Report to the Washington Fish and Wildlife Commission: The Use of Nontoxic Shot for Hunting in Washington

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Washington Department of Fish and Wildlife Nontoxic Shot Working Group

I. Introduction

Lead shot use and possession has been prohibited for all waterfowl, coot, and snipe hunting in Washington since a nationwide phase-in of nontoxic shot was implemented in 1986-1991. At the April 7, 2000 Commission meeting, WDFW presented proposed amendments to WAC 232-12-068, Nontoxic Shot Requirements. The amendments expanded nontoxic shot requirements for hunting of all species to 10 pheasant release sites and other areas, based on a high potential for ingestion of lead by wildlife. During consideration of amendments, the Commission directed the Department to study the impact and feasibility of a statewide ban on the use of lead shot for all hunting. In addition, the Department was directed to develop a timeline for public comment, adoption, and public education on the possible statewide ban. In consideration of a timeline proposed by WDFW at the August 10, 2000 meeting, the Commission identified a literature review and survey of other states as the first steps in evaluating nontoxic shot requirements in Washington. This report provides a summary of relevant literature and a survey of other states' nontoxic shot requirements, and also examines other aspects of nontoxic shot use related to ballistic performance, compliance, and regulatory options.

II. Review of Literature Related to Lead Poisoning

Lead is a soft, bluish-gray metal that is poisonous to animals and plants. Remedies aimed at decreasing exposure to lead have been undertaken (e.g., banning the sale of paint with lead additives, leaded gasoline, and lead shot for waterfowl hunting), however lead exposure from smelting and mining processes, batteries, old paint, lead shot from some upland hunting, and lead fishing weights is still a threat to living organisms (Eisler 1988). In humans, exposure to lead can impair proper function of the nervous, endocrine, muscular, circulatory, immune, and reproductive systems, or cause death (Eisler 1988). Similar effects occur in livestock, pets, and wildlife.

In wildlife, acute lead poisoning (where exposure to lead occurs at relatively high levels) can be a quick, direct cause of mortality (USFWS 1986). Chronic lead poisoning (where exposure to lead is at relatively low levels but over a longer period of time), may act as a direct cause of mortality but may also compromise an animal's health or alter its behavior so that it lacks its normal ability to avoid predators (i.e., causes indirect mortality) (USFWS 1986). Large, localized die-offs of hundreds and thousands of waterfowl due to lead poisoning have been documented in the U.S. since the late 1800s, however most losses of waterfowl to lead poisoning go undetected, as sick birds often seek dense cover

and die there or are consumed by predators (Bellrose 1959). Lead shot deposited by waterfowl hunters was a major source of lead available to waterfowl (i.e., primary poisoning), because waterfowl ingest lead while feeding or obtaining grit (Sanderson and Bellrose 1986, USFWS 1986). Species other than waterfowl may also ingest lead shot and die directly or indirectly from lead poisoning (Table 1). Birds of prey and scavengers can succumb to lead poisoning after ingesting lead shot embedded in the tissues of wounded birds or in the digestive tracts of birds that consumed lead shot (i.e., secondary poisoning) (Scheuhammer and Norris 1995). As with waterfowl, the number of lead poisoning cases is only minimally estimated by the number of birds found and diagnosed (USGS, 1999).

A. Primary Poisoning

Primary poisoning may occur after wildlife ingest lead shot from the environment (Scheuhammer and Norris 1995). Ducks, geese, and swans commonly succumb to primary poisoning as a result of ingesting shot while feeding or collecting grit (Jeffrey 1977, Sanderson and Bellrose 1986, USFWS 1986, Lagerquist et al. 1994). Waterfowl are highly susceptible to lead shot ingestion and poisoning compared to other species, because of the way they feed in wetlands. Their bills are morphologically adapted to feed in wetland bottoms and strain seeds, benthic invertebrates, and grit from the mud, muck, and silt of pond bottoms. Waterfowl may actively select shot as grit (Moore et al. 1998). When lead shot are ingested, the acid conditions in the gizzard and its grinding action tend to break down shot and make it available for absorption into the bloodstream.

Prior to its prohibition for waterfowl hunting in 1991, lead shot was regularly deposited and accumulated in important waterfowl feeding areas. These areas were often wetlands or other aquatic habitats where not only waterfowl but a number of other species of wildlife occurred. As a result, other species ingested lead shot and died from lead poisoning, including shorebirds, wading birds, and gulls (Table 1).

