13.2.6. Lead Poisoning: The Invisible Disease

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Synonym

Plumbism

Cause

Lead poisoning is an intoxication resulting from absorption of hazardous levels of lead into body tissues. Lead pellets from shot shells, when ingested, are the most common source of lead poisoning in migratory birds. Other far less common sources include lead fishing sinkers, mine wastes, paint pigments, bullets, and other lead objects that are swallowed.

Species Affected

Lead poisoning has affected every major species of waterfowl in North America and has also been reported in a wide variety of other birds. The annual magnitude of lead poisoning losses for individual species cannot be precisely determined. However, reasonable estimates of lead-poisoning losses in different species can be made on the basis of waterfowl mortality reports and gizzard analyses. Within the United States, annual losses from lead poisoning have been estimated at between 1.6 and 2.4 million waterfowl, based on a fall flight of 100 million birds. Proportional adjustments that reflect current waterfowl populations and increasing use of nontoxic shot should be made when estimating current lead-poisoning losses.

Lead poisoning is common in mallards, northern pintails, redheads, scaup, Canada and snow geese, and tundra swans. The frequency of this disease decreases with increasing specialization of food habits and higher percentages of fish in the diet. Therefore, goldeneyes are seldom affected and mergansers rarely affected (Figure 1). Among land birds, eagles are most frequently reported dying from lead poisoning. Lead poisoning in eagles generally is a result of swallowing lead shot embedded in the flesh of their prey.

Distribution

Losses occur coast-to-coast and border-to-border within the United States. Documented occurrences of lead poisoning in migratory birds vary widely between States and do not necessarily reflect true geographic differences in the frequency of occurrence of this condition. For example, although the geographic distribution of lead poisoning in bald eagles is closely associated with their wintering areas, the number of lead poisoning cases from Wisconsin and Minnesota is disproportionately high. The reported distribution of lead poisoning is more a function of recognition than of frequency of occurrence. The general distribution of this disease in waterfowl on the basis of lead shot ingestion surveys and documented mortality is reflected in Figure 2.

Adapted from: Friend, M., editor. 1987. Field guide to wildlife diseases. U.S. Fish Wildl. Serv., *Resour. Publ.* 167. 225 pp.

Type of bird	Relative occurrence
Whistling-ducks	○
Swans	
Tundra swans	●●●
Mute swans	●●
Other swans	●
Geese	
Canada geese	●●●
Snow and Ross' geese	●●●
Brant and other geese	○
Ducks	
Puddle ducks	●●●
Bay diving ducks	●●●
Teal, shoveler, wood duck	●
Sea ducks	○
Mergansers	○

●●● Frequent reports of mortality including individual die-offs involving hundreds to thousands of birds

●● Often reported mortality

● Occasionally reported mortality; lead shot ingestion studies generally indicate low levels of exposure to lead shot

○ Rare reports of mortality; lead shot ingestion studies generally indicate little or no lead shot ingestion

Figure 1. Relative occurrence of reported lead poisoning in North American waterfowl.

Lead poisoning has also been reported as a cause of migratory bird mortality in other countries, including Australia, Canada, Denmark, Germany, Great Britain, Italy, Japan, New Zealand, and Sweden.

Seasonality

Losses can occur at any time of the year, although most cases of lead poisoning occur after the waterfowl hunting season has been completed in northern areas and during the later part of the season in southern areas of the United States. January and February are peak months for cases in tundra swans, Canada geese, and puddle ducks. Spring losses are more commonly reported for diving ducks. Tundra swans are also frequently lead poisoned during spring migration.

Field Signs

Lead-poisoned waterfowl are often mistaken for hunting season cripples. Special attention should be given to waterfowl that do not take flight when the flock is disturbed and to small aggregations of waterfowl that remain after most

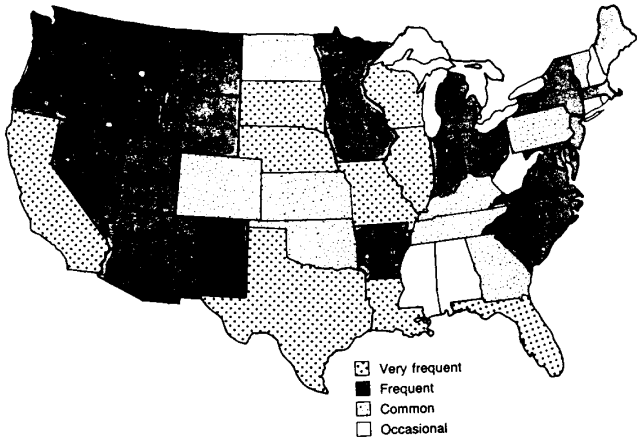

Figure 2. Relative occurrence of lead exposure in waterfowl based on gizzard analyses and reported mortality.

