

A photograph of three wild turkeys in a body of water. The turkeys are white with black wings and necks, and orange feet. They are looking towards the camera. The water is dark and rippled.

Lead Warnings

by Joni Greenberger

Photo © by Bill Byrne

The adult female wild turkey arrived at the Tufts Cummings School of Veterinary Medicine Wildlife Clinic (TCSVM) on a busy Monday morning. A man from Wilbraham, MA, had found the bird in his yard. He said that it had been sitting in one spot since the early morning. While wild turkeys frequently forage in backyards and other open areas around dawn and dusk, they are normally quick to take alarm and escape into nearby brush or woods when approached by people. In contrast, this one seemed like it just didn't care, and offered little resistance to capture.

As a team of students and veterinarians examined the bird, they found her weight (3134g) to be about normal for a mature hen, but she was a bit thin and dehydrated. Her crop was empty, indicating that she had not eaten in about 48 hours. While the turkey had some feather loss over her abdomen, the physical exam revealed no wounds, fractures, or signs of parasites or disease. Following treatment with pain medication and fluids she was still lethargic and refused to eat, so the doctors decided to take X-rays and a blood sample to find out more.

X-rays showed multiple small metal objects in her digestive tract, and her blood lead (Pb) level was higher than our machine could read, exceeding 65mg/dL. (For reference, the level considered toxic

in humans by the EPA is 10µg/dL). Most of the objects in her gut resembled bird-shot, but a few were larger, oval, and of unknown origin. The hen had probably swallowed the shot and other objects along with the grit that birds normally ingest to help grind food in their gizzard. As the metal was exposed to stomach acid, lead was released into the circulatory system of the bird, causing emaciation, disorientation, and other symptoms including breakdown of red blood cells and wasting of the kidneys, liver, and spleen. In a last ditch effort to give her a chance of recovery, veterinarians decided to surgically remove the lead to prevent her blood lead levels from rising any further. They were able to remove the metal objects (along with 40 small stones) from her stomach compartments. However, despite tube feeding, fluid therapy, and removal of the swallowed objects, the effects of the lead had already become too severe for the patient, and she failed to recover from surgery.

Although this turkey was just one individual, her case illustrates important health concerns for wildlife and humans in Massachusetts. For decades the Wildlife Clinic at TCSVM has received loons, swans, squirrels, pigeons, and other species of wildlife that have ingested lead sinkers, bullets, and other lead objects. Displaying symptoms such as lethargy,

disorientation, and altered posture, they often wander into roads or areas where they are more visible and likely to be picked up by people. Some patients are able to recover with surgery or treatment with chelating agents to remove lead, but this treatment is expensive and stressful, and many lead poisoned animals are so severely affected by the time they reach the clinic that they do not survive it.

Why Do Wildlife Ingest Lead?

Because of its extensive use throughout history, lead is now one of the most common metals found polluting our ecosystems. Although the manufacture of housepaints containing lead was banned in the United States in 1978, and leaded gasoline was banned in the mid-1980s, years of using these products have contributed to elevated lead levels in dust, soils and sediments. Lead is particularly concentrated near mining activities, smelters, refineries, and battery recycling plants. It is also found in areas where lead arsenate pesticides (first used in Massachusetts against gypsy moths in 1892) have been used.



Photo courtesy TCSVM Wildlife Clinic

An X-ray displays lead projectiles in the digestive tract of a lead-poisoned wild turkey. The bird presumably fed in the shotfall zone of a shooting range.

Virtually all vertebrates are at risk from lead toxicosis.

So where do wildlife pick up lead? Many birds regularly feed in areas where we shoot, hunt and fish, and can ingest spent shot and lead sinkers, perhaps mistaking them for food or the small stones that they use for grinding food in their gizzards. Both avian and mammalian predators and scavengers eat discarded gut piles and crippled game containing lead shot



Photo © by Bill Byrne

Lead shot was banned in for waterfowl hunting to help protect dabbling ducks like the mallards (above left) from lead poisoning, but upland birds like these wild turkeys, as well as many other wild birds and mammals, are also at risk of ingesting lead shot and bullet fragments with serious, often fatal results.



