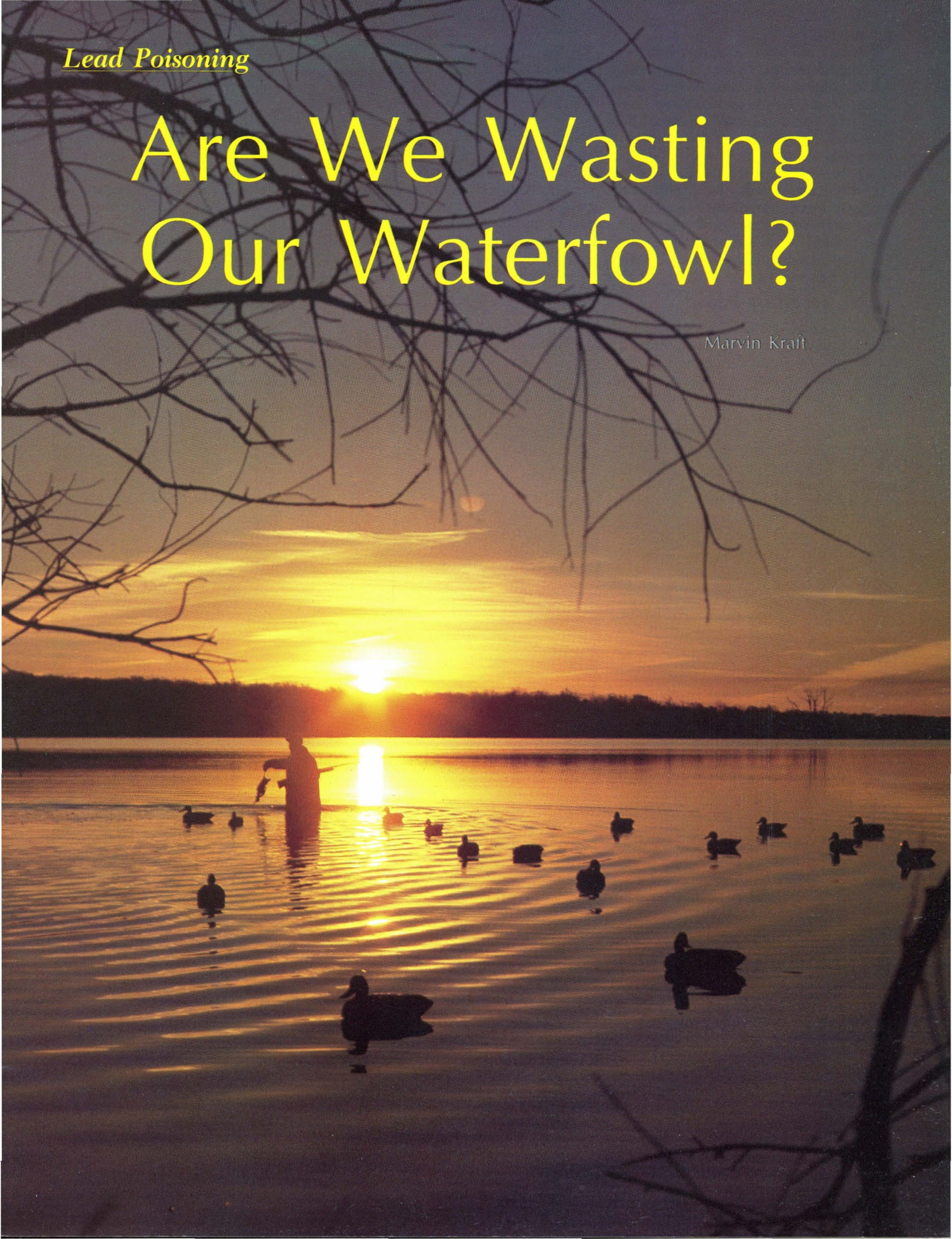
Lead Poisoning

Are We Wasting Our Waterfowl?

Marvin Kraft



Just as pheasant and quail stocking, antlerless deer hunts, and long hunting seasons have at one time or another been controversial, so is the use of steel shot today. The debates over this issue have been ongoing for at least 15 years, fueled by considerable misinformation and poorly drawn conclusions. With the exception of habitat loss, lead poisoning is the single most important management problem facing waterfowl managers and hunters in North America today.

Lead: The Silent Killer

Lead is a long-lasting, toxic substance that has no known beneficial biological function. It is one of the few elements that is not necessary for the growth and survival of plant and animal life.

Within the U.S., more than a million tons of lead per year are used in items ranging from gasoline to batteries to ammunition, resulting in widespread exposure to both human and animal life. Exposure to lead causes a broad range of physiological effects, involving the nervous system, blood vessels, and major organs. Lead poisoning causes a loss of red blood cells and a reduction in the ability of the bone marrow to produce new cells. It can also cause mental retardation, degeneration of the kidneys and liver, reduced resistance to infections, and death.

