

Conflicts in Lead Ammunition and Sinker Regulation: Considerations for US National Parks

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Centuries of traditional use of lead in hunting and fishing constitutes a toxic risk to wildlife

LEAD EXPOSURE IN WILDLIFE FROM INGESTED SPENT LEAD AMMUNITION and lost fishing sinkers is well-documented in the primary scientific literature and is a global phenomenon. Lead toxicosis appeared, initially, as a disease of waterfowl caused by ingestion of spent shot in wetlands. Recent evidence reveals that the disease is prevalent in upland game birds, piscivorous waterbirds, avian predators, and scavengers exposed to lead of anthropogenic origin (Pain et al. 2009; Pokras and Kneeland 2009). Furthermore, humans who consume game killed with lead ammunition may be seriously lead-exposed (Johansen et al. 2006; Kosnett 2009). Awareness of this health risk to both wildlife and humans has evolved rapidly, as scientists have defined the various dimensions of this disease. Debate about the sources of the lead was settled by lead isotope ratio analyses that identified lead from spent ammunition and sinkers as the primary source of exposure in both wild birds and humans (Scheuhammer and Templeton 1998; Tsuji et al. 2008).

Much scientific research indicates that the chronic and acute manifestations of lead exposure are fundamentally similar across a wide range of animal species (including humans) that ingest lead, both in terms of the organ systems affected and the expression of the disease (Pokras and Kneeland 2009). Lanphear et al. (2005) and the US Centers for Disease Control and Prevention stated that, in humans, there may be no safe level of lead exposure, especially in children (CDC 2005a). Thus, there is a common environmental lead syndrome, regardless of the source(s) of the ingested lead and the species that ingest it. However, concerns about lead on the health of humans have trumped similar concerns about the impacts of ingested lead on the health of wildlife (Thomas 2010).

The history of regulating lead shot and sinkers is less than 40 years old, and continues to be extremely contentious, despite the enormous amount of scientific evidence identifying the precise cause of the disease. Replacement of toxic lead shot and sinkers by non-toxic substitutes has begun in a number of countries, but not in a consistent manner across all uses of

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lead ammunition and sinkers, and not in all jurisdictions of any nation (Mateo 2009; Thomas and Guitart 2010). Non-toxic shot use in wetland hunting has been regulated in some countries (e.g., the US, Norway, Canada, and the United Kingdom) where lead-induced mortality was most apparent in waterfowl, but non-toxic ammunition use in all categories of hunting and target shooting is not legally required in any country. The same situation exists for non-toxic sinkers and rifle ammunition. Where they are required, it is on a local basis, as in the US and the United Kingdom, or in certain areas such as Canadian national parks.

If recreational hunting, target shooting, and angling were newly created sports, current knowledge of the environmental toxicity of elemental lead and existing regulations would preclude its use in ammunition and sinkers. This raises the question of why it has been so difficult to ban such lead products, and to regulate use of proven non-toxic substitutes. This paper examines the issues and positions of US stakeholders that have proposed or prevented broad-scale adoption of lead substitutes for hunting and angling. The potential role of the US National Park Service (NPS) in regulating use of lead ammunition and sinkers in national park areas is presented. It is necessary to consider national parks and lead reduction in the context of what is occurring in other US jurisdictions, because the manifestations of lead exposure, the stakeholders, and resolution using non-toxic substitutes are the same. Central to this paper is the premise that resolving lead exposure and toxicosis of wildlife is more about the development of appropriate social and governmental policy than the state of science.

State of current science on lead exposure in wildlife

No single pathology of wildlife has been so well researched as lead toxicosis from ingested lead. Detailed reviews have been conducted by federal and state agencies, conservation organizations, professional organizations, and academics. The current state of knowledge of the dimensions of lead exposure is best represented by the symposium proceedings edited by Watson et al. (2009), and reviews by Rattner et al. (2008) and Goddard et al. (2008). The Wildlife Society has reviewed the science and presented its own expert policy recommendations in which it calls for a transition to the use of lead substitutes by hunters and anglers (The Wildlife Society 2009). The single, unequivocal conclusion is that ingested elemental lead is toxic to birds, mammals, and other animal life, and, depending on dose and factors that mitigate uptake, may cause chronic or acute exposure. This conclusion is based on controlled laboratory studies as well as observations from lead-exposed wild animal species. Numerous studies have attempted to estimate the total mortality from lead shot and sinker ingestion in individual species, but such estimates are crude, reflecting the problem of detecting fatally lead-exposed wildlife, and determining the degree of lead exposure across lead-exposed individuals.

