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Attitudes and Issues Preventing Bans on Toxic Lead Shot and Sinkers in North America and Europe

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ABSTRACT: It is paradoxical that lead shot and fishing sinkers are still used widely, given society's understanding of lead contamination and avian lead toxicosis. The statutory action taken by governments varies from total bans on both lead products to no regulation of either shot or sinkers. Many government agencies and field sport organisations are reluctant to use the precautionary principle and the polluter pays principle and regulate use of available non-toxic substitutes. The attitudes of individuals towards their roles in environmental lead contamination and remediation reflect marked self-deception about the need for changes and the benefits to be derived from substitution. Fatal lead poisoning of highly symbolic, revered species such as British mute swans and American bald eagles promoted development of national regulations to ban lead shot and fishing weights. Despite the parallels between these countries' reforms, there has been little parity between the banning of lead shot and fishing sinkers.

KEYWORDS: Waterfowl conservation, attitudes, beliefs, lead shot and sinkers, non-toxic regulations, precautionary principle.

INTRODUCTION

For centuries lead has been the preferred metal for making gun shot and fishing weights because of its widespread availability, low price, ease of manufacture, and chemical stability. However, severe poisoning of waterbirds is related, directly, to the use of these products by hunters and anglers.

Discharged shot accumulates in wetlands and may be eaten by waterfowl (ducks, geese and swans), which mistake it for grit or seeds. Lead fishing weights are frequently lost during use, especially when fish break free from lines. The weights may be consumed accidentally by fish-eating birds, swans, and geese and cause fatal lead poisoning (Pokras and Chafel 1992; Pain 1995). In North America, alone, the death from lead shot poisoning has been estimated at 1.5-4.0

million waterfowl annually (Feierabend 1983). This mortality occurs to varying extents wherever waterfowl are hunted in the World (Pain 1992).

The amount of ingested lead which will produce toxicosis and fatalities of waterfowl varies according to nutritional and physiological conditions of birds. However, a single ingestion of 0.2-2.0 grams of lead shot may prove acutely fatal to most waterfowl (Pain and Rattner 1988; Rattner et al. 1989). Yet each year about 6,000 tonnes of lead shot are deposited in the wetlands of Europe and about 3,000 tonnes in North American wetlands by waterfowl hunters, alone. Given that shot has been accumulating for at least 200-300 years, and that it erodes slowly (Jorgensen and Willems 1987), there is a great risk that waterfowl will contract lead poisoning, both at present and in the future. Indirect lead poisoning occurs when birds such as waterfowl are wounded by gunfire and later are consumed by predators such as eagles, which ingest the embedded lead and die (Elliott et al. 1992).

It was the extent of this toxic threat to waterfowl, and especially the bald eagle (*Haliaeetus leucocephalus*), which led the US government to ban the use of lead shot for waterfowling in 1991 (Morehouse 1992). Widespread mortality among British mute swans (*Cygnus olor*) due to lead poisoning from ingested lead fishing weights (Sears 1988) led to a regulatory ban on the use of lead weights in 1987. Similarly, the mortality risk posed by lost lead fishing weights to common loons (*Gavia immer*) and trumpeter swans (*Olor buccinator*) has led the US government to impose an outright ban on such weights in Yellowstone National Park and two other federal reserves, and caused the US Environmental Protection Agency to propose a national ban on the use of lead weights (USEPA 1994). However, this proposal is encountering a large amount of opposition from some sectors of society and may not proceed to becoming law (Thomas 1995).

Lead poisoning of waterbirds is only one facet of a common anthropogenic toxic lead syndrome. Lead poisoning has been researched more intensively and extensively than any other form of metal poisoning (Royal Society of Canada 1986; Southwood 1983; US Fish and Wildlife Service [USFWS] 1986; Organisation of Economic Cooperation and Development [OECD] 1993). In view of the known risks posed to humans and wildlife by the use of lead, the many international precedents involving reduced use of lead, and the existence of many non-toxic substitutes, one might expect rapid phase-out of lead products by nations.