Photo © by Bill Byrne

For the average sportsmen, handling lead fishing weights and ammunition has long been routine, but given the personal and environmental risks involved, we should replace it with nontoxic substitutes. Children should not handle it at all.

or bullets. Wild and domestic grazing animals may browse near areas of lead concentration in soil and water. Birds may feed or gather grit in the “shotfall zones” or earthen backstops of shooting ranges. In one study of over 300 animals presented to the Wildlife Clinic at TCSVM between 2002-2006, we found lead levels above 10 μ g/dL (the threshold for toxicity in humans) in 32% of cases. These samples included waterfowl, raptors, songbirds, mammals, and even reptiles. The Wildlife Clinic has also performed necropsies on over a thousand loons in the past 20 years, and found that about 48% of adult birds in New England lakes died from lead poisoning.

Sources of Lead

Humans and domestic animals are also affected by lead through exposure to old paints, cosmetics, contaminated soils and water, as well as in many occupations and hobbies that involve handling lead-containing products such as hunting, fishing and automotive mechanics. Thus, lead poisoning is not just an environmental issue, but also a recurring public health concern that impacts oc-

cupational health, wildlife management and conservation, agriculture, hunting and fishing, and other facets of the interaction between humans, animals, and the environment.

Lead occurs in trace amounts naturally in soil, plants and water, but additional lead is deposited in the environment by mining and smelting, as waste from the manufacture and recycling of plastics and electronics, and by the burning of petroleum and coal. Even today, lead is also found in many paints, glazes, cosmetic products, pressure treated wood, pesticides, and batteries. Lead can be deposited in the environment as a free metal, a salt, or bound to dust, and thus can be both inhaled and ingested. Under alkaline (basic) pH in streams and lakes lead compounds are fairly insoluble. However, acidification increases the solubility of many lead compounds in water, while erosion easily suspends particles in the water column.

Thousands of tons of lead are deposited annually by hunting, fishing, and shooting sports. While lead shot was banned in the US for waterfowl hunting in 1991, a great deal of residual lead still remains in the sediments and waters of marsh and



Scavengers such as the Turkey Vulture are highly susceptible to lead poisoning when they feed on unrecovered game or discarded gut piles containing lead shot or bullet fragments. Below, a large amount of shot can be seen in the gizzard of a Mute Swan, poisoned while feeding on aquatic vegetation

wetland habitats. Because lead pellets resemble grain or grit, game birds, waterfowl, songbirds, wading birds, and small mammals often mistake them for food or ingest them as grit. At least 59 terrestrial bird species have been documented to suffer from lead poisoning, including 9 threatened species. Once ingested, the acid and mechanical grinding in the digestive tract allows lead particles to be eroded and absorbed into the blood stream.

Lead birdshot obviously enters the meat of harvested gamebirds, and lead

bullets tend to fragment in the meat of game animals. Therefore, some lead ingestion is almost inevitable for humans or animals eating meat or offal from game killed with lead shot or bullets. This is the most common route of lead exposure for raptors and carnivorous mammals, and it may be a risk for humans, especially children, eating game. Acute lead poisoning from ingesting lead ammunition fragments has been documented in a wide variety of birds, including golden eagles, sea eagles, bald eagles, peregrine falcons, American kestrels, osprey, Cooper's hawks, sharp-shinned hawks, northern goshawks, California condors, and turkey vultures. The Raptor Center at the University of Minnesota reported lead poisoning in 25% of the bald eagles admitted each year since 1996.

