Lead Ammunition Discussion Paper

Disclosure

The author of this discussion paper is a current member of the Moncton Fish and Game Association who does not hunt but is an active target shooter. The MFGA proposed the initial lead reduction resolution in 2015 and a follow-up resolution/motion in 2016. The author has a background in environmental science with Environment Canada (BSc Chemistry), and worked for CWS, but is not an expert in heavy metals or ecotoxicology. Some readers may view this professional background as introducing bias, but the author has tried to be objective in reviewing documents and web sites.

Scope

The scope of this document is to gather some relevant science and public policy documents related to lead-based hunting ammunition to assist the NWBF in determining its path forward on the topic.

The purpose of this document lies in the MFGA originally introduced a motion to take **voluntary action to reduce lead used in hunting ammunition and to promote non-toxic ammunition as an alternative.** It is important that the MFGA help support the motion by providing some of the credible scientific evidence in support.

Some fish and game clubs are opposed to such an idea, and some are awaiting more information to help in their decision making. It is hoped that this document will encourage further examination and discussion, and that individuals examine some of the science themselves.

This compilation of internet available information **is not** in any way intended to promote a ban or prohibit the use of lead in ammunition, but only to present a weight of evidence approach to show that voluntary reduction may be a reasonable measure for the NBWF to endorse and promote. To repeat, this **is not** intended as promoting a ban or prohibition on lead hunting ammunition.

Methods

The author solicited relevant research papers from a former colleague who is an ecotoxicologist with Environment Canada, and also conducted some Google searching using key words including 'lead poisoning, lead in ammunition, bullet performance, lead regulations, public policy', and several other combinations. Google Scholar was also used as this search engine searches scientific and technical journals. Fifteen scientific papers were sent to the President of the NBWF in an email and are not included in this document due to length.

There are some web sites that are very opinionated claiming that hunters and their lead are "killing eagles". These sites tend to bend the science for their own animal rights agenda and want all lead out of hunting. Not intending to categorize; but some of these sites represent environmental groups and not groups who endorse ethical hunting, sportsmanship and conservation. There were two petitions to the USEPA to ban lead ammunition completely, but these did not go forward because of the broad impact on police, military and recreational target shooters. The USEPA determined that hunting ammunition and ammunition was outside the scope of their legislation. (A similar petition was made in Canada in 2005 under CEPA and the Minister determined ammunition did not fall under the provisions of CEPA). Also, some anti-gun groups were using lead as a means to eliminate ammunition for the purposes of their antifirearm agenda. These sites or data are not included as they too were viewed as biased, not objective or not scientific, and contrary to the scope. Any sites of the NRA or NSSF were also excluded as they generally view any ammunition change as a potential threat to the US Second Amendment. It should be noted that the NRA and NSSF are sympathetic to the issue but will not discuss any action that might change availability of ammunition.

Introduction

Lead has been phased out or banned in many North American products and imports including paints, cosmetics and gasoline. It is no longer used in solder for plumbing or water distribution. It is generally accepted that lead is not an essential element or nutrient and in fact poses considerable heath concerns from direct and secondary exposure for a multitude reasons (neurological and physiological).

While lead impacts on wildlife have been researched back to the 1800's, the first actionable wildlife impacts were observed in waterfowl resulting in the US Fish and Wildlife Service banning lead for waterfowl hunting in 1991, and Canada doing the same in 1999. A major hunter education program was undertaken by

the Canadian Wildlife Service at the time of the Canadian prohibition to show that non-toxic shot was effective. Lead shot can presently be used for upland game birds, though some States in the US have stopped allowing lead in upland game hunting.

There has been mounting scientific evidence to suggest that lead ammunition greatly fragments when it penetrates large game (deer, moose and bear), and when hunters leave "gut piles" after a successful hunt, these fragments are ingested by scavenging species (especially raptors and birds of prey) with severe negative physiological and neurological effects. It is also possible for humans to ingest small pieces from eating wild game.

Dr Helene VanDoninck DVM for the Cobequid Wildlife Rehabilitation Center in Nova Scotia made a presentation to the Moncton Fish and Game in 2015, and recently made one to the NB Wildlife Federation, on the impact of lead on raptors (eagles) and has shown through rather graphic videos the effects of lead on these birds. Many people do not know that there is enough lead in a single 130 grain lead bullet to kill 10 bald eagles, and it only takes two #6 shotgun pellets (size of a BB) to kill an eagle. Avian species because of relative size cannot withstand a high body burden of lead contamination.