In this paper I examine the attitudes and beliefs of the principal interest groups of western society which have promoted or hindered progress in the regulation of toxic lead weights and shot. This issue is replete with inconsistencies; among the policies of different nations, among different interpretations of simple science, and among various sectors of environmental conservationists. By analysing the different values of individuals, organisations, and political parties, and how they compete in public, one can realise why the Precautionary Principle (UNCED 1992) has yet to be embraced and applied broadly to reduce the use of these two forms of lead.

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INTERNATIONAL ACTIONS TO RESOLVE LEAD TOXICOSIS

The role of shooting in this toxicosis has been known for over a century in North America and Europe (Sanderson 1992). Research was conducted sporadically through the 1930s, 1950s, and 1970s in the USA to assess the impact of this disease upon continental waterfowl populations and to develop non-toxic alternatives. However, only during the 1980s did a concerted effort begin to address this widespread problem (USFWS 1986). In Europe, Denmark has shown much leadership in developing non-toxic steel shot during the 1970s and 1980s and requiring its use for waterbird hunting in 1986 (Clausen 1990).

To date, only Denmark and the Netherlands require non-toxic shot for all forms of hunting. The regulation of lead fishing weights by these nations is also underway. Britain banned lead fishing weights in common use by anglers in 1987 and a regulatory ban on the use of lead shot in or near British wetlands in 1997 is possible, unless a voluntary transition to the use of non-toxic shot occurs widely. In 1991, lead shot was banned for hunting waterfowl throughout the USA, but lead shot is still permitted for hunting other categories of game. Norway has required non-toxic shot for waterbird hunting since 1991 and will effect a transition to lead-free shot for all hunting before 2000. Canada will impose a nation-wide, statutory ban on lead shot in 1997, but only for migratory bird hunting. Australia, Canada, and Germany presently require the use of lead-free shot in small zones where either the prevalence of lead poisoning of waterfowl exceeds some arbitrary level, or where contamination of ground water is likely (Thomas and Pokras 1993; Thomas 1996; Thomas and Owen 1995). The most progressive actions have been taken by those countries with the lower incidence of lead poisoning, whereas those countries with the highest prevalence of poisoning (e.g. northern Mediterranean nations) have barely begun remediation (Pain and Handrinos 1990; Thomas and Pokras 1993). As more nations become aware of the prevalence of lead poisoning and its impact upon wild life, there is a growing admission of the need for local research and voluntary adoption of non-toxic substitutes. Details of individual nation's current positions are presented in Fawcett and van Vessem (1995).

WILDLIFE TOXICOSIS, MANAGEMENT AND THE PRECAUTIONARY PRINCIPLE

A utilitarian approach to wildlife characterised management during the 20th century, and the principal *raison d'être* of a managed species was to be hunted. Management was then (and is often now) defined as the art of producing a surplus of animals which could be harvested for recreation (Leopold 1933). This caused a dichotomy to exist between the conservation of game and non-game species. This still persists, together with a related inequality of fiscal and managerial

resources, whether in the more feudal wildlife schemes of European nations or the government-regulated systems of Canada and the USA.

Lead poisoning of waterbirds is seen as a regrettable, but inevitable, externality of waterfowl hunting. It has been dealt with by game agencies alone, because it falls within their mandate and jurisdiction. This has precluded an awareness and call for remedial action from the majority of the public not involved with game. Wildlife agencies in North America place other environmental issues above lead poisoning in priority, especially waterfowl habitat losses due to encroaching, subsidised, agriculture. Yet, during the 1980s Feierabend (1983) calculated that as many as 1.6 to 3.8 million waterfowl died annually from lead toxicosis.