The wetland habitats of San Juan, Skagit, Whatcom, Island, and Snohomish counties provide wintering areas for tundra and trumpeter swans, which are classified as game birds but have no open season. Although lead shot deposition in these sites ceased years ago, swan mortalities from lead shot poisoning still regularly occur in some areas. Capable of foraging deeper in bottom sediments than other waterfowl, swans can ingest lead shot deposited years earlier which occur deep in sediments (Lagerquist et al. 1994).

While lead shot deposition and accumulation were recognized as severe in some waterfowl hunting areas, little attention has been focused on deposition and accumulation of shot at upland sites such as particular clay target ranges (Roscoe et al. 1989) and fields frequently used for mourning dove hunting (Lewis and

Legler 1968, Carrington and Mirarchi 1989). Lead concentrations in blood and tissues of mourning doves, small mammals, and passerines indicated that these species are exposed to dangerous levels of environmental lead in the vicinity of some clay target ranges (Ma 1989, Vyas et al. 2000). Mourning doves using heavily hunted grain fields have also been shown to die from mistaking lead shot for seeds during feeding (Franson 2000, Kendall et al. 1996), which may also have implications for other seed-eating birds.

B. Secondary Poisoning

Secondary lead poisoning occurs when predators and scavengers ingest lead shot while feeding on wildlife containing lead pellets. Secondary poisoning of wildlife remains a concern to wildlife managers, but the link between the use of lead shot for upland game hunting and secondary lead poisoning has only been demonstrated in a few instances in the literature (Scheuhammer and Norris 1995, Wayland and Bollinger, 1999).

Ingestion of lead shot by bald eagles that fed on wounded or dead waterfowl containing pellets resulted in lead poisoning in over 100 bald eagles prior to the phase-in of nontoxic shot (USFWS 1986), including some in Washington (Scheuhammer and Norris 1995). Lead poisoning of bald eagles was one impetus for banning the use of lead shot for waterfowl hunting (USFWS 1986). In one study in Minnesota and Wisconsin, the incidence of lead poisoned bald eagles did not decline from 1987 to 1995, even though lead shot was prohibited for waterfowl hunting (Kramer and Redig, 1997). The authors speculated that the sources of lead could have been waterfowl which were ingested by eagles in Canada (where lead was allowed for waterfowl hunting in 1995), or embedded lead from non-retrieved game birds and mammals which could still be hunted with lead shot in those states.

Free-ranging golden eagles, red-tailed hawks, rough-legged hawks, prairie falcons, and peregrine falcons have also succumbed to lead poisoning after ingesting lead shot (Wayland and Bollinger 1999; Platt 1976, as cited in Scheuhammer and Norris 1995) (see Table 1). A golden eagle collected near Republic, Washington in 1999 and 2 golden eagles collected in early 2000 along the Columbia River near Wenatchee and at Cashmere, carried acute and toxic levels of lead (E. Stauber, Washington State Univ., pers. comm.; T. Talcott, Univ. of Idaho, pers. comm.). Sources of lead were unknown, but potentially included residues from pesticide used in orchards along the Columbia River (W. Yake, WDOE, pers. comm.). These residues might have been passed through the food chain, particularly via ground squirrelsor other mammals that fed on or near orchards, to golden eagles nesting nearby. Other studies have shown mammals to be the most important food item for golden eagles during the breeding period, but food habits during other parts of the year are unknown (Wayland and Bollinger, 1999).

Because little was known about the food habitats, feeding locations, residency, or movements of these golden eagles, possible contaminant passage through the ecological food chain was unknown. A WDFW research proposal to study lead poisoning of golden eagles is currently being evaluated by Washington Department of Ecology.

Deaths of California condors have been attributed to lead poisoning as a result of feeding on carcasses of deer or other mammals killed with lead shot or slugs (Janssen et al. 1986, Meretsky et al. 2000). While free-ranging mammalian predators and mammalian scavengers undoubtedly ingest lead shot and bullet fragments when consuming wounded game, there is little documentation of lead poisoning in these groups of species.

C. Population Impacts

For wildlife species occurring in Washington (other than waterfowl), there is little evidence in the literature of population level impacts related to poisoning from lead shot. Availability of lead shot to wildlife has declined since it was phased out for waterfowl hunting during 1986-1991. It is clear that individuals of several species ingested lead shot or succumbed to lead poisoning, and that lead poisoning might periodically affect a number of individuals (see Table 1), but the significance to these populations has not been demonstrated. However, as noted earlier, the number of lead poisoning cases (and impacts to populations) are only minimally estimated by the number of birds found and diagnosed (USGS, 1999).