other birds of that species have migrated from the area. Lead-poisoned birds become reluctant to fly when approached; those that can still fly are often noticeably weak flyers, unable to sustain flight for any distance, flying erratically and landing poorly. Birds that attempt to escape pursuit by running may exhibit an unsteady gait. In lead-poisoned Canada geese, the head and neck position may appear "crooked" or bent in flight; a marked change in the tone of call is also sometimes evident in this species. As the disease progresses and waterfowl become flightless, the wings are held in a characteristic "roof-shaped" position (Figure 3), followed by wing droop as the birds become increasingly moribund. There may be a fluid discharge from the bill, and often there is an absence of escape response.

Lead-poisoned waterfowl are easily captured during advanced stages of intoxication. Because severely affected birds generally seek isolation and protective cover, well-trained retrieving dogs can help greatly to locate and collect these birds. An abundance of bile-stained feces on an area used by waterfowl is suggestive of lead poisoning and warrants ground searches even if other field signs have not been observed. Green-colored feces can also result from feeding on green wheat and other plants, but the coloration is somewhat different.

Gross Lesions

Lead-poisoned waterfowl are often emaciated because of the prolonged course of the illness and its effect on essential body processes. Therefore,

Figure 3. Characteristic "roof-shaped" position of the wings in a lead-poisoned mallard (*leading bird*).

Figure 4. "Hatchet-breast" appearance of a lead-poisoned mallard (*top bird*) and northern pintail. The skin has been removed from the breast of the pintail to further illustrate the severe loss of muscle tissue.

many affected birds appear to be starving; they are light in weight, have a "hatchet-breast" appearance, (Figure 4), and the undersurface of their skin is devoid of fat. The vent area of these birds is often stained with a bright green diarrhea. The heads of Canada geese may appear puffy or swollen because serumlike fluids accumulate in the tissues of the face.

Lesions observed at necropsy of lead-poisoned birds that have died after a prolonged illness generally consist of the following:

- Severe wasting of the breast muscles.
- Absent or reduced amounts of visceral fat.
- Impactions of the esophagus or proventriculus in about 20–30% of affected waterfowl. These impactions may contain food items, or combinations of food, sand, and mud. The extent of impaction may be restricted to the gizzard and proventriculus, extend to the mouth, or lie somewhere between.
- A prominent gallbladder that is distended, filled with bile, and dark or bright green.
- Normally yellow gizzard lining discolored a dark or bright green. Gizzard contents are also often bile-stained.
- Lead pellets or small particles of lead often present among gizzard and proventricular contents. Pellets that have been present for a long time are well worn, reduced in size, and disklike rather than spherical (Figure 5). Careful washing of contents is required to find smaller lead fragments. X-ray examination is often used to detect radiopaque objects in gizzards, but recovery of the objects is necessary to separate lead from other metals. Flushing contents through a series of progressively smaller sieves is one method for pellet recovery.

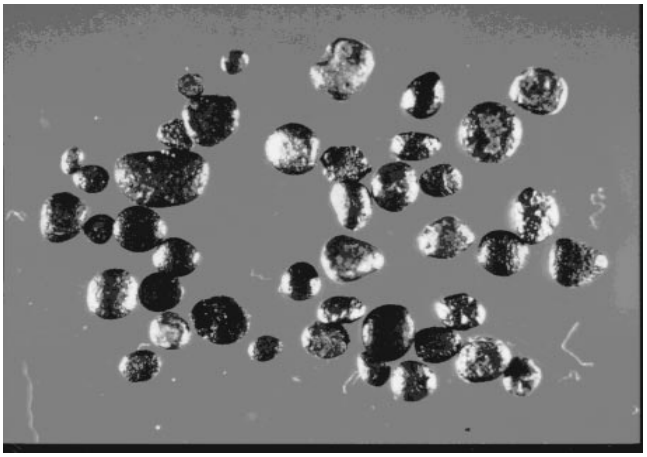

Figure 5. Lead shot, originally round, have been worn down in a waterfowl gizzard. Note the flattened, disklike shape of many of these pellets.