Lead shot poisoning has been documented in waterfowl since the late 1800's. Presently it is estimated that between 1.6 and 2.4 million ducks die annually in North America from lead poisoning. This is eight to ten times the recent legal harvest in Kansas and about equal to the entire annual harvest in the ten states of the Central Flyway.

Each year waterfowl hunters deposit tons of lead shot into critical waterfowl habitat. Many of these pellets remain available for years, with an additional supply added annually to areas where waterfowl concentrate. Lead poisoning results when these birds mistakenly ingest the pellets as food or grit.

Once ingested, the lead pellets pass to the gizzard, where grinding and digesting of both food and pellets begin. The eroded lead is absorbed as a soluble lead salt and transferred to the circulatory system, where it causes severe anemia (the inability of the blood to carry oxygen and nutrients to the body tissues). The result is a gradual loss of muscle and fatty tissue: starvation.

Studies have found the percentage of gizzards containing lead shot to range from near zero to more than 50, with 5 to 10 percent being common. Lead pellets remain in the gizzard approximately 20 days before being completely consumed or ground away by the bird. This is significant, since it means that the 5 or 10 percent incidence is a "20-day rate", not an annual rate. Not all birds that ingest lead die; still, gizzard analysis provides a good indication of the extent of the problem.

The impacts of non-lethal doses of lead or continued exposure to lead are not completely understood, but may be just as serious as waterfowl losses from acute lethal exposure. Sublethal or chronic exposure to lead impairs sight and hearing and may cause loss of motor reflexes. The impairment of these biological functions may lead to increased losses to predation, greater susceptibility to disease, and decreased reproduction. The thought of reduced production due to lead poisoning is particularly disturbing, considering the habitat degradation and other problems presently faced by waterfowl on their breeding grounds.

Waterfowl are not the only animals suffering from lead poisoning. A number of other wildlife species have been known to ingest lead pellets and/or succumb to lead poisoning. The list includes loons; Virginia, king, clapper, and sora rails; godwits; California gulls; coots; gallinules; scaled and bobwhite quail; ring-necked pheasants; mourning doves; prairie falcons; kestrels; red-tailed hawks; Andean condors; bald eagles; a California condor; and a whooping crane.

The secondary poisoning of bald eagles resulting from their eating lead-contaminated waterfowl is significant. In one study, 7.2 percent of 650 eagle carcasses autopsied were diagnosed as lead poisoned.

Cutting Our Losses

The primary cause of lead poisoning in ducks, geese, and other wildlife results from the ingestion of lead shot. To reduce this disease we must reduce the availability of toxic shot through physical methods such as soil tillage, water manipulation, or the use of non-toxic shot.

Soil tillage reduces the availability of shot to waterfowl at times, but is a temporary measure at best, since annual hunting activity renews the lead poisoning potential at a time when waterfowl are present and concentrated in the area. Also, tillage is impractical over the vast majority of wetland habitats in the U.S. Water level drawdowns and deep-water flooding can reduce lead ingestion, but they also reduce or eliminate important marsh habitat. It is against the principles of most wildlife managers to develop critical waterfowl habitat, harvest ducks from it, and then destroy it or make it unavailable to waterfowl immediately after the hunting season. The bottom line is that lead poisoning will continue as long as lead pellets are deposited in marshes and other habitats used by waterfowl.

The search for a substitute for toxic lead shot has been the focus of a great deal of research. Many solutions to the problem have been offered, among them: 1) coating lead pellets with substances which do not erode in the gizzard, 2) combining lead with other substances to reduce toxicity, 3) combining lead with other substances which disintegrate in water, and 4) using other non-toxic metals. Any alternative shot would have to be non-toxic, ballistically acceptable, and economical to produce.

So far, only one viable substitute has been found for lead shot; and that is steel shot. Waterfowl managers presently support the use of steel shot for waterfowl hunting because, after conducting and reviewing numerous studies, they feel that the use of steel shot is in the best interests of the waterfowl resource and the waterfowl hunting tradition. Recently, waterfowl biologists representing the 24 states of the Central and Mississippi Flyways voted unanimously in favor of a resolution urging the exclusive use of non-toxic shot for waterfowl hunting.

But getting waterfowlers to adopt the same stance has been difficult. Popular literature during the early years of the controversy planted seeds of doubt and/or created con-

Preceding page photo by Ron Spomer.

Gene Brehm photo

Gene Brehm photo

Nebraska Game and Parks photo

Nebraska Game and Parks photo

fusion in the minds of hunters. Much of what was written had little factual basis. Unfortunately, little can be done about the distribution of "bad" information. But increasing numbers of shooting editors for major sports magazines now acknowledge steel shot as a satisfactory hunting load for waterfowl.

Here are some of the most common questions and concerns of hunters who doubt the need for non-toxic shot and/or the suitability of steel shot as an alternative for lead shot.

If lead poisoning is such a bad problem, why don't we see dead and dying ducks?