Bellrose (1959) estimated that lead poisoning was responsible for the loss of 2-3% of the entire fall population of North American waterfowl (100 million), or 2-3 million birds. In Washington, biologists reported that 4.1-4.5% of harvested waterfowl contained ingested lead shot (Jeffrey 1977, Driver and Kendall 1984), however the extent of lead poisoning in the entire Washington waterfowl population was unknown. In the Mississippi Flyway, losses of mallards to lead poisoning declined 64% during the 1996-97 season, five years after lead shot was prohibited for waterfowl hunting (Anderson et al., 2000).

Large die-offs or consistent mortality, such as that of swans in northwestern Washington, prompt concern that lead poisoning could negatively impact populations. In 2000-01, over 300 trumpeter swans died in Whatcom County from ingestion of lead shot (WDFW, unpublished, 2000). The 2001 population of trumpeter swans in this area was 916, and it is likely that lead poisoning is affecting the population in this area. However, the North American population of trumpeter swans has been increasing, and currently numbers over 17,000 birds.

One of the highest incidences of lead shot mortality in raptors is reported for bald eagles, and more than 100 free-ranging bald eagles are known to have died from lead poisoning (Scheuhammer and Norris 1995, Kramer and Redig 1997). The

North American bald eagle population has almost doubled in the last 10 years to 5,700 pairs, and the Washington bald eagle population has more than quadrupled in the last 20 years to more than 664 pairs.

Lack of evidence for a cause and effect relationship between lead shot availability and impacts on wildlife populations may reflect difficulty in demonstrating such a relationship, lack of research, or low significance at the population level. Kendall et al. (1996) analyzed ecological risk to non-waterfowl avian species of lead shot exposure from current hunting uses, for possible action by the U.S. Environmental Protection Agency (EPA). This study concluded that documented cases of lead poisoning in upland birds and raptors were of concern, but population level risk to these species could not be determined from available data. The authors believed that additional research was needed to determine whether the risk was large enough to merit regulatory action by EPA.

Table 1. Wild, free-ranging birds that occur in Washington, other than ducks and geese, that have died from lead poisoning in North America[a].

SPECIES	CLASSIFICATION IN WASHINGTON
A. SPECIES COMMONLY REPORTED IN THE LITERATURE	
Swan (trumpeter & tundra)[b]	Game bird (no season)
Bald eagle[b]	Threatened (federal and state)
Golden eagle[b]	Candidate (state)
Sora	Protected
B. SPECIES OCCASIONALLY / RARELY REPORTED IN THE LITERATURE[c]	
Mourning dove	Game bird
Common loon[d]	Sensitive (state)
American coot	Game bird
Rough-legged hawk	Protected
Red-tailed hawk	Protected
Northern harrier	Protected
Prairie falcon	WDFW Priority species
Peregrine falcon	Endangered (state), Sp. of Concern (fed)
Turkey vulture	Protected
White pelican	Endangered (state)
Brown pelican	Endangered (fed, state)
Wild turkey	Game bird
N. bobwhite	Game bird
Ring-necked pheasant	Game bird
Gray partridge	Game bird
Sandhill crane	Endangered (state)
Great blue heron	Protected
American avocet	Protected
Black-necked stilt	Protected
Long-billed dowitcher	Protected
Sandpiper (2 spp.)	Protected
Common snipe	Game bird
Gull (4 spp.)	Protected

[a] Sources: USGS (1999), USFWS (1986), Locke and Friend (1992), Lagerquist et al. (1994), Scheuhammer and Norris (1995).
[b] Documented mortality in Washington.
[c] Lead shot ingestion studies generally indicate low levels of exposure to lead.

[d] Species documented ingesting lead fishing weights (sinkers) rather than lead shot.

III. Environmental Fate of Lead Shot

A. Deposition rates

Deposition rates of lead shot depend on the density of hunters using an area and number of shots fired. For example, deposition rates are higher in heavily used agricultural fields where mourning doves are hunted, and lower in forested areas where grouse are hunted. Prior to its prohibition for waterfowl hunting in 1991, lead shot was a particular problem because of high deposition rates near waterfowl blinds or other sites that were used for many years. This caused much higher concentrations of pellets in primary waterfowl feeding areas than would occur from other types of hunting. Mourning dove hunting in the eastern U.S. often occurs over specific fields or food plots that have been used for many years, concentrating pellets similar to waterfowl hunting. However, in Washington, hunters and doves are not as concentrated on specific food plots.

