

"I came over a coulee and saw an eagle on the ground." It was cold and cloudy that afternoon in early November when Hannah Leonard nearly tripped over the bird. She was hunting a block management area just outside of her hometown of Missoula, Montana.

Fully grown, a golden eagle can stand more than three feet tall, has a wingspan of nearly eight feet, and can dive at speeds reaching 200 miles per hour. Their talons, used to puncture all manner of birds and mammals, can grow almost three inches long and have the crushing power of 440 pounds per square inch. The iconic bird is so revered as a symbol of power that it graces the emblems of five countries scattered across the globe: Albania, Germany, Austria, Mexico and Kazakhstan.

THE WEIGHT OF LEAD

Words by JASON G. GOLDMAN
Photos by CHARLES POST



AS HANNAH GAZED INTO THE grounded animal’s eyes, a defiant predator stared back. But its body betrayed its suffering. “Its talons were super tensed; its wings were drooping,” Leonard recalls. “It didn’t flush, and I knew enough about birds that I knew something was wrong. I figured it might have been electrocuted.”

But it wasn’t a jolt of electricity that downed this once-magnificent creature; it was a beakful of poison.

Veterinarians from a nearby raptor rehabilitation center confirmed that it had ingested lead, almost certainly from swallowing bullet fragments hidden in gut piles left behind by hunters on the block management area. Despite the rehabilitators’ best efforts, the eagle died. But looking back, Leonard highlights that moment as particularly formative. “It has now led me in this career path with Sporting Lead Free,” a Wyoming-based nonprofit where she works full time as outreach coordinator. “It was a great learning moment for me,” she says.

LEAD IS BOTH PLENTIFUL AND CHEAP, which explains why it’s been used for everything from roofing to water pipes, from bullets to fishing tackle. It doesn’t rust after coming into contact with water.

It’s got a low melting point. It can be easily formed into any shape. Afterward, it hardens quite quickly.

More than a century ago, ammunition manufacturers developed a structure called a shot tower. You climb a ladder and pour molten lead through a sieve. Gravity goes to work, pulling the liquid metal through the sieve in the form of droplets. As they fall through the air, friction causes those droplets to form into spheres. After their brief fall, the spheres splash into a tub of water, where they quickly set, oxidize and harden. “You have what they call chilled lead shot, which is perfectly spherical and uniform in size,” says British firearms expert Diggory Hadoke. “Fantastic from a production point of view.”

Shotguns work not just by inflicting a fatal wound into an animal, but also because the pellets impart shock. If the material is too hard, pellets can too easily fly straight through an animal, delivering less shock trauma. That could injure rather than quickly kill a bird, causing unnecessary suffering. Or it could indeed kill a bird, but too slowly, leaving the victim with just enough energy to fly far enough away that it and its meat become unrecoverable. Lead is something of a Goldilocks metal: hard, but not too hard. “It is soft enough to deform on impact, [which] imparts its energy into the body of what it’s

hit, rather than flying straight through it,” Hadoke explains.

And there’s an added benefit for hunters: when you bite onto a lead pellet inside your game meat, it will deform rather than shatter your teeth.

From the perspective of quickly, efficiently and inexpensively killing your quarry, lead has many benefits. It’s also got one important downside: it’s made of poison.

Indeed, too many sportsmen and women are pumping the ecosystems they love full of toxic metals. They blast millions of lead pellets across wetlands while shooting ducks and geese, or over agricultural fields while hunting doves, or over woodlands while targeting ruffed grouse and pheasants. They fire thousands of lead projectiles into deer, elk, sheep and bears on high-altitude mountain slopes. They leave lead weights on the bottom of rivers after they break off their fishing lines, or hide lead wires beneath the precisely arranged feathers of their fly fishing lures. A 1999 study in Minnesota estimated that more than 1.1 million kilograms (2.6 million pounds) of lead shot were used each year in hunting and shooting ranges across the state. A Boeing 747 only weighs about a third as much.

Day after day, season after season, that lead winds up killing or harming dozens or

perhaps hundreds more animals than any single hunter would ever intend to kill. It’s the mallard that sucks up lead pellets from the bottom of a marsh. It’s the dove that fills its gizzard with lead pellets instead of stone grit. It’s the whitefish that swallows a lead-lined nymph. It’s the osprey that feeds that whitefish to its offspring. It’s the wounded pheasant that’s easily preyed by a hawk. It’s Hannah Leonard’s golden eagle gorging on a gut pile studded with fragments of a lead bullet.