In the province of Nova Scotia the provincial hunting and angling federation has been working on a voluntary program to reduce the lead hunting ammunition and to promote non-toxic ammunition as an alternative.

SEARCH RESULTS

General Overview Information

The scientific evidence is quite clear that there are concerns for lead in hunting ammunition across all jurisdictions in the US and Canada. The proceedings of a 2008 scientific conference entitled "The Ingestion and Spent Lead Ammunition: Implications for Wildlife and Humans" at Boise State University are available online. The proceedings may be found at

http://www.peregrinefund.org/subsites/conference-

<u>lead/2008PbConf</u> <u>Proceedings.htm</u> This appears to be one of the more comprehensive conferences with just over 50 published articles. Some are human health oriented while others are more wildlife related. It is a good link for highly technical reports presented by the scientific community.

The following web site is perhaps the most comprehensive non-toxic shot site as it includes everything from science references to bullet performance to lists of manufacturers. It is very balanced and appears to be put together by conservation minded hunters who value the traditions of stewards of the

resource. This site is highly recommended as it is written in plain language and has numerous relevant links. <u>http://huntingwithnonlead.org/about.html</u>

For readers who like a PowerPoint format the following is a good overview presentation by the University of Iowa.

https://www.extension.iastate.edu/forestry/tri_state/tristate_2013/Talks/Lead_a nd_Wildlife.pdf

Biological Considerations

The following link <u>http://wildlifecenter.org/sites/default/files/WCV-Position-on-</u> <u>Lead4.pdf</u> is a very balanced position paper by the Wildlife Center of Virginia. It covers some of the history of the issue and the problems in the USA where efforts were made by some groups to ban lead. The WCV recommends that the most effective way to reduce exposure to raptors is to voluntarily use non-toxic shot and to dispose of gut piles in a manner scavengers cannot consume them. One key statement is that ethical hunters do not want to harm other species especially raptors such as eagles.

This link <u>https://www.raptor.umn.edu/our-research/lead-poisoning</u> is from the University of Minnesota with some statistics spanning 40 years of research and observation. They also speak to using voluntary reductions. This site also has a brochure that could be used as a hunter education tool if adopted for NB.

It is possible to find information from several State Natural Resource or Wildlife Divisions and from several universities. The two citations above are presented because of the balance and that Minnesota is a northern state adjacent to Canada.

Ecotoxicology. 2003 Feb-Aug;12(1-4):23-30. Lead poisoning in upland-foraging birds of prey in Canada.

Clark AJ¹, Scheuhammer AM. This paper is from 2003 but was done in Canada. Scheuhammer has also published work on lead sinkers and their impacts on Loons. <u>The author could only get the abstract for this paper</u>.

Abstract We examined the degree of lead exposure, based on tissue-lead concentrations, in 184 raptors of 16 species found dead across Canada. The most prevalent species available for examination were Red-tailed hawks, Great horned owls, and Golden eagles (n = 131). The majority of individuals examined had very low lead accumulation, however 3-4% of total mortality in these 3 most commonly encountered species was attributed to lead poisoning. In addition, 1 of 9 Bald Eagles found dead far from aquatic environments was lead poisoned; and a single Turkey Vulture had a highly elevated bone-lead concentration (58 microg/g dry weight). Evidence from our study, along with other published

research, indicates that upland-foraging birds of prey and scavengers that typically include game birds and mammals in their diets, are at risk for lead poisoning from the ingestion of lead projectiles from ammunition used in upland hunting. The use of non-lead ammunition for hunting upland game would effectively remove the only serious source of high lead exposure and lead poisoning for upland-foraging raptors.

The following is likely the definitive study to date in Canada that presents a complete picture as at its publication date in 1995 http://publications.gc.ca/collections/Collection/CW69-1-88E.pdf though 20 years old this CWS technical report does mention lead poisoning in eagles in the USA where 10% of the necropsies of 3000 eagles showed lead poisoning. Keep in mind this was just before the Canadian prohibition on lead in waterfowl ammunition.

