2017; Van Bommel and Johnson 2012; Shivik 2006, Smith *et al.* 2000); the use of visual and/or physical barriers (Shivik *et al.* 2003; Shivik 2006) such as fladry (Musiani *et al.* 2003) or turbofladry (Lance *et al.* 2011); using specific stockmanship techniques (Barnes 2015-a, Barnes 2015-b); and pasturing animals in consideration of the biophysical landscape and seasonal patterns (Muhly *et al.* 2010, Treves *et al.* 2011, Haswell *et al.* 2019). Stone *et al.* (2017) demonstrated that adaptive use of a variety and combination of nonlethal strategies could be effective at preventing predation on sheep in large open-range grazing operations.

Supervision of livestock by humans is an age-old tradition still in practice in several countries and some jurisdictions in North America, that can help deter wolf predation on domestic animals (Bjorge 1983, Linnell *et al.* 1999, Muhly *et al.* 2010, Barnes 2015a), and can simultaneously provide additional benefits through increased care and attention for livestock and rangeland health (Barnes 2015a, Barnes 2015 b). Research in Alberta indicates that producers who monitor livestock losses have recorded reduced conflicts with wolves after initiating non-lethal conflict prevention (Musiani *et al.* 2004). Prevention of

[1] See, e.g. van Eeden *et al.* (2018) for a useful consolidation of the current evidence base.

livestock predation could, therefore, offer an effective tool for addressing the problem of livestock predation on a local scale while promoting responsible nature conservation (Musiani *et al.* 2004).

III. Conclusions

Where wolves and other predators overlap with livestock, there will always be occasional losses. However, not all predators hunt livestock. The type of husbandry used and human surveillance of livestock may have a stronger influence on predation of livestock when compared to the type of wolf management used or wolf population densities (Muhly *et al.* 2010; Musiani et. al 2005).

In summary:

i) An assessment of a pest control product's value is a requirement of registration, and yet the value of strychnine, Compound 1080, and sodium cyanide when it comes to reducing livestock losses has not been assessed by the PMRA.
ii) Evidence suggests that predator removal can result in increased predation on livestock (Peebles *et al.* 2013, Wielgus and Peebles 2014, Santiago-Avila 2018, Natrass *et al.* 2019).
iii) Non-lethal management of large carnivores has proven to be more effective and safer than lethal control at minimizing future predation on livestock (Krofel *et al.* 2011, McManus *et al.* 2015, Fernandez-Gil *et al.* 2016, Stone *et al.* 2017, Lennox *et al.* 2018).
iv) The evidence for success of non-lethal methods at reducing future predation on livestock is stronger than for lethal removal (Treves *et al.* 2016).
v) Non-selective methods, such as the use of the poisons strychnine, Compound 1080, and sodium cyanide, for killing predators have long been known to kill non-target animals – leaving livestock predators in place (Bjorge and Gunson 1985, Knowlton *et al.* 1999, Sacks *et al.* 1999, Mitchell *et al.* 2004, Greentree *et al.* 2000, Allen and Sparks 2001) and causing harm to non-target organisms throughout the ecosystem.
vi) Large carnivores play a valuable role in the ecosystems in which they live and have inherent value. These important animals should be protected now and into the future.

The use of poisons to reduce livestock predation is scientifically and ethically unfounded and should therefore not be an accepted management technique. In addition to their lack of proven efficacy at reducing predation on livestock, poisons present serious environmental and safety risks as explained in the enclosed requests for special review. Wildlife management should be founded in ethical science as well as ecology. Poisons cannot meet any of these requirements and as such their use should be discontinued.

References

Allen, L.R. (2014). Wild dog control impacts on calf wastage in extensive beef cattle enterprises. Animal Production Science, 54(2), pp.214-220.

Allen, L. R., and Sparkes, E. C. (2001). The effect of dingo control on sheep and beef cattle in Queensland. *Journal of Applied Ecology*, *38*(1), 76-87.

Barnes, M. (2015a). Livestock management for coexistence with large carnivores, healthy land and productive ranches. People and Carnivores, Bozeman, Montana, USA. [online] URL: http://www. People and carnivores. org/PC_2015_WhitePaper. pdf.

Barnes, M. (2015b). Low-stress herding improves herd instinct, facilitates strategic grazing management. Stockmanship Journal, 4(1), 31-43.

Bjorge, R. R. (1983). Mortality of cattle on two types of grazing areas in northwestern Alberta Canada, woodland pastures, intensively managed pastures. Rangeland Ecology & Management/Journal of Range Management Archives, 36(1), 20-21.