A proclivity exists among game managers to emphasise increased production of game rather than increasing the efficiency of its use. This provides a yardstick of their effectiveness as managers and, simultaneously, satisfies an obligation to hunters. This bias also explains the persistent claims for predator control, whether on British grouse-moors, salmon spawning rivers, or duck breeding habitats. As a further example of this bias, in 1986 the American and Canadian governments signed a \$1.5 billion North American Waterfowl Management Plan to acquire and rehabilitate waterfowl habitats in order to increase the annual autumn continental population to 100 million birds (Anon. 1986). The goal of this plan is to add 75 thousand birds to the total population for each of 15 years. Yet waterfowl wounding losses (birds hit but not retrieved) amounting to 1.6-4.4 million birds annually have not been addressed by wildlife agencies, let alone remedied (Norton and Thomas 1994). These losses parallel lead poisonings closely, both in their generation and their absolute magnitude.

Central to the problem of lead poisoning is the perception of hunters and anglers of themselves as the major conservationists and protectors of wildlife in society. This stems from the licence fees they pay to government, or syndicate fees to land owners, or habitat acquisition through organisations such as Ducks Unlimited or Trout Unlimited, and the naive belief that their hunting is part of a broad management tool designed to maintain game populations at appropriate levels. To hunters, anglers, and their representative organisations, the negative consequences of lead poisoning pale by comparison with the multiple goods which they believe they afford wildlife and society.

Except for eagles, which are classified as endangered in the USA, and British mute swans, in no instance have the reported mortality levels from lead poisoning been of such a magnitude that they could be blamed, with a high degree of probability, for any population's decline or endangerment. The possibility that deaths from lead poisoning and natural mortality are compensatory (i.e. lead poisoned birds would have died soon from other natural causes) rather than additive, has been raised to diminish the importance of any impact of lead poisoning on populations.¹ Those opposed to the banning of lead shot or fishing

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weights have requested that scientific evidence be produced to show what is the critical threshold level of lead poisoning at which population depression begins.² However, this experiment cannot be performed under realistic field conditions on wild waterfowl and fish-eating birds because of limitations posed by the large number of birds which need to be monitored and the other complicating factors which defy control.

This approach assumes that decisions warranting a change in human behaviour should be based upon rigorous scientific study alone. However, the Precautionary Principle (UNCED 1992) states that:

Where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.

Thus it is not necessary to define and validate some threshold level of lead-induced mortality only above which remedial action is initiated. It is necessary to validate the existence and extent of lead toxicosis or water pollution in a jurisdiction, and that substitutes for lead do not pose a different toxic risk. Because lead particles cannot be removed satisfactorily from wetlands, the pragmatic remedy is to avoid adding more by requiring use of non-toxic substitutes (Thomas 1994).

Moreover, there is likely to be much variation among individuals' perceptions of what constitutes significant, serious mortality, this reflecting an array of attitudes and values. These may almost certainly conflict with some empirically-derived definition. Thus, although the prevalence of lead poisoning among waterbirds may be low, action by a government may be warranted because it is consistent with the precautionary approach, to preclude the situation where risk of lead poisoning increases to the point where remediation is ineffective.

THE HUMAN CAPACITY FOR SELF-DECEPTION

This general human trait can be used to explain the reluctance of some government agencies and individuals to refrain from using toxic lead products. It is knowingly externalising the consequences of a behaviour to some other entity or person in the belief that the behaviour may long continue unabated to afford the perpetrator personal gain (Johanson and Shreeve 1989; Postel 1992). This deception about the consequences of lead poisoning is not recent. In 1786, Benjamin Franklin wrote about the pernicious effects of lead poisoning, stating that:

...the Opinion of this mischievous Effort from Lead is at least above Sixty Years old; and you will observe with Concern how long a useful Truth may be known and exist, before it is generally receiv'd and practis'd on' (Tackett 1981)

Fatal lead poisoning of birds has been known for well over a century (Calvert 1876).

Adoption of non-toxic shot in the USA from 1986-1991 was estimated to have saved 6.5 million waterfowl from lead poisoning with the result that they were, in theory, available for hunters (Morehouse 1992). During the 1990s Canada has been losing about one third of a million waterfowl annually from lead toxicosis.³ Despite the immediate benefits to waterfowl to be derived from banning lead shot, the other beneficiaries, i.e. hunters, have remained staunchly opposed to its replacement. However, the Federation of Hunting Associations of the European Union has indicated that, given the existence of satisfactory non-toxic shot, continued hunting with lead shot is not a wise use (in the sense of the 1978 World Conservation Strategy) of waterfowl resources (Lecocq 1992). However, this Federation does not have jurisdiction to regulate hunting within individual nations of the European Union, in most of which a different view prevails (Thomas and Pokras 1993).

