Is Lead "Steeling" Your Ducks?

by Dan Rosenberg

High lead levels have been found in Cook Inlet ducks. Some mallards and pintails on three popular hunting spots in Cook Inlet are ingesting and absorbing spent lead shot in large enough quantities that it could be causing increased mortality in waterfowl populations. While hunters have little to fear from eating ducks with elevated lead levels (lead is concentrated in the organs and not muscles) they, as well as all Alaskans, should be aware of the problem and the steps being taken to restore healthy duck populations. Before we discuss the results of our study, let us first look at the regulatory changes designed to alleviate lead poisoning and the nature of lead poisoning itself.

September 1, 1991, will mark a big change for waterfowl hunting in Alaska, as well as the rest of the United States. When the season opens one-half hour before the sun comes up on a Sunday morning, waterfowl hunters will be firing shotgun shells containing steel shot. With the firing of the first shot, a nationwide changeover from lead to nontoxic (steel) shot will have been completed. This will mark the biggest change in waterfowl hunting since the implementation of the Migratory Bird Treaty Act of 1918, which gave the federal government authority to regulate the waterfowl harvest and protect all migratory birds.

A nationwide phase-in to convert from lead to steel shot was ordered by the U.S. Fish and Wildlife Service (USFWS) in 1986. By this fall, 15 states will have converted entirely to steel shot, with another five scheduled to convert by the 1989 hunting season. Every state but Alaska and West Virginia will have some mandatory steel shot areas by 1989, and by 1991, the transition will be complete. Only steel or other forms of nontoxic shot will be allowed for waterfowl hunting in the United States as of 1991.

Biologists estimate that between 1.5 and 3 million ducks and geese die each year in the United States from lead poisoning, as a result of swallowing spent shotgun pellets while feeding. For humans, lead has long been recognized as a public health issue. We have removed lead as an additive to gasoline, banned its use in paint, and set standards for our drinking water. For over 100 years the problem of lead poisoning has been known in waterfowl.

Every time a waterfowl hunter fires a shot, over 150 lead pellets rain down upon the landscape. In heavily hunted areas such as the Palmer Hay Flats State Game Refuge near Anchorage, this can add up to several hundred thousand pellets being deposited on opening day alone. These pellets can remain available for at least a year, if the bottom is hard and within reach of feeding ducks.

Waterfowl pick up lead shot while feeding or foraging for grit (coarse sand and gravel required for digestion). The lead shot is swallowed along with food and grit and passes down the esophagus to the gizzard. The gizzard is a muscular part of a bird's stomach that grinds food and has been compared in its digestive function to the chewing of mammals. The grinding action of the gizzard which breaks down food items is aided by the abrasive action of grit. Grit can be retained in the gizzard for several weeks and not passed to the intestine with the partially digested food. Lead resembles grit and may also be retained in the gizzard for two to three weeks. Lead, which is a soft metal, is eroded by the grinding action of the gizzard, and strongly acidic digestive juices, and converted to a soluble salt that can be absorbed into the bloodstream.

The effects of elevated lead levels include anemia as well as nervous system and cardiac disorders, all of which can lead directly to death or indirectly by making the bird more susceptible to other diseases or more prone to predation. The concentration of tissue lead levels necessary to cause death directly from lead poisoning varies greatly depending upon a host of environmental and internal factors such as weather and diet. Typically, ducks on a high cereal grain diet such as corn or wheat can develop chronic lead poisoning after ingesting just a few pellets. The resulting illness may progress slowly for two to three weeks before ending in death.

With all that was known about lead poisoning throughout the rest of the country, it still remained to be seen whether ducks in Alaskan marshes were being affected. From past studies conducted in the 1970s, we knew that birds were picking up lead

These are gizzard contents of a pintail collected opening day on the Palmer Hay Flats. The shiny round pellets are lead shot ingested by the bird.