Calls for yet more research on lead exposure in wildlife

The present understanding of lead toxicosis in wildlife is based on *individual* animals or experimental treatment groups, followed by extrapolation to wild populations. Most research has not dealt with entire populations of a species because that is beyond the scope of experimental reductionistic science. However, there are recent calls for such science (as by

the Western Association of Fish and Wildlife Agencies (WAFWA 2010)) to be undertaken, and for the impacts of lead ingestion to be measured at the population level before a decision to end the use of lead products is considered. Governmental wildlife agencies are mandated to manage at the population level, rather than the individual animal level, and to consider the impacts of various factors, both natural and anthropogenic, which determine population levels of species. The criterion of impact at the population level is not the vital criterion to use, and its absence does not negate decisions to ban use of lead sinkers and shot already implemented by a variety of agencies in the US and elsewhere. This criterion has not been invoked when dealing with the use of lead-based products in the human environment because of the accepted importance of individual health. Basing a decision on risks to individuals or segments of populations reflects human values and not scientific findings. Moreover, requiring that scientists assess population impacts across species could be interpreted as maintaining the *status quo* in use of lead sinkers and ammunition for many years. Deleterious impacts of ingested lead at the population level have been reported for California condors (*Gymnogyps californianus*) (Green et al. 2009), and formed the basis for the passage of the 2007 Ridley-Tree Condor Preservation Act by California that requires use of non-toxic ammunition when hunting in the range of condors. Similarly, the nationwide transition to non-toxic shot in the US in 1991 was predicated on the impact of lead poisoning on the then-endangered bald eagle (*Haliaeetus leucocephalus*), a species protected under several US federal laws (Anderson 1992).

A population-based criterion may arise from wildlife agencies dealing with human actions that may afflict more individuals in populations than lead exposure. Hunting has a high inefficiency level, based on wounding (crippling) losses that may exceed mortality from lead toxicosis, and is accepted as a conventional externality of hunting (Norton and Thomas 1994). Managers have factored such losses in with population losses from natural mortality and other anthropogenic actions. Given the traditional acceptability of these losses, hunters may find concerns about lead-induced mortality unwarranted. However, lead exposure from spent ammunition and sinkers is preventable, and it is impractical to recover spent sinkers and shot from most wildlife habitats.

Although more scientific investigations of this issue are welcome (Rattner et al. 2008), understanding of the causes of lead poisoning from ingested shot and sinkers has probably reached an asymptote. More research will add mainly to what is already known about prevalence, susceptibility, species affected, and geographic range of lead exposure. However, emphasizing that decisions have to be based on the best available science needs to be tempered with the realization that science, alone, does not make decisions: it provides only evidence accompanied by confidence limits. How that science is interpreted depends on other human considerations. Thus, Friend et al. (2009) stated that the US decision to ban the use of lead shot nationally in 1991 was as much a societal decision as an environmental science decision. Moreover, different regulatory agencies presented with identical rigorous scientific evidence of detrimental population impacts of ingested lead on California condors have made very different decisions. Thus, California passed a regulatory ban on lead ammunition use in condor range in 2007; Arizona opted for a voluntary adoption of non-toxic ammuni-

tion in its condor habitat, and Utah has made no decision about regulating the issue, despite sharing condors' range.