Historically, lead poisoning in waterfowl and other wildlife has been mostly due to ingestion of spent lead shot from hunting. More recently, however, it has also been associated with the ingestion of lost or discarded lead fishing sinkers and jigs. Ingestion of lead sinkers or jigs is considered a leading cause of mortality for loons in eastern North America, with lead poisoning accounting for 20-30% of adult loon mortality in habitats where





Photo © by Bill Byrne

Lead poisoning caused by the ingestion of lead fishing gear accounts for 20-30% of adult loon mortality. It could be eliminated if anglers switch to readily available non-toxic alternatives. Below, a lead fishing weight in the gizzard of a loon that succumbed to lead poisoning. The bile-green color is diagnostic of the affliction.

recreational angling is prevalent. These long lived, fish eating birds may be exposed to lead when they eat fish that have broken free from anglers, but still contain tackle. Water birds may also pick up lead sinkers or jigs when they are sifting for invertebrates or gathering pebbles from the bottom to use in their crop.

Dabbling ducks, such as mallards and pintails, skim the bottom in shallow areas to feed on roots, leaves, and seeds. In places where lead split shot and sinkers are used, the birds may mistake them for dietary items like seeds or snails. Shorebirds ingest discarded pellets and tackle when probing soil along banks as they dig for insects and seeds. Diving ducks, swans, and geese are exposed to sinkers and shot when feeding in deeper water. As a result, newly deposited lead is available to some species, while older shot that has sunk into sediments is available to others. Researchers have also found that invertebrates in these sediments can concentrate large amounts of lead, to the point that a single earthworm can contain enough lead to kill a bird like a robin or a woodcock.

Lead fishing gear not only carries risks for animals that ingest it, but also for people who make and handle it. Anglers

often use their teeth to clamp split-shot sinkers onto fishing line and inadvertently ingest lead particles. Even handling sinkers without washing hands can lead to low-level exposure that may have cumulative effects over years of use. Children are especially at risk, considering their increased frequency of hand to mouth activity and the fact that children absorb lead more readily than adults.

Melting and casting lead can be another major source of lead exposure for sportsmen and their family members. Casting

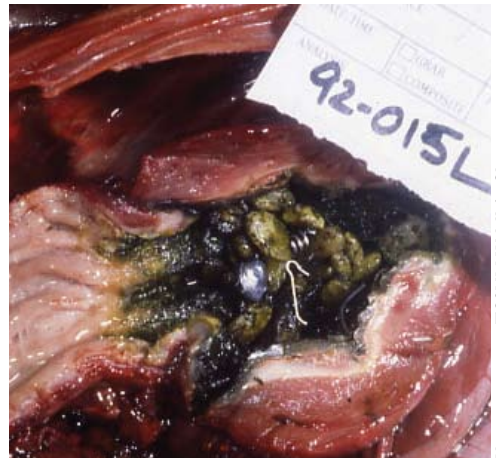


Photo courtesy TCSVM Wildlife Clinic

sinkers, jigs and bullets in houses and garages can produce extremely toxic lead vapors and lead-contaminated dust that poses a health threat to all household members. Years of doing this can deposit lead in wallboard, furniture, fabrics, wood and other household materials, making the house a reservoir for lead exposure even when melting and casting of lead has long since ceased.

Public health departments all over the US are concerned with these risks, and OSHA recommendations include:

- ❖ avoid purchasing or using products known to contain lead
- ❖ avoid inhaling dusts or fumes of lead or lead-containing compounds
- ❖ avoid consuming food and beverages or putting items in the mouth in areas where lead, lead-based compounds or lead-based materials are used
- ❖ wash hands with soap and water after handling lead

Especially now, with many efforts being made to get families outside and participating in activities like fishing, hunting, hiking, boating and swimming, it is important to be mindful of the presence of lead in the environment and the associated risks.

Effects of Lead

A 1998 Report to Congress state “the lead problem in the United States can be expressed in a simple statement: ‘lead is potentially toxic wherever it is found, and it is found everywhere.’”