Bjorge, R.R., and J. R. Gunson. (1985). Evaluation of wolf control to reduce cattle predation in Alberta. *Journal of Range Management* **38**, 483-486.

Breck, S.W., Kluever, B.M., Panasci, M., Oakleaf, J., Johnson, T., Ballard, W., Howery, L. and Bergman, D.L. (2011). Domestic calf mortality and producer detection rates in the Mexican wolf recovery area: Implications for livestock management and carnivore compensation schemes. Biological Conservation, 144(2), pp.930-936.

Breck, S., Clark, P., Howery, L., Johnson, D. Kluever, B., Smallidge, S., and C. Cibils. (2012). A perspective on livestock-wolf interactions on western rangelands. Society for Range Management. 10, 6 – 11.

Conner, M.M., Jaeger, M.M., Weller, T.J. and McCullough, D.R., 1998. Effect of coyote removal on sheep depredation in northern California. The Journal of wildlife management, pp.690-699.

Cooley, H. S., Wielgus, R. B., Koehler, G., and Maletzke, B. (2009a). Source populations in carnivore management: cougar demography and emigration in a lightly hunted population. *Animal Conservation*, *12*(4), 321-328.

Cooley, H. S., Wielgus, R. B., Koehler, G. M., Robinson, H. S., and Maletzke, B. T. (2009b). Does hunting regulate cougar populations? A test of the compensatory mortality hypothesis. *Ecology*, *90*(10), 2913-2921.

Eklund, A., J. V. López-Bao, M. Tourani, G. Chapron, J. Frank. (2017). Limited evidence on the effectiveness of interventions to reduce livestock predation by large carnivores. *Scientific Reports* **7**, 2097 | DOI:2010.1038/s41598-41017-02323-w).

Fernandez-Gil, A., Naves, J., Ordiz, A., Quevedo, M., Revilla, E., and Delibes, M. (2016). Conflict misleads large carnivore management and conservation: brown bears and wolves in Spain. *PLoS One*, *11*(3).

Greentree, C., Saunders, G., Mcleod, L., and Hone, J. (2000). Lamb predation and fox control in south-eastern Australia. *Journal of Applied Ecology*, *37*(6), 935-943.

Haber, G. C. (1996). Biological, conservation, and ethical implications of exploiting and controlling wolves. *Conservation Biology*, *10*(4), 1068-1081.

Haswell, P. M., Shepherd, E. A., Stone, S. A., Purcell, B., & Hayward, M. W. (2019). Foraging theory provides a useful framework for livestock predation management. Journal for Nature Conservation, 49, 69-75.

Imbert, C., Caniglia, R., Fabbri, E., Milanesi, P., Randi, E., Serafini, M., ... & Meriggi, A. (2016). Why do wolves eat livestock?: Factors influencing wolf diet in northern Italy. *Biological Conservation*, *195*, 156-168.

Knowlton, F. F., Gese, E. M., and Jaeger, M. M. (1999). Coyote depredation control: an interface between biology and management. *Journal of Range Management*, 398-412.

Krofel, M., Černe, R. and Jerina, K., 2011. Effectivness of wolf (Canis lupus) culling as a measure to reduce livestock depredations. *Zbornik gozdarstva in lesarstva*, (95), pp.11-21.

Lance, N. J., Breck, S. W., Sime, C., Callahan, P., & Shivik, J. A. (2011). Biological, technical, and social aspects of applying electrified fladry for livestock protection from wolves (Canis lupus). Wildlife Research, 37(8), 708-714.

Landry, C., Rsten, W., Linnell, J. D., and Weber, J. M. (2005). Non-lethal techniques for reducing depredation. People and Wildlife, Conflict or Co-existence?, (9), 49.

Lennox, R. J., Gallagher, A. J., Ritchie, E. G., and Cooke, S. J. (2018). Evaluating the efficacy of predator removal in a conflict-prone world. *Biological Conservation*, *224*, 277-289.

Linnell, J.D.C., Odden, J., Smith, M. E., Aanes, R., & Swenson, J. E. (1999). Large carnivores that kill livestock: do" problem individuals" really exist?. Wildlife Society Bulletin (1973-2006), 27(3), 698-705.

McManus, J. S., Dickman, A. J., Gaynor, D., Smuts, B. H., & Macdonald, D. W. (2015). Dead or alive? Comparing costs and benefits of lethal and non-lethal human–wildlife conflict mitigation on livestock farms. Oryx, 49(4), 687-695.

Miller, J. R., Stoner, K. J., Cejtin, M. R., Meyer, T. K., Middleton, A. D., and Schmitz, O. J. (2016). Effectiveness of contemporary techniques for reducing livestock depredations by large carnivores. *Wildlife Society Bulletin*, *40*(4), 806-815.