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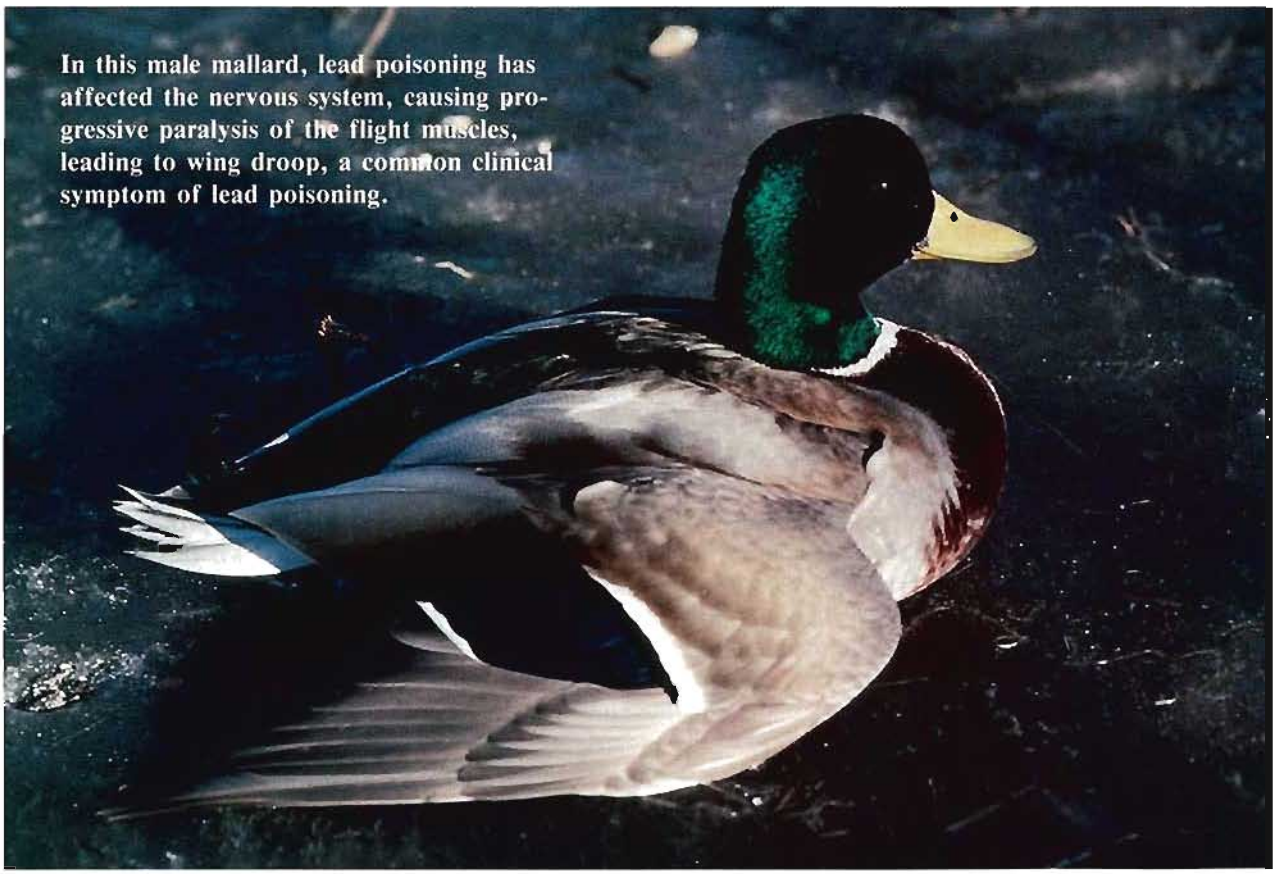
shot in Cook Inlet marshes at relatively high rates when compared with other parts of the country. The presence of lead pellets in the gizzard indicates that birds are being exposed to lead directly. However, without an adequate number of corresponding liver samples, we did not know with certainty the extent to which lead was being absorbed into tissues and organs.

Even though birds ingest lead, it may not be absorbed into the tissues. To determine if lead is being absorbed, livers are analyzed. Lead in the liver reveals the degree of assimilation of lead by tissues and indicates the presence of an actual health threat. If birds had elevated lead levels in the liver, but showed no signs of ingesting shot, perhaps another environmental source would be the culprit.

In 1985, the USFWS formulated guidelines for identifying areas where lead poisoning of waterfowl is a significant problem. If one or more ingested shot was found in 5 percent of the gizzards sampled and 2 parts per million (ppm) or higher lead concentrations occurred in 5 percent or more of the livers



In this male mallard, lead poisoning has affected the nervous system, causing progressive paralysis of the flight muscles, leading to wing droop, a common clinical symptom of lead poisoning.

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sampled, then a lead poisoning problem exists. Based on these guidelines, ADF&G initiated a study in 1985 to determine whether a lead poisoning problem occurs in Cook Inlet, the most heavily hunted portion of the state.