Assuming an average of 250 pellets in a typical upland bird load, and an average of 6 shells fired for each bird harvested, up to 732 million pellets may be fired each year to harvest the average of 488,000 upland birds taken annually in Washington. If distribution of pellets on the total huntable land in Washington was equal (which it is not), approximate annual deposition rates would be 21 pellets per acre each year, or 420 pellets per acre after 20 years. Viewed another way, it would take 20 years to accumulate one pellet on each 100 square feet. Actual deposition rates exhibit much more variation depending on upland bird harvest densities and hunter distribution. Upland bird harvest estimates are obtained at the county level; therefore, reliably estimating actual deposition rates on specific sites or wildlife areas is not possible using available harvest information.

Sampling lead pellet densities in soil and analysis of tissue samples are the best ways to document problem areas, but these methods are labor intensive, expensive, and sometimes difficult to interpret. Higher densities of pellets equate to higher risk of lead poisoning by wildlife, but consistent standards for designating problems areas based on pellet densities are not available. As a result of limited monitoring of soil pellet densities that has been completed by WDFW, nontoxic shot has been required at the Skagit Wildlife Area pheasant release site since 1988. In this area, soil sampling found an estimated 344,000 pellets per acre in the top four inches of soil on the 85 acre release site, or 6.8 tons of lead on the site. Sampling at the Voice of America pheasant release site in Clallam County estimated 188,000 pellets per acre in the top five inches of soil on 35 acres of the release site, or 1.5 tons of lead in 1998. This site was included in the list of nontoxic shot areas approved by the Commission in April 2000.

B. Lead shot mobility (solubility, transport through system) and availability

Past sampling by WDFW of lead shot in sediments at the Skagit Wildlife Area showed pellets in various stages of degradation. Degradation of lead pellets deposited onto soils and wetland sediments varies depending on many factors, and may take hundreds of years in some environments. Aerobic, acidic conditions enhance the rate of pellet breakdown, along with physical factors such as water flow rates, sediment type, and frequency of disturbance (Scheuhammer and Norris, 1995). Mobility of elemental lead and compounds originating from pellets is influenced by rainfall, vegetative cover, soil acidity, and amount of organic matter in soil (Scheuhammer and Norris, 1995). Studies of lead uptake by plants, fish, and invertebrates have not been conducted, except near clay target shooting areas. These studies have found elevated lead levels in species tested, but these areas contain much higher shot densities than typical hunting areas.

Pellet availability to wildlife depends on physical and chemical factors affecting shot degradation, and how long shot remains in the wildlife feeding zone on or under the soil surface. In some soil substrates, shot may quickly migrate from wildlife feeding zones, especially due to certain agricultural practices. Conversely, other soil types and agricultural practices enhance availability (Scheuhammer and Norris, 1995). Anderson et al. (2000) estimated that 25% of the spent pellets available to ducks in the Mississippi Flyway were lead, five years after its use was prohibited for waterfowl hunting. As noted earlier in this report, lead shot in wounded or dead game birds is another source of transport to wildlife, through ingestion by predators and scavengers.

Lead shot availability to wildlife also depends on the substrate or habitat type on which the shot is deposited. Wetlands are primary feeding areas for waterfowl and many other avian species, and lead shot deposition in wetlands is known to result in primary and secondary poisoning. Of the 817,000 acres managed statewide by WDFW, 8% of these lands are wetlands (WDFW, 1998). Two-thirds of the statewide wetland total includes lakes, estuaries, and marine areas, which are generally not subject to lead shot deposition by upland bird hunters. Therefore, about 3% of WDFW lands represent a potential problem, depending on upland bird hunting activity on these lands. Wetlands comprise 42% of WDFW lands in western Washington (WDFW, 1998).