The argument posed by hunters is that steel shot (the first non-toxic shot developed) would wound more birds than lead shot poisoned, so requiring non-toxic shot would be counter-productive. It is noteworthy that wounding is attributed to steel shot, not the act of shooting by a person, this being the essence of self-deception.⁴ This view has become the mantra of many organisations and government agencies opposed to regulations requiring lead-free substitutes (see, e.g. Wendt and Kennedy 1992, Shedden 1992), but has been refuted completely (see review by Morehouse 1992). Furthermore, no published evidence exists from Denmark, Norway, The Netherlands or the USA showing that higher wounding rates attend the use of non-toxic shot. However, the myth has persisted in different countries and is used repeatedly to thwart or denounce any intent to ban use of lead shot.

Some nations, reluctant to regulate the use of non-toxic shot products, have adopted chauvinism towards the issue of lead toxicosis and its remediation. This is despite the universally-uniform nature of lead toxicosis in birds and the general applicability of lead-free substitutes in shooting sports, wherever practised. Japanese policy requires that the nature of lead poisoning in Japanese waterbirds first be determined by Japanese research before remediation can be considered. The UK contends that the non-toxic substitutes currently available are not appropriate for British shooting conditions and that British-generated substitutes have to be developed (Thomas 1993). Yet several UK companies produce cartridges with non-toxic shot made from iron or bismuth which are sold overseas in large quantities.

Pollution abatement has been achieved in many nations by restricting the emissions from industry and municipalities, whose release of certain pollutants is measured in tonnes per year. While attitudes towards field sports vary widely, only recently have shooting and angling been regarded as sources of pollution

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(OECD 1993). Hunters are inclined to dismiss their personal discharge of lead as being trivial relative to that released by heavy industry and land-fill sites, and they contrast the extreme dispersal of shot over wild lands with the local loadings by industry and municipalities (see Pain 1992 for the converse view). Thus a double standard persists.

A strong anthropocentric bias exists in social perceptions of the severity of lead contamination of the human environment, as opposed to that of wild life and its environment. Current environmental philosophy contends that human social health and environmental integrity are inseparable (UNCED 1992). Several national enquiries (eg. USEPA 1977; Southwood 1983; Royal Society of Canada 1986) have examined, exhaustively, the contributions of different forms of lead use to human contamination and malaise, but, except for Southwood (1983), omitted – perhaps out of ignorance – any reference to the inputs from lead shot and sinkers. However, if the same prevalence of lead toxicosis which occurs in wild life were to be encountered in human beings, lead would have been replaced in sporting use a long time ago (Thomas 1995). The US Department of Health has indicated that lead poisoning constitutes the greatest single health risk to American children (USEPA 1977). Because children will acquire lead from different sources, not just lead weights, and because the syndrome is subtle, traditional uses of lead continue and are defended.

An egregious example of this arises from the 1994 US Environmental Protection Agency public hearings on the proposal to ban commonly-used lead fishing weights. The association representing the US angling equipment industry cited as the basis of its objection a lack of scientific evidence of a problem, interference in the recreational lives of Americans by a zealous Democrat government, and blatant disregard for the redundancy which would be created among the many small cottage industries lacking the capital and developmental capacity to produce new non-toxic products.⁵ It is interesting to note the sanctity attributed to these small-scale industries in the face of a government threat to ban lead. Yet the same industries could be easily merged and eclipsed in the competitive quest for greater market control and centralised production efficiency.