Wildlife agencies and jurisdictional issues

Jurisdictional authority is critical in understanding the regulation of lead products, and is based on which animal species fall under federal or state control. Individual states have jurisdiction over angling and the hunting of non-migratory game animals: federal jurisdiction applies to migratory birds and species protected under endangered species legislation. Thus, non-toxic shot requirements for hunting waterfowl and coots is federal law, non-toxic sinker use in New York state and five other states is state law, non-toxic shot requirements for taking pheasants in South Dakota is state law, and the Ridley-Tree Condor Preservation Act of 2007 requiring non-toxic bullet use is California state law. To date, no single federal agency has the jurisdiction to regulate *use* of non-toxic shot, sinkers, and rifle bullets, collectively, across the entire United States because they all lack jurisdiction (Thomas 2009a). The federal and various state agencies managing angling and hunting have not agreed on how to manage lead exposure, while acknowledging the importance of the issue. A large variation in the requirement for non-toxic shotgun ammunition exists in the US, as detailed by Thomas (2009a). Not all migratory bird hunting requires use of non-toxic shot. Species such as mourning doves (*Zenaida macroura*) and woodcock (*Scolopax minor*) can still be hunted with lead shot ammunition, despite strong evidence that mourning doves are subject to marked lead exposure from spent gunshot (Schultz et al. 2009). Twenty-six US states have regulations requiring the use of non-toxic shot for upland game hunting, although there is much variation among these states' regulations concerning their applications. Some apply to the hunting of federally regulated species (e.g., mourning doves) not addressed under federal law (Thomas 2009a). Only six states require non-toxic sinker use for angling, although non-toxic fishing weights are required when angling in other diverse federal locations (Thomas 2003; Rattner et al. 2008).

Accordingly, a group of non-governmental conservation organizations (American Bird Conservancy 2010) petitioned the US Environmental Protection Agency (EPA) in July 2010 to use provisions in the Toxic Substances Control Act to require use of non-toxic substitutes in the manufacture of shot, bullets, and lost sinkers. This petition contended that the EPA could prohibit use of toxic lead in the manufacture of ammunition and sinkers, provided that non-toxic substitutes were available. This novel approach would have bypassed the agencies mandated to manage wildlife and its consumptive use. In August 2010, the EPA denied the petition, contending that the agency lacked the authority to regulate such ammunition, nor was about to seek it (EPA 2010). Thus the search for a suitable jurisdiction continues. Were the use of non-toxic shot to be required for the hunting of all federally regulated bird species, an enormous transition to the hunting of birds with non-toxic shotgun shot would then have occurred, facilitating a complete nationwide transition (Thomas 2009a).

Two reasons beyond jurisdiction may explain the absence of concerted action by game agencies and the slow rate of transition to non-toxic materials. Not all wildlife professionals see the issue of lead exposure having such importance as to warrant wide-scale transitions to

non-toxic shot, bullets and sinkers (see WAFWA 2010 on this point). Other professionals fear that regulated bans on all lead products would drive hunters and anglers from their sports, resulting in a decline in dedicated funding (e.g., Pittman-Roberts funds) to state and federal agencies (Miller 2009; WAFWA 2010), and with that a reduced ability to manage. All agencies are obliged to serve the public, comprising those who favor species preservation or the consumptive use of wildlife, as well as the interests of wild species. Wildlife agencies are also self-interest groups, and therein lies the basis of conflict.

Public stakeholders' concerns

While sporting organizations purport to represent all hunters and anglers, individuals often fall into discrete camps according to their principal sporting interests. There are anglers, waterfowl hunters, upland game hunters and big game hunters, and clay target shooters each with their own special interests in the lead exposure issue and what regulation would mean to their sport. Most of the sporting public and their representative organizations in the US and other nations have resisted the adoption of non-toxic products. By contrast, non-hunters and their representative organizations tend to favor regulation of all lead products (Keats and Wolf 2009).