IV. Availability to hunters and performance of nontoxic shot

A. Availability of nontoxic shot types to hunters

Currently available nontoxic shotshell loads include:

(1) Steel (including 4 types of coated steel)
(2) Tungsten (including tungsten, tungsten-iron, tungsten-nickel-iron, and

tungsten polymers)
(3) Bismuth
(4) Tin

Not all types of shotgun loads are currently available from all manufacturers in all gauges and pellet sizes. For example, the selection of nontoxic loads for .410 bore and 28 gauge shotguns, which may be more popular with some upland game bird hunters, is far less extensive than currently available lead loads in the same gauges. Although selection of nontoxic loads increases with popularity of a gauge, some loads are simply unavailable in some gauges.

Price, too, remains a factor in influencing availability of products in the marketplace. Manufacturers and retailers generally produce and distribute products for which a ready market exists. For example, the "traditional" market for nontoxic shotshells was primarily waterfowl hunting, so most loads developed by manufacturers were directed towards that market. Initial manufacturing and retail costs for steel shot were significantly higher than today; nontoxic shot mandates, combined with increased manufacturing competition and increased public demand have moderated costs of steel shot.

New steel shot loads have recently been marketed for about $0.25 per shell, versus about $0.20 per shell for lead, and almost $2.00 per shell for equivalent newer nontoxic loads (i.e., tungsten, bismuth). A recent informal survey of ammunition retail outlets in the Spokane area found that while nontoxic waterfowl loads were available at moderate prices, acceptable nontoxic loads for upland birds were difficult to find, presumably due to low demand. Purchasing through mail order or Internet suppliers offers an alternative for finding less popular gauge and size loads.

B. Ballistics

Ballistics is defined as, "the study of the dynamics of projectiles," or, "the study of flight characteristics of projectiles." Necessary elements of such studies include projectile component materials, weights, velocities, energy levels (both initial and terminal), and operating pressures, etc. Because precision equipment is required to conduct such studies, almost all ballistic information is provided by ammunition manufacturers and based on test data collected under controlled, measurable conditions. Generally speaking, lighter pellets (e.g., steel shot) will exhibit faster initial velocities, while more quickly losing retained energy as distance to target increases.

In-the-field shotshell performance can be influenced by such non-controlled factors as species hunted, pellet selection, range estimation, shotgun patterning

characteristics and densities, choke selection, shooting skill and other variables. Generally speaking, objective performance of nontoxic shotshell loads available today is appropriate for hunting game birds, providing the hunter has the subjective skills to use the load within ballistic parameters established by the manufacturer. Shotshell velocity, energy, and pellet count will vary among steel, bismuth, and tungsten loads. Table 2 summarizes ballistic information from several different manufacturers to illustrate these varying levels.

Table 2: Examples of current 12 gauge, 2-3/4 inch shotshell properties and ballistics

MANUFACTURER	PELLET COUNT[1]	TYPE OF SHOT	SHOT SIZE, WEIGHT	VELOCITY
Federal Cartridge Company	169-438	Lead	2,3,4,5,6,7-1/2 1-1/4 oz	1330 fps
Bismuth Cartridge Company	N/A	Bismuth	4,6,7-1/2 1-1/4 oz.	1300 fps
Federal Cartridge Company	197-240	Steel	3,4 1-1/4 oz	1365 fps
Kent Cartridge America	169-281	Tungsten	3,5,6 1-1/4 oz	1400 fps

[1]Pellet counts vary depending upon shot size (i.e., the larger the shot size, the fewer the number of pellets contained in the shotshell).

C. Effect on shotguns

Given the pellet hardness of some nontoxic shot, particularly steel and some tungsten types, there remains a potential for damage to (1) shotguns with tightly-constricted chokes, and (2) older shotguns, regardless of choke constriction. Potential for damage increases with larger shot sizes. Hunters are generally cautioned by ammunition manufacturers to check first with the firearms manufacturer before using a particular load. Manufacturers of bismuth or tungsten-polymer shot report no such potential barrel damage problems.

D. Wounding loss

A number of studies have been conducted to determine if steel shot was comparable to lead shot for killing waterfowl (Feierabend 1983, USFWS 1986). One argument against steel shot was that hunters were more likely to wound and not retrieve birds when using steel shot, thereby exceeding losses to lead poisoning. However, most research has shown no significant difference between the wounding rates for steel or lead (Feierabend 1983, Scheuhammer and Norris 1995). Initial concerns about increased wounding loss rate for steel shot users generally resulted from poorer initial success of hunters who were not familiar

with shooting steel shot loads. Since the ban on lead shot for waterfowl hunting, most hunters have become more familiar with performance of steel shot loads. Some nontoxic loads (e.g., bismuth, tungsten) now available to hunters perform as well or better than older lead loads. As a consequence of hunter familiarity with steel shot loads and availability of new high-performance bismuth and tungsten loads, concerns about use of nontoxic loads and excessive wounding loss have declined.