Humans and animals absorb lead mostly through the gastrointestinal and respiratory systems. Lead affects all organ systems, but the most profound effects are seen in the nervous, digestive, and circulatory systems. In blood, it follows the movement of calcium, interfering with many body functions that require calcium, and it is stored in bone instead of calcium. Eventually, most of the lead in the body is stored in bone. Lead interferes with the functions of hemoglobin, limiting the amount of oxygen that is carried to organs by the blood. Effects in the skeletal and reproductive systems cause problems such as stunted growth and infertility. Lead often persists for decades in top predators and humans, leading to a slow, cumulative toxicity.

Most work on lead poisoning in wildlife has been done on water birds and raptors



Photo © by Bill Byrne

Young children are at the greatest risk of the neurotoxic effects of lead exposure because their brains and nervous systems are still forming.

to date, but effects of lead poisoning are similar in all animals. Frequently, birds ingest small amounts of lead over a long time period, retaining it in the digestive tract for several days or weeks and suffering chronic poisoning. Chronic high-level exposure will lead to paralysis of the wings, legs and digestive tract, anemia, anorexia, disorientation, and increased susceptibility to infection. Emaciation, respiratory distress, and green, bile-stained feces are also typical. Thus, lead poisoned birds have difficulties breeding, nesting, and caring for their young. Poor health and behavioral changes may result in an increased risk of predation for animals with chronic lead exposure, and thus to lead ingestion by raptors and other predators who feed upon poisoned animals. The sub-lethal effects of lead exposure may therefore have more serious ramifications for wildlife populations than those due to acute lead toxicosis.

In livestock such as cattle and horses, most lead exposure is due to contaminated soil. Animals often graze and drink along roadsides or in areas where the soil or water is contaminated by lead from industrial uses, vehicle emissions, or from

old paint. Cattle have also been known to lick grease from farm machinery, drink crankcase oil, and chew on batteries, plumbing materials, or any other items found in their fields. Calves in particular are notoriously curious feeders, and can receive lead from suckling as well.

Poisoning most often occurs after a change in environment, such as in the spring when animals are turned out to pasture, or in the fall when they are brought into yards before being shipped out. Lead objects settle in the stomach of the cattle, often persisting for years, while smaller lead particles get converted into salts by stomach acids. Lead poisoning in cattle causes symptoms similar to those of other animals, including anemia, kidney and liver damage, sterility, and abortions.

Lead also has been found to affect small mammals, including pet cats and dogs and wildlife such as raccoons, opossums, and mice. Ingestion of lead-based paints is the most commonly identified source of lead in cats and dogs. Other sources include roofing materials, plumbing supplies, bullets, solder, pewter, linoleum, grease, putty, and batteries. While dogs may chew on or ingest many of these items, cats ingest lead in dust that has accumulated on their fur and paws when they groom. Lead toxicity in dogs is characterized by vomiting, diarrhea, and neurological signs. Cats usually exhibit a loss of appetite and can also show abnormal aggression. In wild mammals, lead exposure usually comes from contaminated soil and water, as well as ingestion of discarded hunting and fishing gear. As in other animals, lead ingestion causes anemia, neurological signs, and damage to kidneys and liver of raccoons, mice, squirrels, and shrews.

Despite all the information on lead in animals, the effects of lead exposure are best understood in humans. In both children and adults, much of our lead exposure comes from paint in older buildings. Paints containing lead are a risk when they begin to flake and contaminate household dust, soils, or water. Lead paint was commonly used in homes until 1978 and the US Department of Housing and Urban Development estimates that close to 40 million homes in the US still contain lead paint. Poisoning occurs when these paints start to

deteriorate and contaminate household dust or soils. Remodeling and renovation of old houses also contributes to lead-containing dust that can be inhaled or ingested. Material salvaged from old houses, including doors, windows and moldings, often contain lead paint, but there are no regulations on the sale or use of such items.

Lead also has a mildly sweet taste which encourages children, pets and farm animals to eat the paint chips off of houses or out of the dirt, leading to many cases of lead poisoning. Use of tetraethyl lead in gasoline was discontinued in the US many years ago, but it is still a major soil contaminant around roadways and poses a poisoning risk to animals, adults and children. Water contamination from plumbing materials including brass faucets and lead-containing solder that joins copper pipes together can be another risk, especially in areas with acidic water.