Thanks to the cooperation of local duck hunters, we collected the liver and gizzard from 574 mallards and pintails in Redoubt Bay, the Susitna Flats, and the Palmer Hay Flats during the 1985 and 1986 hunting seasons. Mallards and pintails were chosen because among the dabbling ducks (which also includes wigeon, teal, and shovelers) these two species are the most susceptible to lead poisoning. Mallards and pintails feed off the bottom of shallow ponds and marshes, areas where spent lead shot can be deposited heavily. Mallards and pintails are also of concern because their populations have been declining dramatically in recent years.

Each gizzard was X-rayed and those containing lead were visually inspected to determine whether the shot was ingested or shot-in. Livers were sent to the University of Alaska Agriculture and Forestry Experiment Station laboratory in Palmer for atomic absorption analysis. Thus, for each bird we knew when and where it was shot, the species, its sex and age, and whether it recently ingested lead and if so how much lead, and the lead concentrations in its liver.

We found that mallards and pintails in upper Cook Inlet are ingesting spent shot and absorbing it in levels that not only exceed the federal guidelines but also are relatively high when compared with studies conducted throughout the United States. Ingested lead pellets were detected in the gizzards of 27 percent of mallards and 17 percent of pintails. Seven percent of the birds had five or more pieces of shot in their gizzard, with one pintail ingesting over 80 pieces of shot. Highest ingestion rates occurred in birds collected from the Palmer Hay Flats, where 38 percent of mallards and 28 percent of pintail gizzards contained ingested lead shot.

Twenty-six percent of all birds collected in upper Cook Inlet on September 1, the opening day of waterfowl season, contained ingested lead shot, indicating that shot deposited in previous years is available to spring migrants, nesting females, and young birds produced on these hunting areas. Lowest ingestion rates for mallards were from birds collected on the Susitna Flats where 18 percent of the birds contained one or more ingested shot. Lowest rates for pintails were from Redoubt Bay. Over 7 percent of Redoubt Bay pintails contained ingested shot. All these figures exceed federal guidelines.

The percentage of ducks with liver lead levels greater than or equal to 2 ppm exceeded five percent for both mallards and pintails in Redoubt Bay, the Susitna Flats, and on the Palmer Hay Flats. Liver lead levels were greatest from birds collected from the Palmer Hay Flats, where 29 percent of the birds exceeded federal guidelines. Lowest percentages of birds with elevated liver lead levels, but still well above federal guidelines, were from birds collected on the Susitna Flats.

Although large scale die-offs of several thousand lead poisoned birds have been known to occur in the lower 48 where weather conditions restricted feeding birds to areas with abundant shot, generally, lead poisoned birds are hard to find. This makes it difficult to directly assess the severity of the problem in any given area and for hunters to notice in the field. One reason is that birds become sick and weakened individually, unlike contagious disease outbreaks, and tend to seek secluded areas to hide. Another reason is that weakened birds are more susceptible to predation, or, once dead, are quickly scavenged.

In a study conducted in Texas coastal marshes, 47 carcasses disappeared at the following cumulative rates: 32 percent in less than one day, 47 percent in two days, 62 percent in three days, and 89 percent by the eighth day. Further, vegetation makes finding carcasses difficult. As part of the same study, 100 carcasses were planted over a 100 acre area. Beginning their search thirty minutes after placement, eight searchers could locate only six carcasses, all placed on top of vegetation.

Many factors determine the lethality of shot once it has been ingested. These include diet and type of grit consumed, and the rate of passage of food and grit through the digestive tract. Some studies of pen-reared birds indicate that certain diets may prevent or reduce tissue absorption of lead. It is possible that such a situation occurs in some of our marshes where birds have a diet high in protein, calcium, and often eat soft vegetation, all factors that may reduce the breakdown and uptake of lead. However, there is no doubt that a significant portion of the mallards and pintails in upper Cook Inlet have elevated lead levels that, if not directly, may indirectly be a significant cause of mortality to a dwindling resource.

Except for habitat loss, lead poisoning is the single most important management problem facing waterfowl managers and hunters in North America. With the alarming decline in waterfowl nesting habitats in recent years, and subsequent population loss, currently exacerbated by the drought in the prairie states and provinces, waterfowl managers believe all reasonable measures to protect populations should be implemented. With the problem of lead poisoning in waterfowl, there is a practical solution: converting to steel shot.

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