The principal reasons for resistance by hunters and anglers are concerns about the state of the science and the perceived extent of lead exposure, relative costs of substitutes, their availability and effectiveness. There are calls for more information and education before actions are considered (see WAFWA 2010) and for measures to be implemented to ease any proposed transition to non-toxic substitute use. There has been very little carry-over of the understanding and rationales for banning lead for wetland hunting in 1991 to the current issues of lead exposure from lost sinkers, upland game hunting, and big game hunting with lead-based ammunition. However, one may question the effectiveness of reliance on public education/awareness programs and providing optional use provisions to drive a transition to use of non-toxic sporting products in the absence of regulatory change. The costs of non-toxic tackle that are presented as obstacles to participation could be viewed as investments in a more sustainable sport and a public display of responsibility accompanying rights to fish, especially given the low entry-participatory costs for this sport in the US. The same statement applies to upland game and big game hunting with lead-based ammunition, especially in view of the documented lead exposure it creates for upland birds, predators, scavengers, and humans eating shot game.

One aspect of non-toxic shot use deserving especial comment is the paucity of public information on how effective this management decision has been in protecting waterfowl from mortality. Given that it has been 19 years since the national ban was implemented, the public should know how this has benefited waterfowl populations. This is one area where both levels of government and sporting organizations could do much more to inform the public and to promote the use of non-toxic products (Thomas 2009a). Anderson et al. (2000), Samuel and Bowers (2000), and Stevenson et al. (2005) have reported on the rapidity with which use of non-toxic shot has reduced lead exposure in waterfowl and prevented loss of birds to lead shot poisoning. Given the large number of waterfowl estimated to have been saved from fatal lead poisoning by Anderson et al. (2000), this single measure ranks as

a most effective conservation tool for promoting waterfowl populations, and, in theory, could apply to other species known to ingest spent lead shot (Thomas 2009a).

Hunters, anglers, and clay target shooters can be compared to a municipality or industry that has discharged toxic lead to the environment for many years, has never practiced reclamation or cleanup, and has so far resisted efforts to change. Insofar as municipalities and industries are required to conform to modern federal and state standards of toxic waste regulation, the sporting communities ought to be subject to the same standards, especially in view of the tonnage of elemental lead released per year across the US (Thomas and Guitart 2010).

Position of the non-toxic ammunition industry

Cartridge manufacturers have created non-toxic shot cartridges suitable for waterfowl hunting, upland game hunting, and target shooting in a range of gauges and in various types of federally approved non-toxic materials (Thomas 2009b). Several companies make non-toxic rifle bullets in various calibers designed for big game hunting and destruction of pest animals. Such rifle ammunition is very effective in killing deer species (Knott et al. 2009). A wide range of lead-free fishing sinkers is also available in the US. These manufacturers have allowed a complete transition to non-toxic materials to occur and do not constitute a hindrance to adoption of lead-free products. One has only to visit the catalogue of a large retailer such as Cabela's to see the large amount of non-toxic ammunition and fishing tackle available. The manufacturing issue is investigated further in Thomas and Guitart (2010). The fundamental request of manufacturers is an assurance of a market for their products that only regulation can provide. Voluntary use provisions do not create strong markets, especially when non-toxic products cost more than lead equivalents. It costs manufacturers a lot to develop, secure federal approval, market, and distribute new non-toxic products, and these costs must be recouped from retail sales. Product availability in a given region is a simple function of demand. Assured markets create competition and product development, and large economies of scale benefit consumers with lower market prices. World market prices for lead, copper, tungsten, and tin mean that the non-toxic substitutes will always be more expensive than their lead counterparts. However, fishing tackle has a long life span, cartridges made with steel shot are comparable in price with high-quality lead ammunition, and big game hunters do not fire large numbers of cartridges when hunting.

Considerations for the US National Park Service

NPS administers all US national park system units, which include national seashores, parks, recreation areas, preserves, and many other designations. Wilderness areas may be within such units, and also within units of several other federal land management agencies, such as the Bureau of Land Management and USFWS. Where sport fishing and hunting is permitted in the national park system, it has mostly been practiced with traditional lead materials. Concerns about lead exposure in wildlife have prompted NPS to consider banning the use of all lead ammunition and sinkers within its jurisdiction (National Park Service 2009). The agency is in a unique position to regulate use of non-toxic ammunition and sinkers in every national park unit in the US because it controls public use of these protected areas. The