V. Regulation compliance issues

Recent case information does not exist to estimate compliance with current regulations regarding nontoxic shot in Washington. Compliance in the Mississippi Flyway was estimated at 99% in 1996-97 (Anderson et al., 2000) Considering specific areas, regulations requiring nontoxic shot possession and use for all species are more effectively enforced than regulations requiring nontoxic shot use for some species but not others.

VI. Regulations in other states, federal lands

A. Summary of Federal Cartridge Co. / Wildlife Management Institute survey

In September 2000, Federal Cartridge Co., in conjunction with the Wildlife Management Institute, surveyed all states regarding nontoxic shot regulations for upland game hunting (Appendix 1) (Federal, 2000). Currently, 23 states, including Washington, require nontoxic shot for upland game hunting on some state-managed lands. However, in 7 states restrictions only apply to mourning dove and/or marsh species such as snipe and rails (these states account for almost 10% of affected acreage). All states indicated restrictions were implemented to reduce potential ingestion of lead by waterfowl. Nationwide, upland game hunters must use nontoxic shot on approximately 1.33 million acres. Two states (Nebraska and South Dakota) account for 60% of this acreage (>804,000 acres). Among other states, upland acreage under nontoxic shot restriction ranges from 100 to 80,000 acres and number of sites ranges from 1 to 65. Thirteen states maintain shot restrictions on <8 individual locations. Washington currently requires nontoxic shot use for hunting all species on all or part of 11 areas encompassing approximately 20,000 acres.

The earliest nontoxic shot requirements began in 1976 and most states with restrictions implemented programs by the time nontoxic shot was required nationwide for waterfowl hunting (1991). Sixteen states implemented upland game nontoxic shot regulations prior to 1992, and another seven have implemented upland game nontoxic shot regulations since that time. Two states are considering establishment of new requirements for nontoxic shot and 5 states

are considering some kind of expansion of current programs. Data on shot ingestion by wildlife have been collected in 16 states. Interestingly, 8 of those states with data have no current restrictions; but 2 are considering nontoxic shot requirements for at least some upland hunting. Only 1 state has a quantitative minimum standard for spent shot density: the Wyoming legislature set a threshold of 20,000 pellets/acre for requiring nontoxic shot "to protect waterfowl and other species." In addition to restrictions for hunting upland game, 8 states either prohibit "target shooting" on wildlife areas or require nontoxic shot in designated areas.

B. Federal lands

The U.S. Fish and Wildlife Service (USFWS), through their refuge system, is the primary federal agency concerned with nontoxic shot regulations There is no overriding policy of prohibiting lead shot for hunting nonwaterfowl species on all refuges. Other federal agencies with land management responsibility have apparently not been involved in shot type issues to date. The primary concern of USFWS in this region is for situations where upland hunting occurs in or adjacent to wetlands where waterfowl have access to shot. Refuge nontoxic shot restrictions are likely a result of juxtaposition of habitats and ability to enforce regulations. There is not an overriding policy of prohibiting lead shot on all refuges. However, refuge managers have substantial discretion in developing regulations if resource protection issues are identified. For lands in eastern WA recently included under USFWS management, the Service plans to continue management under current strategies and regulations until comprehensive conservation plans (CCPs) are produced, including public input. Finalization and implementation of CCPs will likely not occur for several years.

VII. Regulatory options for restricting use of lead shot

Several approaches exist to address potential problems from the continued use of lead shot for hunting game birds. These approaches are based on varying levels of risk assessment and evidence of potential population impacts from lead poisoning.