BIOLOGISTS HAVE KNOWN that wildlife suffers from lead exposure for more than a century. In 1876, H.S. Calvert published a paper called “Pheasants Poisoned by Swallowing Shot” in a journal called The Field. In 1894, the anthropologist and naturalist George Bird Grinnell, best known for his work to conserve the American bison and for co-founding the Boone and Crockett Club, the Audubon Society and the New York Zoological Society (now the Wildlife Conservation Society), published an article titled “Lead Poisoning” in Forest and Stream, a magazine for which he also served as editor.

Since that time, biologists have published research documenting that more than 130 species can become ill or die by directly ingesting lead shot, or rifle projectile fragments, or can suffer from secondary poisoning by consuming prey animals that themselves ate or were shot with lead ammunition.

Those species include doves, mallards, Canada geese and trumpeter swans; bald eagles, Andean condors, Cooper’s hawks and great horned owls; greater flamingos, sandhill cranes, wild turkeys, and white-throated sparrows; gray squirrels, rabbits and white-tailed deer; American alligators, saltwater crocodiles and snapping turtles; domestic dogs and cats; bats, horses and fish; and so many more.

In the UK, domestic cattle had an increased risk of stillbirths and decreased milk production after eating lead-contaminated hay harvested from a field used for clay pigeon shooting. Lead can even be

taken up from contaminated water and soil into plants. In a 1993 study in Finland, lingonberries that grew near a shooting range had a lead content of 0.3 mg/kg, which was considered inedible according to Finnish food safety regulations.

“Lead is one of those elements that has zero use in the body. There’s literally no need for it,” says Dominique Keller, Chief Veterinarian and Director of Animal Health and Wellness at the Los Angeles Zoo. And she should know: the L.A. Zoo has bred and released hundreds of California condors over the years, and continued to treat them for lead poisoning even after they’ve been returned to the wild.

Lead, she explains, is not used in cellular metabolism. It’s not used in cellular signaling. It’s not used, at all, in any human or animal body, ever. The trouble is the body easily mistakes it for calcium, zinc and magnesium, all vital elements for everyday biological functioning. Calcium, for example, is required every time a nerve cell fires a message around the body. It’s used every time a nerve cell instructs a muscle to contract, and every time the brain attempts to learn new information or a new skill.

Lead binds to calcium receptors in blood cells and nerve cells. It can restrict blood flow and decrease blood oxygenation. It can impact brain function and impair the digestive system. These consequences, in turn, can increase the risk of a variety of complications, including cardiac arrest and stroke.

The ultimate consequence of lead intoxication for critically endangered California condors is starvation. That’s because lead toxicity leads to a condition called crop stasis. Affected birds are unable to transfer food from the crop into the esophagus and down into the stomach because the muscles involved in peristalsis aren’t able to function correctly. “They can swallow food, but it gets stuck in their crop,” says Keller. “But their body’s drive to eat is still there. They gorge, and the stuff just keeps filling the crop. The food starts to rot; the lining of the crop starts to slough. They try to eat, but get no nutrition. They start to lose muscle mass, and they don’t

have a lot of fat reserves to begin with. They’re starving to death.”

Spoiler alert: that’s what happened to Condor #431, a male brought to the L.A. Zoo with acute lead poisoning in May 2021.

His story begins fourteen years earlier, when a pair of wild condors — #168 and #208 — laid an egg in 2007. Biologists removed the egg to encourage the pair to lay a second one as part of ongoing conservation work. The first egg was brought to the L.A. Zoo, where it was incubated. Foster parents called Topa Topa (#1) and Malibu (#43) did the hard work of raising the chick.

Twenty months later, a few days after Thanksgiving in 2008, the juvenile condor was released in Pinnacles National Park, east of Monterey. Less than a year after that, he returned to the L.A. Zoo to be treated for lead poisoning. Over the next decade, Condor #431 would return to the zoo and receive a course of chelation treatment for acute lead poisoning five more times.