The large US national manufacturers of angling weights support the proposed USEPA ban because they have already developed and distribute lines of non-toxic substitutes, and would be well placed to supply the majority of the market for non-toxic products following a putative ban on lead weights.⁶ Ironically, under existing US regulations, such a company could be fined heavily for having minute traces of lead waste contaminating the human work-place, but might receive accolades and government awards for excellence in selling many tonnes of lead weights, largely destined to be lost in American fresh waters.⁷ Thus there is no consistency in the regulation of lead in the human and natural environment.

SYMBOLIC SPECIES INDUCE REGULATORY CHANGES

A parallel exists between the events which brought about the banning of lead shot in the USA and lead fishing weights in England and Wales. The ban on fishing weights in 1987 was induced by the deaths of a highly-visible, esteemed, symbolic species, the mute swan. Mute swans are the property of the Sovereign, hence the term Royal Fowl. They are also owned by two City livery companies, the Worshipful Company of Dyers and the Worshipful Company of Vintners (Scott 1972). These facts only enhance the symbolic significance of this species.

The research of Owen and Cadbury (1975) and Birkhead (1982; 1983) showed a strong causal link between mortality of mute swans and lead poisoning from lead fishing weights. Because the mortality was most apparent in the River Thames population, an urgency to resolve this toxicological problem can be understood, especially given the availability of non-toxic substitutes. In this case research identified the cause of the problem and appropriate legislation followed. The ban on lead weights has achieved the desired effect, Delany et al. (1992) having reported an 37% increase in the national mute swan population from 1983 to 1990.

It was conservationists eager to protect eagles, and not hunters, who provided the impetus to ban lead shot for waterfowl hunting throughout the USA. The bald eagle is highly symbolic, being the emblem of the USA. It is protected in the USA by three powerful federal acts; the Endangered Species Act, the Migratory Birds Treaty Act, and the Bald and Gold Eagle Protection Act. During the 1970s and 1980s substantial numbers of bald eagles died of lead poisoning, and the 1991 ban on lead shot was implemented primarily to protect eagles (USFWS 1986, Anderson 1992, Morehouse 1992). The collective power of these three Acts enabled ten challenges to the proposed ban on lead shot use, mainly by the hunting lobby, to be defeated (Anderson 1992).

From 1963-1986, 2018 bald eagles were examined by US government pathologists, and 119 were diagnosed to have died from lead poisoning (USFWS 1986). The comparable figure for Canada is 14% (Elliott et al. 1992). Although it is invalid to compare these values with much larger waterfowl deaths from lead poisoning, the comparison does reveal the importance of the public's perception of the avoidable loss of high-profile, extremely symbolic species.

The bald eagle mortality data reported by Elliott et al. (1992) were derived only from the province of British Columbia. This province was the first in Canada to require the use of steel shot for waterfowl hunting in 1995, in order to resolve the secondary lead poisoning of eagles. This regulation was passed by the British Columbia government before parallel federal regulations were passed to take effect in 1997 in the rest of Canada. The British Columbia government took action despite the prevalence of lead toxicosis in waterfowl being much lower than in other parts of Canada (Dickson and Scheuhammer 1993). Bald eagles in this province are of supreme religious significance to the native Haida

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Indians and they also constitute a significant component of the province's Pacific coast eco-tourism.

The bald eagles of British Columbia are part of a migratory Pacific coast population extending between Canada and the USA. The legislative action taken by British Columbia on lead shot effectively complements the regulatory initiatives of the USA and ensures an uniformity of protection throughout the bald eagles' annual Pacific range.

TEMPORAL DEVELOPMENTS OF LEAD REGULATIONS

There is no pattern in the way different jurisdictions have introduced statutory bans on lead products (OECD 1993). Moreover, there is no apparent carry-over from a ban imposed on shot to facilitate a ban on fishing weights, and vice-versa. The UK ban on fishing weights in 1987 was prompted by death of mute swans, caused by the loss of lead weights associated with coarse fishing. Shooting in the UK has yet to cause lead poisoning of a highly symbolic, native species, as it has in the USA. Coarse fishing in the UK involves a different socio-economic sector of society than fly fishing, which has added little lead to waterways. Moreover, swans do not normally associate with the faster flowing rivers used by fly-fishers. In Britain both shooting and fly-fishing are the pursuits of the affluent, who are well organised to resist the imposition of statutory bans on lead products. These factors explain partly the 10 year delay in the imminent restriction on the use of lead shot in Britain.