A. **Prohibition of lead shot use on selected problem areas**

This approach is based on qualitative field assessments to identify areas with a high potential for ingestion of lead by wildlife. To date, sites converted to nontoxic shot use have been limited to obvious problem areas, with high concentrations of hunters depositing lead shot, and significant numbers of waterfowl and other wildlife present that may be impacted by ingestion of lead on the areas. Lead shot deposition still occurs at clay target ranges, and wetland and upland sites where species other than waterfowl are hunted. Under this approach, WDFW would continue considering impacts to wildlife in local areas where lead

shot deposition and accumulation still occurs. Sites where deposition of lead shot poses threats of primary and secondary poisoning to wildlife would be converted to nontoxic shot use for all shooting. However, with this approach, the potential exists that some problem areas will not be identified. The approach of designating specific problem areas as nontoxic shot zones is the method most commonly used by other states that have implemented additional lead shot restrictions. **(Note: this approach was selected by the Washington Fish and Wildlife Commission at their February 9, 2001 meeting in Tukwila, WA).**

B. **Prohibition of lead shot use on all state wildlife areas**

This approach also involves requiring nontoxic shot for all shooting on specific areas, but expands the requirement to all state wildlife areas. Based on recent field assessments, not all sites on wildlife areas present potential problems for lead ingestion by wildlife (e.g., upland forested sites, or wetland sites rarely used by upland bird hunters). As noted earlier, WDFW manages 817,000 acres statewide, and 8% of these lands are wetlands (WDFW, 1998). Of this total, about 3% of WDFW lands represent a potential problem, depending on upland bird hunting activity on these lands. Wetlands comprise 42% of WDFW lands in western Washington (WDFW, 1998), but many of these areas were converted to nontoxic shot use in April 2000. Two states that have implemented additional lead shot restrictions using the approach of designating all state wildlife areas as nontoxic shot zones.

C. **Statewide prohibition of lead shot use for some or all game bird hunting**

This approach expands nontoxic shot requirements to some or all game bird species statewide based on the potential for primary or secondary lead poisoning impacts. If this approach was adopted, further evaluation would be needed to determine which species should be hunted with nontoxic shot only. This approach would also include a requirement for nontoxic shot use for clay target shooting on WDFW lands. Ingestion of lead shot has been documented in numerous species other than waterfowl (Table 1). As noted previously, Kendall et al. (1996) analyzed ecological risk of lead shot exposure to non-waterfowl avian species, for possible action by the U.S. Environmental Protection Agency (EPA). This study concluded that documented cases of lead poisoning in upland birds and raptors were of concern, but population level risk to these species could not be determined from available data. The authors believed that additional research was needed to determine whether the risk was large enough to merit regulatory action by EPA. The approach to expand nontoxic shot requirements to some or all game bird species statewide has not been used by other states that have implemented additional lead shot restrictions.

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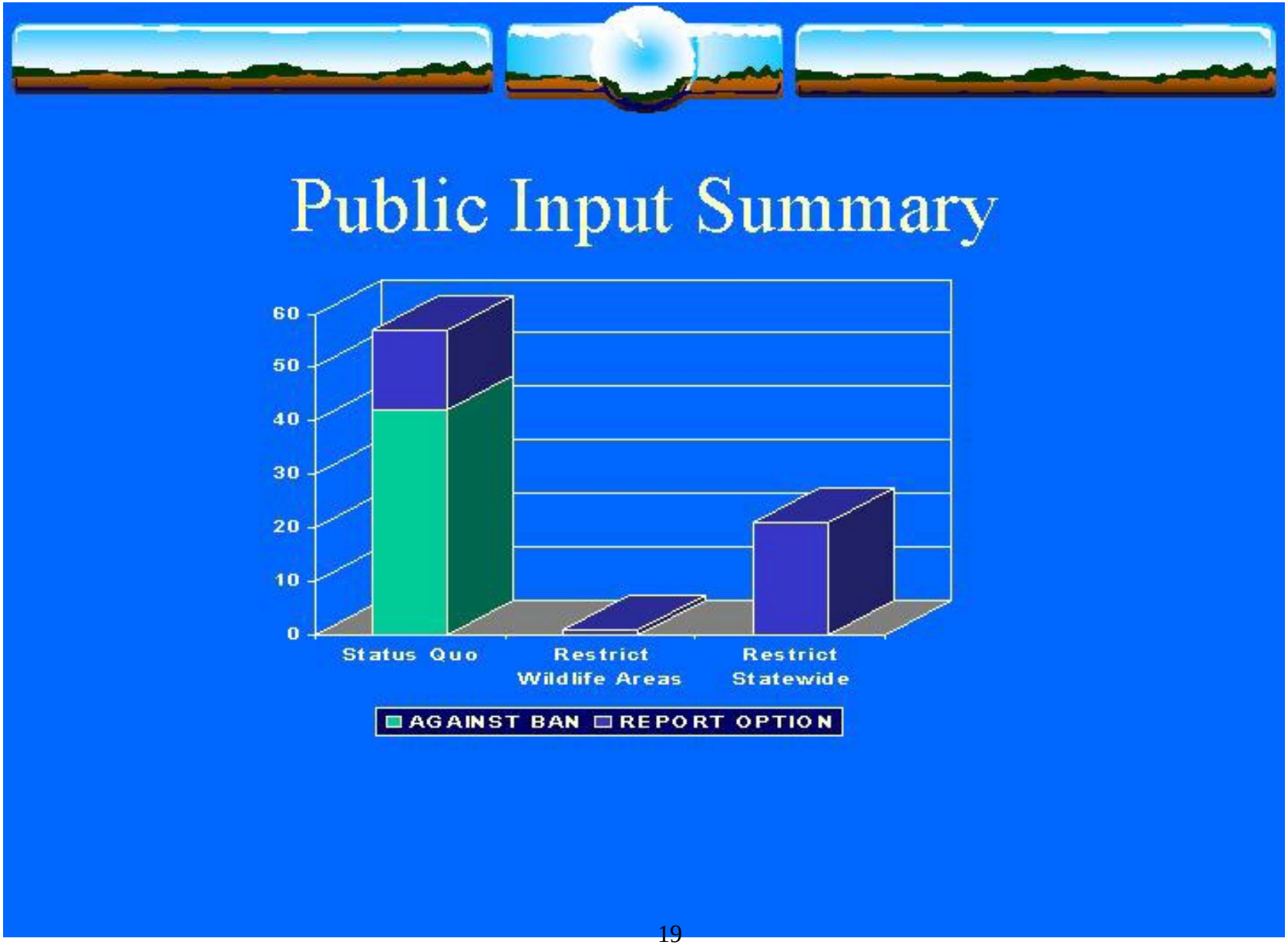
Appendix 1. Summary of nontoxic shot regulations for upland game hunting in the United States (Federal, 2000)