After being ingested or inhaled, lead easily passes into the bloodstream, where it can persist for up to two weeks. Chelation therapy helps to clear the bloodstream and organs, but not before some of the lead becomes deposited into the skeleton. Later, as lead slowly leaches out of the bones, it can re-infiltrate the bloodstream and soft tissues. That’s why virtually all condors, says Keller, suffer from chronic lead intoxication even after a blood test deems them healthy enough to return to the wild.

In 1982, just 22 California condors remained. Once commonplace throughout North America, the species was brought to the brink of extinction in part because of lead poisoning. Thanks to decades of intensive conservation work, today there are nearly 500 condors in all. But the species’ apparent conservation successes are only possible because of the continued intensive treatment provided to them for lead poisoning. That’s despite the fact that lead-based ammunition was outlawed within the condors’ range in California starting in 2007, with steep fines imposed for anyone caught using lead bullets or shot. Begin-



ning in July 2019, that restriction extended throughout the State of California.

For L.A. Zoo condor keeper Michael Clark, the solution is fairly simple. “If the lead was off the landscape, we’d be done,” he says. “Hunters really are doing good for conservation; they’re the original conservationists. But they are really inhibiting this program.” Despite the restrictions, some hunters are quite clearly continuing to use lead. Indeed, when researchers compared condors’ blood lead levels

“From the perspective of quickly, efficiently and inexpensively killing your quarry, lead has many benefits. It’s also got one important downside: it’s made of poison.”

before and after the 2007 ban, they found no significant decrease.

It doesn’t take much lead to cause a condor — or any other bird — to suffer. “The first time I saw one [in an X-Ray], I totally missed the fragments,” says Keller. “They’re so tiny.” Because lead is more easily absorbed in substances with low pH levels, like stomach acid, lead is especially damaging when it’s ingested. And while most birds have more acidic stomachs than humans do, condors and other carrion specialists have especially acidic gastrointestinal tracts in order to safely digest all the rotting meat they eat. “It’s an evolutionary trait that is now working to their disadvantage,” says Keller.

Condors have an exceptionally high tolerance to lead. With blood lead levels of 500 micrograms per deciliter, condors don’t yet begin to show clinical signs. It takes just 20 percent as much lead to kill a golden eagle or a bald eagle, says Clark, who has been working on the Condor Recovery Program for more than three decades. And yet, wild condors are exposed to lead once every fifty days or so, he explains. Each year, some 20% of all free-ranging condors have blood lead levels high enough to require chelation therapy. There’s no intensive monitoring of this sort for other birds of prey that co-exist within the condor range, so nobody really knows just how many become ill and die from lead intoxication each year.

In a human-dominated world, lead can still be found in glass, paint, pipes, rain gutters and so much more. Yet isotopic analyses conducted by researchers from UC Santa Cruz and elsewhere have confirmed that virtually all the lead that impacts condors comes from ammunition.

And it doesn’t take more than a few rule breakers to severely impact the prospects for condor recovery. Mathematical models suggest that even if just half a percent of carcasses was contaminated with

lead each year, a single condor would have near-certain odds — up to 98% — of feeding on at least one contaminated carcass over ten years. In other words, even very low rates of carcass contamination can be associated with an extremely high risk to the condor population, not to mention all the other species on the landscape.

* * *

“PERSONALLY, I HAVE NO PROBLEM using steel,” says Danish hunting educator and gunsmith David Carsten Pedersen. “The whole discussion about whether or not we should shoot tons and tons of lead pellets, I think when you set it up like that, it’s not really a debate. I think hunters should [give up lead] no matter if it’s banned or if it isn’t.”

Still, he acknowledges that transitioning from lead to steel shot is not necessarily a simple proposition. “We have a lot of old British and German guns, and they’re absolutely beautiful, but they can’t handle modern steel loads.” That’s because steel is harder than lead. The pellets can scratch the barrel as they escape the gun, especially if the choke is too tight. Hadoke agrees. “The guns that people are using are not designed to fire the kind of ammunition that is going to be the future of hunting,” he says.