Different legislative vehicles are involved with the regulation of lead-free substitutes in the USA, confounded by their being administered by different government agencies (Thomas 1995). The US Fish and Wildlife Service administers non-toxic regulations under the Migratory Bird Treaty Act, while the US Environmental agency has proposed the ruling on non-toxic fishing weights under the Toxic Substances Control Act. Although the common loon (*Gavia immer*) is the principal victim of lead fishing weight toxicosis and is a high profile North American species, the symbolism of this species is not as great as that of eagles in the USA. Also, the number of these birds which succumb annually is small relative to the numbers of waterfowl which died continentally from lead shot ingestion (Pokras and Chafel 1992, Feierabend 1983). Resentment of a statutory ban on fishing weights in the USA has led to other regulatory options being proposed. They include requiring the use of substitutes in only those areas where a demonstrated high risk of toxicosis occurs, education programs to induce a voluntary transition to lead-free products and economic incentives to achieve the same end.⁸ Each of these options has its advantages and limitations, which are currently being debated. These options have been advanced largely to mollify the impact of a national ban on anglers, rather than to ameliorate the habitats of waterbirds. The fish-eating species afflicted are

continental migrants and reducing toxic risk requires removing lead weights from species' entire annual range simultaneously (Thomas and Twiss 1994).

Regulation to stop the use of lead products in The Netherlands has not been done on a case by case basis, but from a central government policy which declares that all forms of lead used by humans are undesirable and are to be replaced as soon as substitutes are available. Then individual lead candidates can be regulated out of use within a short time of each other. Thus lead is not allowed in any form of shooting in The Netherlands and angling is about to require the use of lead-free substitutes. This approach avoids the situation where only the most serious forms of lead poisoning are regulated. In the USA, Canada and the UK bans on lead shot apply only to waterfowl hunting, allowing individuals to use lead shot for all other shooting sports. The proposed 1997 regulation of lead shot in the UK specifies use only in the vicinity of a wetland, and then only for the commonest gauge of weapons. Similarly, the 1987 ban on lead fishing weights applies to use in only England and Wales.

In Canada, amendments to regulations concerning the use of lead fishing weights reflect marked differences in the values of the federal and provincial governments. The federal amendments to the Parks Act and the National Wildlife Act regulations will preclude the use of lead weights in all national parks and national wildlife areas as of 1997, i.e. in areas of Canada under exclusive federal jurisdiction. This is consistent with the federal policy on the banning of lead shot. The Canadian provinces and territories, faced with the same information, have yet to initiate any action on this issue. Paradoxically the birds which are afflicted by lead poisoning are under federal jurisdiction, but sport fishing is regulated provincially. While the federal regulations on lead-free sinkers will apply to less than one tenth of Canada's area, they do constitute a legal precedent. This could form the basis of a more stringent federal regulation under the Canada Environmental Protection Act in the future should the provinces and territories remain reluctant to act on this issue.

ECONOMIC IMPLICATIONS OF LEAD REGULATIONS

Principle 16 of the Rio Declaration on Environment and Development states that the costs of pollution remediation should be internalised among those responsible for contamination (UNCED 1992). Because this principle has been applied already to industry, it should, logically, be applied to recreational anglers and hunters in the form of the intrinsically higher costs of non-toxic shot and weights. The incremental costs for angling are both absolutely and relatively small, amounting to less than \$US4.00 per year per average American angler (USEPA 1994). The costs of non-toxic shot, while higher than the lead equivalent, are a minor component of the total costs of this sport in the USA and, especially, in

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Europe. However, this economic factor has been used to oppose bans on lead shot and fishing weights.