This paper is useful because it identifies several species, including Canadian species, where lead contamination has been observed. One author is from the University of Guelph. <u>https://www.peregrinefund.org/subsites/conference-lead/PDF/0108%20Pain.pdf</u> The authors also indicate that it is not only gut piles that are a source of lead but any carrion that may have been killed with lead and not retrieved may be consumed by scavengers. Examples include rabbits, gophers, Richardson's Ground Squirrels(

http://www.bioone.org/doi/abs/10.2193/0022-

541X%282006%2970[295:COSRGS]2.0.CO%3B2) or nuisance pests such as crows that may have been killed with lead ammunition. Scavengers are generally opportunistic and will consume whatever food source is available.

Human Exposure Considerations

Some of the work on human impacts has also been looked at. Field and Stream did a short article on concentrations of lead in wild meats. <u>http://www.fieldandstream.com/blogs/ammunition/2010/06/more-scary-news-</u>

about-lead-levels-wild-game and the Center for Disease Control also looked at it in the USA. The CDC advised that young children and pregnant women should not consume large amounts of wild meat killed with lead ammunition. Some of the ammunition manufacturers did not agree with this advisory, while one said that the industry adapted to the waterfowl ban in 1991. Lead was banned in gasoline and paints to reduce human exposure, and there is no question that lead cause neurological problems. It may be worth noting that some health authorities have also issued similar health advisories for mercury for pregnant women and young children who eat fish. "The Ingestion and Spent Lead Ammunition: Implications for Wildlife and Humans" conference also had a section on human exposure. <u>http://www.peregrinefund.org/subsites/conference-</u> lead/2008PbConf_Proceedings.htm

Ammunition Performance Comparisons

Any discussion of voluntary lead reduction in hunting ammunition will lead to questions about the performance of lead ammunition versus any of the non-toxic ammunition. This is a very sensitive issue for the dedicated hunter. A similar concern was voiced in 1991 when lead was banned in waterfowl hunting.

This is a question and answer item from a company that manufactures non-toxic shot but it does have some suggestions for hunters thinking of switching or trying non-toxic ammunition. <u>https://clarkarmory.com/blogs/news/46855683-lead-vs-lead-free-bullets</u>

This writer did some informal comparisons based on literature and practical experience. He presented his thoughts on various non-toxic ammunition types. It seems to be a balanced approach that speaks of pros and cons of some of the other non-toxic options. <u>http://modern-hunters.com/are-non-lead-bullets-toxic/</u>

This is another online comparison of general nature. Though not scientific it also presents some of the pros and cons. <u>http://www.gohunt.com/read/seven-things-you-didnt-know-about-ammo</u>

This citation <u>http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4100882/</u> is a highly technical article on ballistic properties. The results indicated "All bullets showed an increasing cavity volume with increasing deposited energy. The dimensionally stable and fragmenting lead-free bullets achieved a constant conversion ratio while the deforming copper and lead-containing bullets showed a ratio, which increases linearly with the total deposited energy. <u>The lead-containing bullet created hundreds of fragments and significantly more fragments than the lead-free bullets</u>. The deflection angle was significantly higher for the dimensionally stable bullet due to its tumbling behavior and was similarly low for the other bullets. The deforming bullets achieved higher reproducibility than the fragmenting and dimensionally stable bullets. <u>The deforming lead-free bullet closely resembled the deforming lead-containing bullet in terms of energy conversion</u>, deflection angle, cavity shape, and reproducibility, showing that similar terminal ballistic behavior can be achieved."

A retired wildlife biologist and a retired wildlife technician did a study examining copper bullets versus a lead bullet.

http://www.fwspubs.org/doi/suppl/10.3996/032013-JFWM-029/suppl_file/032013jfwm-029r2-s02.pdf They used various techniques to examine penetration and accuracy. Their study is interesting with lots of photos and was funded by the State of Wisconsin. Page 17 of their report has the following results.

- *"Copper ammunition is accurate."*
- Copper ammunition does not foul barrels. Rifle barrels don"t need any unusual cleaning beyond what is done now with lead core bullets.
- Copper bullets hold together well and are not prone to fragmenting or breaking apart.
- Copper bullets are known for their deep penetration in game, so the entry and exit wounds will give a blood trail which helps in locating the deer carcass.
- One can use lighter weight bullets which will have less recoil in any given rifle.
- Copper bullets will expand at low velocities and high velocities.
- Copper bullets will not contaminate other animals, the environment, or my deer carcass with lead.
- Copper bullets are fun."