That leaves hunters with three options. “You can go and buy bismuth, and

carry on as normal,” says Hadoke. Bismuth is nearly as malleable as lead, but not toxic, and won’t mar the interior of a shotgun barrel — though it is less common and therefore more expensive. “Or you can make sure the chokes are altered, and buy traditional steel,” he offers as a second solution. By opening up the choke, steel shot can safely pass through the barrel without risking damage. Finally, he suggests that hunters can simply procure newer firearms that are designed to accommodate the harder steel pellets. For rifle hunters and for anglers, the prospect of switching from lead to other metals, like copper or tungsten, is much more straightforward.

Some hunters argue that steel shot doesn’t have the same lethal effects as lead, but Pedersen disagrees. “There will always be somebody saying, ‘well the reason that duck didn’t die was because I didn’t use lead.’ No, the reason the duck didn’t die is because you shot it at too far a distance, you hadn’t practiced, or you just didn’t shoot it very well. A lot of us use ammunition as an excuse for bad shooting” he says.

California hunter Holly Heyser says that’s likely true now, but it hasn’t always been. In the Golden State, it became illegal to shoot lead over wetlands back in the early 1990s. “Some of the early steel shot was really, really, really horrible,” she recalls. “Hunters ending up crippling more ducks; shots that used to kill would not kill. Eventually, the ammo manufacturers caught up and refined the technology. Now, tests show that steel is just as effective as lead.”

Still, switching ammunition types isn’t as trivial a proposition as non-hunters might assume. “I will never forget, when California banned lead when hunting in the condor zone, back in 2007, my boyfriend and I went to the shooting range to sight in his 270. He went through two boxes and couldn’t even get the stuff on paper at 100 yards for a long time. It shot that differently,” says Heyser. Still, she says, “people should be sighting in for whatever they’re doing anyway.”

For folks that aren’t convinced by the ecological and animal welfare arguments, Pedersen points out that eating lead is toxic



ABOVE

In this x-ray image of a California condor brought to the L.A. Zoo treatment center for lead intoxication, lead fragments are visible as tiny bright spots scattered throughout the gut. The bright spot in the upper right is from the numbered tag affixed to the bird's wing.



for humans as well. “If you’re against a lead ban, try to think about how much game you eat in a year. And in a whole lifetime. Pound for pound. And imagine that every time you eat a duck or a pigeon or a pheasant, you’ll eat two lead pellets. Every time. Add up the numbers, and ask yourself: if somebody gave me all this shot in a spoon, would I eat it? Would I give it to my kid? Would I give it to my dad? Probably not.”

Indeed, studies from hunting communities as widely distributed as Greenland and North Dakota show that people who eat game meat have reliably higher concentrations of lead in their blood than those who do not. Although those people didn’t show any observable clinical signs of intoxication the way eagles and condors do, the Centers for Disease Control maintains that there is no clinical threshold of lead in the human body that is considered safe. And the consequences of lead exposure are considerably higher for children and for women who are pregnant or breastfeeding. “I’m not a huge health nut,” says Pedersen. “But I don’t want to eat lead. I think it’s common sense.”

Given all the very good reasons for transitioning away from lead ammunition and fishing tackle, it is worth asking why compliance has been difficult to achieve.

“There’s a very real perception that this is an anti-hunting issue,” says Bryan Bedrosian, director and co-founder of Sporting Lead Free. “Anything having to do with firearms and shooting is a sensitive topic.”

Bedrosian argues that hunters seem more amenable to changing their habits voluntarily than through top-down regulatory approaches. Leonard agrees, and adds that many of the hunters who haven’t yet switched from lead simply aren’t aware of its impact on wildlife and wild places. “In hunter education classes [in Wyoming] that you have to take to get a hunter license, there’s no component that talks about choosing lead-free for wildlife,” she explains. “It’s not mandated by the state. So those kids, or the adult-onset hunters, they’re not getting exposed or educated on that.”