Anglers and hunters view these higher costs as a government imposition upon a decreed right rather than a user payment to maintain the sustainability of a recreational practice and reduce the toxic risk to those animals upon which the sport depends. Clearly, there is no reciprocity between the rights and responsibilities of many anglers and hunters. Paradoxically, the same people may contribute large sums of money to non-governmental organisations which purport to bolster wild animal populations and improve their habitats (Canadian and American donations to Ducks Unlimited were \$US95.7 million in 1994). These contributions are much greater than the average costs of adopting non-toxic materials.

In this case, individuals are prepared to pay, voluntarily, for something which benefits their recreation and provides a tangible return to the individual. So does the adoption of lead-free products, but the pathway to the realised good is different from that involving a game conservation organisation. Non-toxic materials reduce toxic risks to existing animals and help to decontaminate environments, but do not, by themselves, increase game production. Game-oriented conservation organisations emphasise habitat acquisition and game production for consumptive sports, and this is what the average sportsman is willing to pay for. Alternatively, or additionally, donations are made to representative organisations which lobby governments effectively to maintain rights of access, rights to pursue consumptive sports, and to resist government infringement upon field sports. This explains the large size of both the National Rifle Association in the USA and the British Association for Shooting and Conservation.

The inclination to accept or reject lead-free products is influenced by perceptions of the value of game animals relative to the costs of the pursuit of fishing and hunting, both in terms of access fees and equipment costs. In Europe, where game is marketed, access fees (riparian fees and syndicate membership fees) greatly outweigh the market value of wildlife (Wigan 1991). State ownership and management of wildlife in North America (and some other countries) precludes marketing wild fish and game, and affords ready access by everyone in society. In such countries government agencies are mandated to provide fish and game for public recreational consumption. Because access licence fees are low (less than \$US15 annually) and the government subsidy of hunting and fishing is subtle, hunters and anglers may not affix a high mental value to fish and game species. Accordingly, when US hunters are required to pay four to five times more for non-toxic bismuth ammunition they contend that the costs borne by them per bird saved appear disproportional.

This view is fallacious because North American game animals have been excluded deliberately from the marketplace (Shaw 1985) and are thus nonvalu-

able. The fact that governments in Canada and the USA have done little to address crippling losses of 30-40% (ducks killed and not retrieved per 100 retrieved) reinforces a belief that incidental losses are publicly acceptable and are not detrimental to the existence of waterfowl populations. Paradoxically, the North American Waterfowl Management Plan is spending approximately \$US127 per duck added to the population. This suggests that total losses due to crippling and lead poisoning are very large, and that individual waterfowl are worth saving, given the relative costs of non-toxic shot (Norton and Thomas 1994).

For many people, angling and shooting represent foremost a diversionary outdoors experience or exclusive, influential, social events (e.g. shooting parties), rather than the acquiring of fish or game. Then gaining access to, and maintaining a position in that group, or expanding the outdoors experience, becomes the principal object of an individual's investment. By contrast, there are some individuals who eagerly support the adoption of non-toxic shot and sinkers because it represents a direct investment in the sustainability of their sport and increases their apparent responsibility. The British Royal Family has recently adopted a policy of using only non-toxic shot on the royal estates. Apart from statutory regulations and voluntary changes, this may be the single most important factor influencing the use of lead-free shot, to date.

NOTES

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¹ Testimony of W. Williams for the Lead Industries Association at the USEPA Public Hearing on Lead Fishing Sinker Rule, Docket 62134. December 1994, Washington, D.C.

² Ibid.

³ Official estimate of the Canadian Wildlife Service, Environment Canada.

⁴ Thomas, V.G. Bang! More Lead Poisoning. *The Globe and Mail*. Toronto, Ontario. October 6, 1992.

⁵ Testimony of M. Hayden for the American Sport Fishing Association at the USEPA Public Hearing on Lead Fishing Sinker Rule.

⁶ Testimony of D. Johnson for Water Gremlin Company at USEPA Public Hearing on Lead Fishing Sinker Rule.

⁷ Ibid.

⁸ Testimony of G. Taylor for the International Association for the International Association of Fish and Wildlife Agencies at the USEPA Public Hearings on Lead Fishing Sinker Rule.

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