State	Nontoxic required	Number of areas	Acres	Year began	Species affected (on management areas)	Future plans for nontoxic	Nontoxic for targets	Ingestion data
AR	yes	1	7,000	1992	rabbit, squirrel, deer			
CA	yes	1	12,000	1990	dove, pheasant		yes	
DE	yes	1	100	1985	dove		yes	
FL	yes	1	3,870		snipe			
IA	yes	65	80,500	1998	partridge, pheasant, turkey, small game		yes	
IL	yes	25		1990	dove, pheasant			yes
IN	yes	3	4,365	1991	dove	yes		yes
KS	yes	16	72,000	1986	dove, upland game		yes	
KY	yes	12	40,000	1989	dove			
LA	yes	2	2,500	1995	dove, gallinule, rail			
MI	yes	7	10,000					yes
MO	yes	18	49,106	1977	dove, quail, rabbit, squirrel, turkey	yes		yes
NC	yes	8	5,000	1980	all			
NE	yes	265	403,868	1986	grouse, prairie chicken, quail			
NM	yes	25	80,000	1993	grouse, pheasant, quail, squirrel			yes
OH	yes	3	1,000	1996	gallinule, rail, snipe			
OK	yes	36	8,000	1997	small game, migratory birds, turkey	yes		yes
OR	yes	8	46,840	1991	dove, pheasant, quail, snipe		yes	yes

SD	yes		400,000	1998	dove, grouse, pheasant, small game		yes	
TN	yes	6	4,534	1990	dove, quail, rabbit, squirrel		yes	yes
UT	yes	5	75,000	1976	dove		yes	
WA	yes	11	20,000	1988	all	yes		
WY	yes	2	4,445	1985	dove, grouse, pheasant, rabbit	yes		
					squirrel, deer			
AK	no						yes	
AL	no							
AZ	no							yes
CO	no							
CT	no							
GA	no							yes
HI	no							
ID	no							
MA	no							
MD	no					yes		yes
ME	no							
MN	no							
MS	no							
MT	no							
ND	no							
NH	no							

NJ	no							yes
NV	no							
NY	no							
PA	no							yes
RI	no							
SC	no							yes
TX	no							
VA	no							
VT	no							yes
WI	no					yes		yes
WV	no							
Total	23 yes	521+	1,330,128			7	9	16
State	Nontoxic required	Number of areas	Acres	Year began	Species affected (on management areas)	Future plans for nontoxic	Nontoxic for targets	Ingestion data

Appendix 2. Summary of written public input on this report.



Public Input Summary