Public Policy Considerations

This was the hardest topic to try to find information on as there has been little discussion in Canada, except for Nova Scotia, and much of the debate in the USA centers on banning lead ammunition. There are lessons to be learned from our southern neighbours nonetheless.

Some groups such as the Humane Society of the United States have taken very strong anti-lead stances and take a very pro-environmental position while the NRA and the National Sports Shooting Foundation take positions that any move to eliminate lead is a threat to the right to bear arms (2nd Amendment). Each group presents their version of the issue using quite emotional language. However neither seems to be willing to talk about voluntary reductions and use of non-lead for hunting. A similar situation occured in England where competing stakeholder interests complicate the issue.

There seems to be one interesting point that is made by the pro-lead groups. Other than for the endangered California Condor there do not appear to be any published research on **population-level** threats from lead ammunition. Though in the late 1980s the Bald Eagle was threatened in the US, and there were broad-based waterfowl concerns resulting in the lead shot prohibition for waterfowl hunting in 1991. This does not mean that there are no effects, but as a general observation, entire populations do not appear to be at threat from lead ammunition. <u>However the scientific evidence is very clear an unequivocal that</u> **individuals** within a population can face lethal threats attributed lead poisoning from fragmented ammunition.

This document <u>http://www.georgewright.org/281thomas.pdf</u> entitled "Conflicts in Lead Ammunition and Sinker Regulation: Considerations for US National Parks" seems to be a most detailed public policy document and presents some interesting perspectives. Interestingly, on page 29 the author states "Voluntary use provisions do not create strong markets, especially when non-toxic products cost more than lead equivalents". This is partially attributed to market demand forces and the generalization that "big game hunters do not fire large numbers of cartridges when hunting". Based on this, one could postulate that education and the sense of stewardship of the natural resource would have to be a key component of any voluntary program. The Knowledge that a person might save an eagle or other bird of prey by using non-toxic ammunition may be the determining factor to spending a few dollars more, or requesting non-toxic shot from the outfitter/supplier.

One might conclude that a voluntary reduction in the use of lead ammunition is appropriate, but only if it is accompanied by effective hunter education and awareness. Awareness has to be created on the impacts of lead ammunition on non-target species, as well as awareness of the effectiveness of non-toxic ammunition as a hunting method.

Other Nearby Jurisdictions

Nova Scotia

Chronicle Herald Sept 12, 2012. The organization representing Nova Scotia's hunters and anglers made something of a trail-blazing decision last week by supporting a move toward non-lead hunting ammunition. Wilfred Woods, president of the Nova Scotia Federation of Anglers and Hunters, said the group will soon begin an education and information campaign on the effort, one that may be the first of its kind from such organizations in Canada.

"We seem to be out in front of this issue," Woods said Sunday in an interview. The issue is something Dr. Helene Van Doninck, a veterinarian, brought to the organization's attention during its annual general meeting in March and in subsequent outreach lectures to groups around the province. Van Doninck, who operates the Cobequid Wildlife Rehabilitation Centre in Hilden, Colchester County, started to be concerned after seeing several bald eagles and other scavenger species that had signs of lead poisoning. Many of those birds died.

Fragmentation of a lead bullet after impact has been shown to travel farther from the wound channel than thought, said Van Doninck. It also creates problems when the carcass is left behind and consumed by scavenger wildlife, even if an animal is properly field dressed.

"Nobody goes out in the morning when they're hunting and thinks, 'I think I'm going to kill a bald eagle today.' But if they leave body parts (with lead fragments) behind, then they can, especially the gut pile." She commended the federation for what she called a proactive and progressive decision. "I think it's great. I'm over the moon about it."

Woods said the decision comes down to reducing a risk that is easily avoidable. "If there is a risk, and there is enough evidence to suggest that there is a real risk from lead fragmentation, why take the chance if there's an easy alternative?" The move is voluntary, he said, and there will always be some resistance to this kind of change. Some hunters who are knowledgeable about ballistics may argue that non-lead ammunition isn't as true, said Woods.