Minnie, L., Gaylard, A., & Kerley, G. I. (2016). Compensatory life-history responses of a mesopredator may undermine carnivore management efforts. Journal of Applied Ecology, 53(2), 379-387.

Mitchell, B. R., Jaeger, M. M., and Barrett, R. H. (2004). Coyote depredation management: current methods and research needs. *Wildlife Society Bulletin*, *32*(4), 1209-1218.

Moreira-Arce, D., C. S. Ugarte, F. Zorondo-Rodríguez, J. A. Simonetti, Management Tools to Reduce Carnivore-Livestock Conflicts: Current Gap and Future Challenges. *Rangeland Ecol. Manage.*, (2018).

Musiani, M. and Paquet, P.C., (2004). The practices of wolf persecution, protection, and restoration in Canada and the United States. BioScience, 54(1), pp.50-60.

Musiani, M., Mamo, C., Boitani, L., Callaghan, C., Gates, C.C., Mattei, L., Visalberghi, E., Breck, S. and Volpi, G., (2003). Wolf depredation trends and the use of fladry barriers to protect livestock in western North America. Conservation Biology, 17(6), pp.1538-1547.

Musiani, M., Muhly, T., Callaghan, C., Gates, C., Smith, M., Stone, S. and Tosoni, E., (2004). Recovery, conservation, conflicts and legal status of wolves in western North America. N. Fascione. In A. Delach, & M. Smith (Eds.), Predators and People: From Conflict to Conservation, pp.51-75.

Musiani, M., Muhly, T., Gates, C. C., & Callaghan, C. (2005). Seasonality and reoccurrence of depredation and wolf control in western North America. Wildlife Society Bulletin. 33 (3), 876-887

Musiani, M., Boitani, L., & Paquet, P. (Eds.). (2009). A New Era for Wolves and People. Wolf Recovery, Human Attitudes, and Policy. Calgary: University of Calgary Press.

Muhly, T., Gates, C. C., Callaghan, C., & Musiani, M. (2010). Livestock husbandry practices reduce wolf depredation risk in Alberta, Canada. The world of wolves: new perspectives on ecology, behaviour, and management. University of Calgary Press, Calgary, Alberta, Canada, 261-286.

Muhly, T.B. and Musiani, M. (2009) Livestock depredation by wolves and the ranching economy in the Northern US. Ecological Economics. 68, 2439-2450.

Nattrass, N., Conradie, B., Stephens, J. and Drouilly, M., 2019. Culling recolonizing mesopredators increases livestock losses: Evidence from the South African Karoo. *Ambio*, pp.1-10.

Peebles, K. A., Wielgus, R. B., Maletzke, B. T., & Swanson, M. E. (2013). Effects of remedial sport hunting on cougar complaints and livestock depredations. PLoS One, 8(11), e79713.

Rutledge, L.Y., Patterson, B.R., Mills, K.J., Loveless, K.M., Murray, D.L. and White, B.N., 2010. Protection from harvesting restores the natural social structure of eastern wolf packs. Biological Conservation, 143(2), pp.332-339.

Sacks, B. N., Blejwas, K. M., & Jaeger, M. M. (1999). Relative vulnerability of coyotes to removal methods on a northern California ranch. *The Journal of wildlife management*, 939-949.

Santiago-Avila, F.J., A.M. Cornman, and A. Treves. (2018). Killing wolves to prevent predation on livestock may protect one farm but harm neighbors. PloS ONE 13(1), p.e0189729

Shivik, J.A., Treves, A. and Callahan, P. (2003). Nonlethal techniques for managing predation: primary and secondary repellents. Conservation Biology, 17(6), pp.1531-1537.

Shivik, J. A. (2004). Non-lethal alternatives for predation management. Sheep & Goat Research Journal, 14.

Shivik, J. A. (2006). Tools for the edge: what's new for conserving carnivores. BioScience, 56(3), 253-259.

Smith, M. E., Linnell, J. D., Odden, J., & Swenson, J. E. (2000). Review of methods to reduce livestock depredation: I. Guardian animals. Acta Agriculturae Scandinavica, Section A-Animal Science, 50(4), 279-290.

Stone, S.A., Breck, S.W., Timberlake, J., Haswell, P.M., Najera, F., Bean, B.S. and Thornhill, D.J., (2017). Adaptive use of nonlethal strategies for minimizing wolf–sheep conflict in Idaho. Journal of Mammalogy, 98(1), pp.33-44.