There has been a great deal of press lately about lead-contaminated toys. This is because children under the age of six are at the greatest risk of the neurotoxic effects of lead exposure because their brains and nervous systems are still forming. Symptoms may include stomachaches, headaches, irritability, and loss of appetite, but often vary from child to child, making detection difficult for parents.

While the current level of concern defined by the CDC is 10 μ g/dL, research published in the *New England Journal of Medicine* in 2003 indicates that even much lower levels than this may cause significant IQ deficits, and that there is probably no such thing as a "safe level of exposure." Low levels of lead exposure have also been linked to learning disabilities, behavioral problems, stunted growth, and impaired hearing in children, as well as increased high school dropout rate, juvenile delinquency and violence in teenagers. Higher levels lead to kidney damage, mental retardation, and even coma or death.

Generally, children absorb about half of the lead that they ingest, and are able to eliminate the other half in feces. Absorbed lead is stored in bones and can be released later in calcium-requiring events such as pregnancy and menopause. Thus, women exposed to lead at a young age

Lead Info Links

Wildlife Without Lead: www.hawkwatch.org/lead_site/index.htm

Project Gutpile: <http://projectgutpile.org/>

Minnesota DNR Lead page: www.dnr.state.mn.us/ecological_services/nongame/projects/leadout.html

Let's get the Lead Out! alternatives for fishing: www.pca.state.mn.us/oea/reduce/sinkers.cfm

American Sport-fishing Assn. - Lead: http://www.asafishing.org/asa/government/lead_in_tackle.html

National Safety Council Lead Poisoning Page: www.nsc.org/issues/lead/index.htm

Toxics Use Reduction Institute at U Mass Lowell: www.turi.org

Lead Action Collaborative - The Medical Foundation: www.leadactioncollaborative.org/index.htm

Michigan DNR Wildlife Disease Laboratory:

www.michigan.gov/dnr/0,1607,7-153-10370_12150_12220-26676--,00.html

are at risk of transmitting lead across the placenta to their fetus when they become pregnant, or in breast milk when they lactate. In older men and women, lead has been shown to contribute to mental problems and heart and kidney disease.

Alternatives

Lead is a major environmental and public health issue, but there are more and more non-toxic alternatives available. Non-lead tackle and ammunition alternatives are now readily available on the market, and hunting and angling groups such as Project Gutpile are working to raise awareness about this issue from within the sporting community. These groups recommend small steps that can be taken to minimize lead exposure to wildlife. These include using non-lead and non-fragmenting bullets when hunting, and making efforts to recover bullets from gut piles and prey items. They also advocate burying gut piles well to deter predators and scavengers. (Some sources of non-toxic gear can be found in the "Links" sidebar of this article.)

There are many non-lead alternatives available for fishing gear, including materials such as tin, steel, and bismuth, and more and more fishing groups recommend removing **all** lead products from the tackle box, especially from children's tackle boxes. They also encourage wearing gloves or washing hands after handling any lead items, and bringing old lead tackle to be recycled safely instead of discarded. As hunters and anglers become more informed about the risks

of lead, increased demand for non-toxic materials should increase the availability of non-lead sinkers and ammunition.

Sportsmen are considered the original conservationists. In the spirit of Aldo Leopold, Teddy Roosevelt and George Bird Grinnell, they have always believed in protecting the waterways and forests where they hunt and fish. While sportsmen and some environmentalists may not see eye-to-eye on every issue, what connects them is a shared understanding that healthy ecosystems mean healthy habitats for both wildlife and humans. Thus, with projects such as the Toxics Use Reduction Institute at UMass-Lowell, and the Lead Action Collaborative, efforts are being made in Massachusetts to better understand the effects of lead on wildlife, humans, and the environment. With increasing awareness of lead's pervasive effects, and a commitment to small changes in our daily lives, perhaps we can make our state a safer place to live and celebrate the outdoors.

Pb

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