While the federation won't convince everyone and isn't trying to force anyone's hand, Woods said the decision to make the recommendation to its 5,500 members is consistent with the long-standing efforts of hunters and anglers to take care of the areas where they practise their craft. "Hunters are the original conservationists. We're aware of our environment and very concerned and want to protect it."

The NS Federation of Anglers and Hunters undertook an ammunition exchange where lead ammunition could be exchanged for a box of non-toxic ammunition. <u>http://www.nsfah.ca/news/view.php?id=220</u> this program may have operated for 2 years. Additionally starting in 2013 NSDNR staff started using non-toxic ammunition when they were required to put down an animal. <u>http://novascotia.ca/news/release/?id=20131213003</u>

State of Maine

In the USA 26 states have enacted some form of additional prohibition related to lead ammunition with most being related to upland game and game birds. Maine essentially follows the federal regulation for non-toxic shot in waterfowl hunting but has an additional prohibition for upland game. **Maine:** Non-toxic ammunition required in shotguns for upland game other than deer and turkey in national wildlife refuges and in wildlife management areas and refuges and for migratory game birds snipe and/or rail on all state and private lands. <u>http://huntingwithnonlead.org/state_info.html</u>

What Can We Reasonably Conclude?

Looking at the totality of the research in this document and other scientific papers, the following general conclusions can be drawn.

- No responsible, ethical hunter wants to intentionally or knowingly kill an eagle, bird of prey or other non-target animal.
- Traditional hunting values are based on stewardship and sustainable harvest. The hunter is viewed as a component of wildlife management by agencies.
- Hunters are not deliberately killing eagles or other raptors with the lead in their ammunition.
- Most hunters have little understanding that their spent lead bullets and shot could be continuing to kill, long after the hunters have left the woods, the season is over, and they have put their firearms away.
- <u>A ban on lead ammunition is not viable</u> because hunters use only a very small percentage of all ammunition sold in the United States (and presumably Canada) each year. A ban on lead-based ammunition would negatively impact most lawabiding firearms users.
- Lead bullets fragment when they enter large game (deer, moose, bear etc.) and fragments in 'gut piles' can pose a threat to scavengers especially raptors (eagles, hawks, birds of prey, as well a ravens and crows).

- Specific scientific study is not needed in New Brunswick as there is sufficient information on pathways, and effects from across North America, and there is local evidence in the Maritimes with the work done at the Cobequid Wildlife Rehabilitation Center.
- The pathway (source) of lead ammunition-sourced poisoning varies across North America, but the behaviour of the scavenger is consistent (opportunistic feeding), as is the impact.
- Aside from the endangered California Condor, there does not seem to be "population level" concern with lead hunting ammunition, but there are certainly impacts on "individuals" within a species or population. (This contrasts with the lead shot ban in waterfowl hunting where several populations involving millions of waterfowl showing negative impacts of lead.)
- Some studies have indicated that 10% of necroscopies of raptors show lead contamination and other studies 16%.
- Copper hunting ammunition seems to be the best non-toxic alternative at the moment, though the technology is evolving with all major manufacturers offering non-toxic options.
- Copper bullets "mushroom" and have good accuracy and energy retention/conversion and most importantly do not fragment like lead bullets.
- Copper may result in more edible meat due to less bullet fragmentation which causes wastage of edible meat.

- For New Brunswick in 2015, 48,839 deer licenses were issued and 4592 moose licenses resulting in 4,378 deer and 3,728 moose being harvested. This represents over 8,000 'gut piles' as potential sources of lead fragments in the Province of NB.
- Voluntary reductions in the use of lead ammunition are possible and can be beneficial, but only if there is a corresponding hunter awareness and education program that promotes nontoxic alternatives.
- Education and awareness has two key aspects; 1) awareness of the impact of lead on non-target species; and 2) education on how to effectively change to non-toxic ammunition.
- Costs are very similar for non-toxic ammunition but the responsible and ethical hunter will more likely be influenced by awareness of the impacts of lead ammunition, and will more willingly try non-toxic ammunition.
- Burying a "gut pile" was also proposed as a best management practice to remove the possibility of avian scavenging, though this will not work with frozen ground.