Tompa, F. S. (1983). Problem wolf management in British Columbia: conflict and program evaluation. *Wolves in Canada and Alaska. Canadian Wildlife Service Report Series*, *45*, 112-119.

Treves, A. and L. Naughton-Treves (2005) Evaluating lethal control in the management of human-wildlife conflict - *People and Wildlife, Conflict or Coexistence?* R. Woodroffe, S. Thirgood, A. Rabinowitz, Eds. (2005), Cambridge University Press, Cambridge, UK, pp. 86-106.

Treves, A., 2009. Hunting for large carnivore conservation. *Journal of Applied Ecology*, *46*(6), pp.1350-1356.

Treves, A., Krofel, M., and J. McManus. (2016). Predator control should not be a shot in the dark. Front Ecol Environ. 14(7): 380–388.

Treves, A., Martin, K. A., Wydeven, A. P., & Wiedenhoeft, J. E. (2011). Forecasting environmental hazards and the application of risk maps to predator attacks on livestock. BioScience, 61(6), 451-458.

Treves, A., Krofel, M. Ohrens, O., and L. M. Van Eeden, (2019). Predator control needs a standard of unbiased randomized experiments with cross-over design. *Frontiers in Ecology and Evolution* **7** 402-413.

Van Bommel, L., & Johnson, C. N. (2012). Good dog! Using livestock guardian dogs to protect livestock from predators in Australia's extensive grazing systems. Wildlife Research, 39(3), 220-229.

Van Eeden, L.M., Crowther, M.S., Dickman, C.R., Macdonald, D.W., Ripple, W.J., Ritchie, E.G. and Newsome, T.M., (2018). Managing conflict between large carnivores and livestock. Conservation Biology, 32(1), pp.26-34.

Wallach, A.D., Ritchie, E.G., Read, J. and O'Neill, A.J., (2009). More than mere numbers: the impact of lethal control on the social stability of a top-order predator. *PLoS One*, *4*(9).

Western Wildlife Outreach. (2014). Living with livestock and wolves - Wolf-Livestock Nonlethal Conflict Avoidance: A Review of the Literature. Online: https://wdfw.wa.gov/sites/default/files/2019-02/wolf_livestock_conflict_avoidance_literature_review_11_2014_final_submitted_version.pdf. Accessed August 15, 2019.

Wielgus, R. B., and Peebles, K. A. (2014). Effects of wolf mortality on livestock depredations. *PloS one*, *9*(12).

Addendum II: Select Incidents of Pet Poisoning in Canada

SUPPLEMENTAL TO SPECIAL REVIEW REQUESTS

Hundreds of household pets have been harmed or killed in Canada after consuming pest control products containing strychnine, Compound 1080, and sodium cyanide. The list below represents some of these documented occurrences based on Health Canada records, news reports, and other sources. The true count likely far exceeds those reported here.

August 2020: Dog died from secondary poisoning after consuming a victim of Compound 1080 in Cranbrook, BC.[1]

May 2020: Two dogs poisoned in Cranbrook, BC, suspected Compound 1080 poisoning.[2]

April 2019: Dog "Topaz" killed after encountering strychnine coyote bait while trail running in Creston, BC.[3]

2019. Three dogs poisoned with strychnine in Saskatchewan. At least one died.[4]

2018: Puppy died in Cochrane, AB, after consuming deer leg laced with strychnine.[5]

2018: Veterinary toxicologist Barry Blakley notes that they see roughly six to seven cases a year of dogs poisoned by strychnine at the Western College of Veterinary Medicine at the University of Saskatchewan.[6]

July 2017: Two dogs died in Cereal, AB, after ingesting strychnine used on a baseball diamond.[7]

June 2017: Dog died after consuming strychnine poison in Indian Head, SK.[8]

---

[1] https://www.thedrivefm.ca/2020/08/12/steeples-veterinary-clinic-confirms-compound-1080-in-gold-creek-dog-death/

[2] https://www.myeastkootenaynow.com/7682/pair-of-dogs-killed-in-suspected-poisoning-incident-in-ta-ta-creek/?fbclid=IwAR3rHu87LCO452ZzR0PmXQq7zhek9iVOicdKzLI55xnDGzEsyjCA7Y0GMvo

[3] https://bc.ctvnews.ca/1-000-reward-offered-for-dog-killer-after-suspected-strychnine-poisoning-1.4394820

[4] PMRA Public Incident Report 2019-6625 and 2019-6626

[5] https://www.cbc.ca/news/canada/calgary/dog-death-alberta-strychnine-pest-control-ban-poison-farms-1.4773270