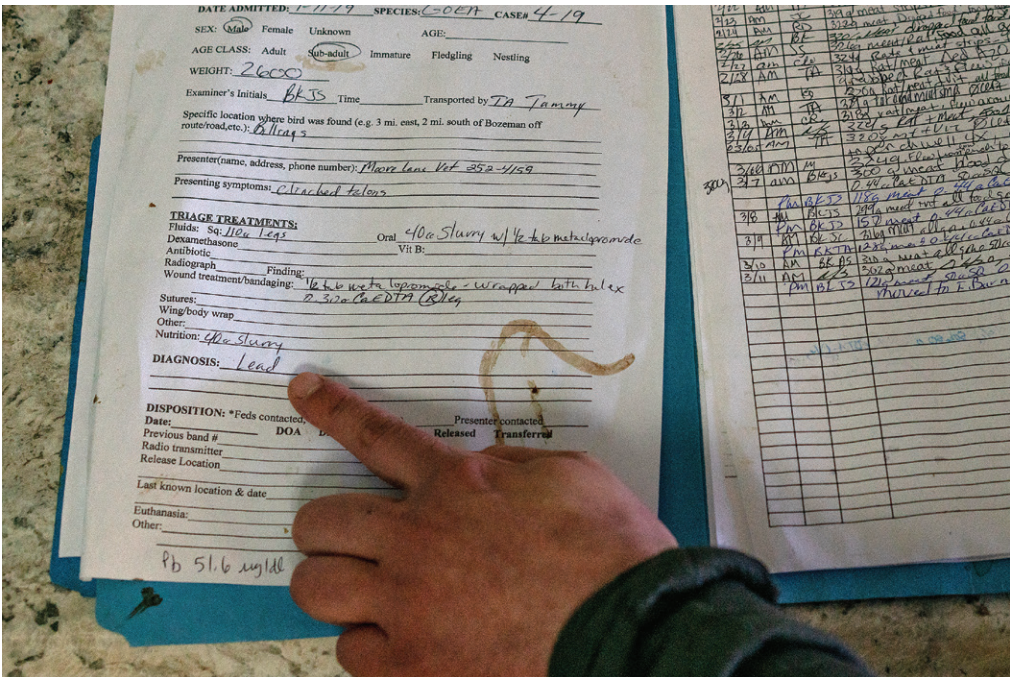
Back at the Los Angeles Zoo, zookeeper Chandra David, who has worked on the condor recovery program for 27 years, recalls a curious experience she had in the Portland airport, waiting for a flight back to Los Angeles. She sat in the waiting area holding a crate in her lap with a condor egg inside. She could already see the hatchling’s beak poking through the shell. A pair of hunters sat nearby, a father and son, complaining to each other about a

lead ban, and in her words, “gripping about the dumb condors.”

She approached and showed them the egg she was caring for, and explained that the condor would be raised by foster condor parents at the L.A. Zoo. “This is a condor,” she told them, “and it needs your help.” She explained how she could say with absolute certainty that after its eventual release into the wild, this particular bird would eventually return to the zoo for chelation treatment following lead poisoning, probably several times. “It was an incredible moment to share, and I think they supported [the lead ban] after that,” she says.

Like Bedrosian and Leonard, David believes that if hunters really understood the impact that lead can have on the birds and other animals that they love, they would more readily give up lead ammunition than if forced to do so by legislation alone.

ON APRIL 29, 2021, field biologists found Condor #431 on the side of a road in Central California, looking thin and dehydrated. The next day, veterinarians at the L.A. Zoo used an X-ray to confirm



the presence of lead fragments in his crop and stomach, and diagnosed crop stasis. They began another course of chelation therapy, the seventh in his short life, and administered fluids. He was anemic, had an increased white blood cell count, and even following chelation, he remained weak and lethargic. “He didn’t have any fight in him,” says Keller.

On May 3, the team prepped the bird for surgery to remove the metal fragments from his stomach. But shortly after the anesthesia began to take hold, Condor #431 went into cardiac arrest. The veterinary

team attempted to resuscitate him, but they were unable to re-establish a normal heart rhythm. They made the difficult decision to humanely euthanize him and end his suffering.

“If we want to keep our culture alive, we have to face the facts that this is going to cost,” says Pedersen. “It’s going to cost in gear, it’s going to cost in time, it’s going to cost in money, it’s going to cost in effort. We’ve always been told that hunters are conservationists, that hunting is part of nature. But we really have to look at ourselves and say: do we practice what we preach?

Using toxic ammunition in order to save a little money, is that in accordance with our ethics?” he asks. “When we practice what we preach, we get the very sweet possibility to look our critics in the eye and say, ‘We are not hypocrites.’”

The tragedy is not that Condor #431 died, but that his death — like the golden eagle that Hannah Leonard found — was entirely avoidable. “More hunting, less lead,” says Clark. “That solves all the problems.” 🦅