Department of the Interior has exclusive jurisdiction within national parks and wilderness areas and can determine its own policy on all aspects of angling and hunting. The Park Service operates under the National Park Service Organic Act and administers designated wilderness areas under the Wilderness Act, both of which contain provisions to warrant banning the use of lead products. The Park Service already regulates use of non-toxic fishing weights in Yellowstone and Glacier national parks (Rattner et al. 2008), so a legal precedent exists. National parks and national wilderness areas contain the most pristine natural environments in the US, and their management is held to very high standards to maintain this attribute in perpetuity. While game management agencies are pre-occupied with sustainable consumptive use of wildlife by the public, the Park Service can focus on nature preservation, but still allow some consumptive use of wildlife. Implementation of a ban on lead fishing weight use in all areas under the Park Service's jurisdiction would complement similar regulations enacted in seven US National Wildlife Refuges, administered by the USFWS (Rattner et al. 2008), and would create a strong rationale for extending this progressive action.

The Wilderness Act requires that users of wilderness areas do not "impair" wilderness. This is a critical part of the rationale to end use of lead products in national parks and wilderness areas. Lost (unrecovered) lead sinkers impair freshwater systems, and their possible ingestion by waterbirds could impair the avian community. Spent lead shot may be ingested by birds within the parks, and may be exported to adjacent areas. Lead bullet remnants in gut piles of shot mammals could pass into avian and mammalian scavengers, causing lead exposure and toxicosis: this is impairment of the animal community. Migratory birds pass through many parks and wilderness areas during their annual cycle, and require unpolluted, unimpaired, flyway habitats. Thus, the Park Service is obliged to act on those preventable human activities that cause impairment and diminish the natural integrity of parks and wilderness areas under its control.

In Canada, Parks Canada administers all national parks. This federal agency amended its fishing regulations in the National Parks Act in 1997 to require use of non-toxic tackle within all national parks. The rationale for this amendment was that lead pollution and exposure from lost lead tackle conflicted with the concept of ecological integrity, a concept stated in the Parks Act that underlines management of all Canadian national parks. The same argument was used to extend a ban on lead tackle use to all Canadian national wildlife areas under the National Wildlife Act in 1997. It is noteworthy that both amendments were accomplished without large-scale risk analyses being conducted, or lengthy public consultations. Moreover, Parks Canada focused on lands under its own jurisdiction, and did not involve provincial and territorial agencies.

In September 2008, Executive Order (EO) 12962 on recreational fishing was revised by President George W. Bush. The EO directs federal agencies to maintain recreational fishing on all federal lands, including national parks, and stipulates that fishing be managed sustainably and responsibly (Center for Coastal Conservation 2008). The terms *responsible* and *sustainable* could be interpreted to include use of non-toxic tackle. The angling lobby that was successful in securing access to public fishing in federal areas could also be influential in leading its constituents towards more sustainable fishing practices. Insofar as NPS is mandated to provide public access to recreational fishing, it can also determine what is sustain-

able. Regulating use of non-toxic ammunition and fishing tackle by the National Park Service is completely consistent with the precautionary principle, the polluter pays principle, and principles of wise use. Moreover, the array of available non-toxic ammunition and tackle is large and does not impede public recreation in national parks. Access to national parks is controlled, so promoting compliance with regulations is feasible. Such a ban would be seen as progressive policy by a growing segment of US society that demands access to unspoiled natural areas (Friend et al. 2009) and is mindful of its ecological footprint.

Conclusions

The US transition to non-toxic ammunition and fishing tackle use is slow, despite scientific support for this progressive form of management and the availability of a wide array of approved lead substitutes. This is best explained by lack of consensus among wildlife agencies, disavowal of the issue of lead exposure by sporting groups, conflict among wildlife conservation groups, and perceived limitations of public awareness. The National Park Service has the rationale, jurisdiction, and legislative provisions to regulate use of hunting and fishing materials in park units. Implementing a proposed ban would complement similar initiatives in the US at the federal and state levels, and both promote and facilitate further adoption of non-toxic products.

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