[6] https://www.cbc.ca/news/canada/saskatchewan/health-canada-considers-strychnine-ban-gophers-1.4771402

[7] http://calgary.ctvnews.ca/toxicology-tests-confirm-dog-died-from-strychnine-poisoning-1.3532441 ; https://www.alberta.ca/assets/documents/ep-the-village-of-cereal-agreed-facts.pdf

[8] https://www.cbc.ca/news/canada/saskatchewan/health-canada-considers-strychnine-ban-gophers-1.4771402

May 2017: Dog died after consuming Compound 1080 near Cranbrook, BC.[9] Additionally, in Saskatchewan, two dogs were poisoned, and one dog dead after strychnine-laced grain was found. It also killed 7 deer.[10]

April 2017. Dog consumed a deer leg laced with strychnine, and died. No nearby legal use on farms.[11]

March 2017: Dog consumed strychnine poison in a "white cupcake container" while being walked in East Kootenay, BC. 17 different batches of poison and two wolf carcasses were found. [12]

October 2016: Three dogs killed near Cranbrook Community Forest after ingesting "fatty substance" suspected to be Compound 1080.[13]

January 2016: Publication in Canadian Veterinary Journal reports 141 cases of strychnine poisoning in dogs in Western Canada from 1998-2013.[14]

May 25 2014. Two dogs killed in Alberta after ingesting strychnine from an unknown source. [15]

2014: Dog "Dulce" killed by strychnine poison in Cremona, AB.[16]

2011: At least 13 dogs killed near Red Deer, Alberta, from strychnine poisoning.[17]

2011: Two dogs killed in Alberta after ingesting strychnine. One dog survived after enduring four hours of symptoms.[18]

April 2 2011. Four bloodhounds died after ingesting strychnine laid to kill wolves in Little Smoky caribou range. Three died at the bait site, while the fourth dog ran for more than a mile before dying.[19]

March 20 2010. Four dogs killed in Alberta after consuming a deer carcass laced with strychnine. No legal use known in the area.[20]

---

[9] https://www.thedrivefm.ca/2020/05/28/194339/ ; https://www.thedrivefm.ca/2020/08/12/steeples-veterinary-clinic-confirms-compound-1080-in-gold-creek-dog-death/

[10] PMRA Public Incident Report 2017-4842

[11] PMRA Public Incident Report 2019-2646

[12] https://www.cbc.ca/news/canada/british-columbia/kootenay-wolf-poisonings-1.4121946 ; http://www.summit107.com/news/east-kootenay-news/dog-poisoned-west-of-canal-flats-prompts-public-warning-from-conservation-officers/

[13] http://calgary.ctvnews.ca/toxicology-tests-confirm-dog-died-from-strychnine-poisoning-1.3532441; personal communication with Haley Walker-Opperman, owner of "Nixon".

[14] Cowan V, Blakley B. Characterizing 1341 cases of veterinary toxicoses confirmed in western Canada: A 16-year retrospective study. Can Vet J. 2016 Jan;57(1):53-8. PMID: 26740698; PMCID: PMC4677609.

[15] PMRA Public Incident Report 2014-3636.

[16] Blackmore, Christina and Peter. Owners of Dulce. Personal communication, August 2017.

[17] http://thenelsondaily.com/news/pet-owners-warned-poisonous-substance-cranbrook-community-forest-42883#.WblctdVSxhF

[18] PMRA Public Incident Report 2011-3172 and 2011-3267

[19] PMRA Public Incident Report 2013-2771

[20] PMRA Public Incident Report 2017-4844

March 13 2010. One dog killed in Alberta from strychnine, likely having consumed illegally baited venison. [21]

2000-2001: Highest confirmed number of strychnine poisoning in dogs, directly attributed to the emergency registration of strychnine to control Richardson's ground squirrel infestations. [22]

2000: Study published in Canadian Veterinary Journal reports that poisoning is the second most common underlying cause of sudden and unexpected death in dogs, with 24 out of 25 cases due to strychnine.[23]

1982: Saskatchewan study identifies 261 cases of strychnine poisoning in dogs between 1968-1982.[24]

[21] PMRA Public Incident Report 2017-4841

[22] Blakley BR. The association of bait formulation of strychnine with poisonings in nontarget species in Saskatchewan from 1975 to 2007. Can Vet J 2009;50:1186–1188.

[23] Olsen TF, Allen AL. Causes of sudden and unexpected death in dogs: a 10-year retrospective study. Can Vet J. 2000 Nov;41(11):873-5.

[24] Blakley BR. Epidemiologic and diagnostic considerations of strychnine poisoning in the dog. J Am Vet Med Assoc 1984;184:46–47.