The above field signs and gross lesions provide a basis for a presumptive diagnosis of lead poisoning. However, none of these signs and lesions is diagnostic by itself and all can result from other causes. Also, many of the above signs and lesions are absent in birds that die acutely following an overwhelming lead exposure.

Control

Two actions can often be taken to reduce the magnitude of mortality from lead poisoning when die-offs occur: denying bird use in problem areas, and rigorous pickup and proper disposal of dead and moribund birds.

Denying birds use of problem areas requires knowing where the birds are picking up the lead. This is complicated by the fact that signs of intoxication may not appear until a week after lead ingestion, and birds may not start dying until 2 to 3 weeks after lead ingestion. Habitat modification is also useful in some instances, but differences in feeding habits must be considered. For example, placing additional water on an area may protect puddle ducks from reaching lead shot on the bottom of wetlands, but this creates attractive feeding areas for diving ducks. Similarly, draining an area may prevent ingestion of lead shot by waterfowl, but creates an attractive feeding area for shorebirds or ring-necked pheasants. Therefore, control actions must consider the broad spectrum of wildlife likely to use the area at the time action is taken. Rigorous pickup and proper disposal of lead-contaminated waterfowl carcasses is required to prevent raptors and other scavenger species from ingesting them. The high percentage of waterfowl with embedded body shot provides a continual opportunity for lead exposure in raptors that far exceeds the opportunity for ingestion of shot present in waterfowl gizzards.

Other management practices that have been used to reduce losses from lead poisoning on site-specific areas include: (1) tillage programs to turn lead shot below the surface of soil so that shot is not readily available to birds; (2) planting food crops other than corn and other grains that aggravate the effects of lead ingestion; and (3) requiring the use of nontoxic shot on hunting areas. The potential contributions of the first two practices toward reducing lead-poisoning losses among migratory birds are, at best, limited and temporary. The use of nontoxic shot is the only long-term solution for significantly reducing migratory bird losses from lead poisoning.

Medical treatment of lead-poisoned birds is generally not a reasonable approach. However, endangered species or other birds of high individual value that are lead poisoned may warrant medical treatment. In those instances, treatment should be done only by qualified persons familiar with and skilled in the proper use of lead-chelating chemicals. Under the best of circumstances, results of treatment are unpredictable and the success rate low.

Human Health Considerations

People do inadvertently consume lead-poisoned waterfowl. Although this is not desirable, no appreciable risks to human health exist. Most lead present in the body of a lead-poisoned bird is in soft tissues such as liver and kidneys rather than in the flesh. The dose relation (mg of lead per kg of body weight) and lead excretion processes are such that a great number of lead-poisoned birds would need to be consumed in a relatively short time before toxic levels could build up in the human body. Persons who eat liver, kidney, and other soft tissues from lead-poisoned birds would consume more lead than those who eat only muscle tissue of these birds. Persons who consume waterfowl bone marrow would be additionally exposed to lead, since lead is stored long-term in bone.

There are a few documented eases of humans developing lead poisoning after having accidentally ingested lead shot embedded in the meat they ate. This type of lead poisoning is rare, perhaps due to caution exercised when eating hunter-killed wildlife so as to avoid potential damage to teeth from biting into shot. Lead shot that is ingested can also become lodged in the appendix, resulting in appendicitis. Although this does not happen often, it happens most in people who hunt waterfowl for subsistence.

Suggested Reading

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Appendix. Common and Scientific Names of Animals Named in Text.

Wood duck	*Aix sponsa*
Northern pintail	*Anas acuta*
Shoveler	*Anas clypeata*
Mallard	*Anas platyrhynchos*
Teal	*Anas* spp.
Redhead	*Aythya americana*
Scaup	*Aythya* spp.
Brant	*Branta bernicla*
Canada goose	*Branta canadensis*
Goldeneye	*Bucephala* spp.
Snow goose	*Chen caerulescens*
Ross' goose	*Chen rossii*
Tundra swan	*Cygnus columbianus*
Mute swan	*Cygnus olor*
Whistling ducks	*Dendrocygna* spp.
Bald eagle	*Haliaeetus leucocephalus*
Mergansers	*Lophodytes cucullatus, Mergus* spp.
Ring-necked pheasant	*Phasianus colchicus*

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