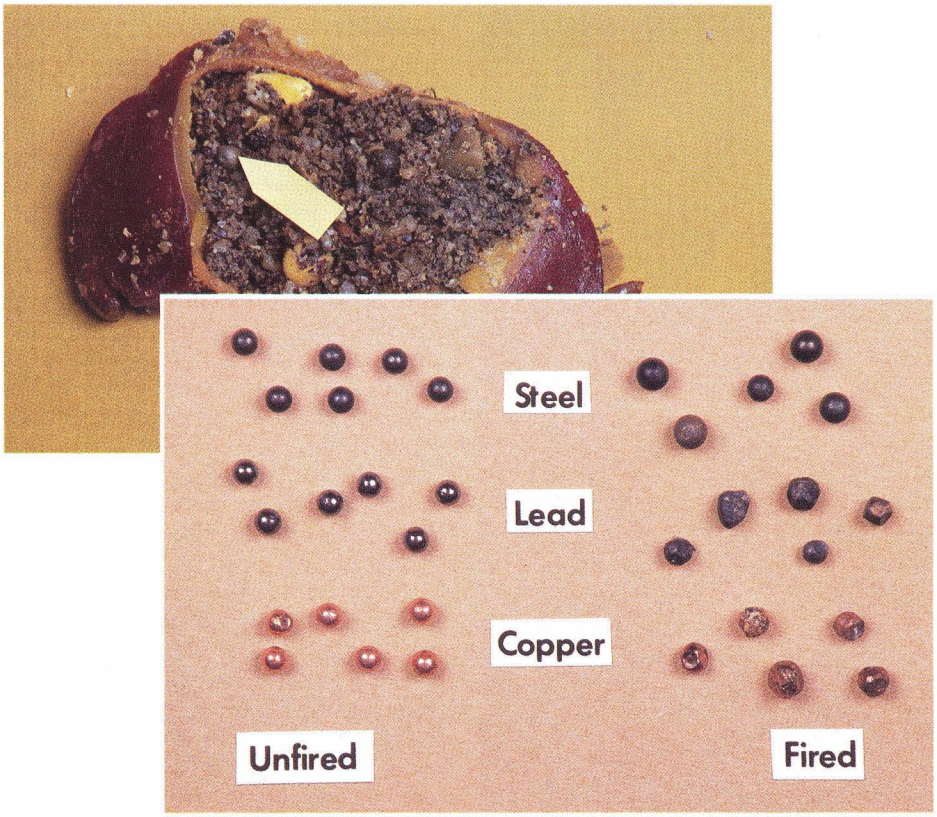
Lead has been called the "silent killer of waterfowl." Although spectacular die-offs do occur, most losses are on an "individual duck" basis, scattered over a wide area. Birds suffering from lead poisoning become weak, unable to fly, seeking cover in dense vegetation where they eventually die or fall prey to scavengers and predators. This loss continues long after sportsmen have left the marshes and fields and is seldom detected by them. It is only when large-scale die-offs occur, and predators and scavengers are unable to remove the evidence, that losses to lead poisoning become readily apparent. In a field study conducted by the Missouri Department of Conservation, 80 to 90 percent of observed duck carcasses were scavenged within five days, and more than one-half disappeared entirely. In Texas, 47 fresh carcasses were placed in varying locations in a typical coastal marsh. In less than one day, 32 percent had disappeared, and by the eighth day, 89 percent were gone.

In another Texas study, 50 carcasses were randomly placed in typical escape cover within a 100-acre marsh site. An additional 50 duck carcasses were randomly tossed atop vegetation. Within 30 minutes of deposition, a search crew

*Lead poisoning is **not** caused by pellets imbedded in a bird's flesh. Rather, it follows ingestion of lead shot by waterfowl foraging on heavily-hunted areas. Geese (top) may pick spent shot up in grain fields, while puddle ducks scavenge it from pond bottoms. Sick and dead waterfowl are seldom seen by hunters. An emaciated breast and protruding sternum (bottom) are evidence of acute lead poisoning.*

composed of five department personnel, a representative of a local conservation club, a commercial waterfowl guide, and an outdoor writer conducted a typical ground search. The search crew found six birds, all of which had been tossed atop the vegetation and were readily visible.

These studies demonstrate the difficulty of observing or noticing ongoing low-level lead poisoning losses, even when hunters are present. Also, the period when lead poisoning is at a peak normally occurs after the hunting season, when hunters and other individuals are no longer in the marsh and severe weather places additional stress on the birds. Lead poisoning mortality is similar to a leaking faucet — the immediate loss is not apparent, but over time significant losses occur.



Nebraska Game and Parks photos

Arrow in top photo points to abraded lead pellets in duck gizzard. The shot is picked up as grit in normal foraging. Compared to lead, steel shot stays rounder in its trip down the barrel. Copper-coated lead combines the desired weight of its core with an abrasion-resistant shell. This shot is effective, expensive — and still toxic.

Will steel shotshells damage my shotgun?

A survey conducted in Ohio in 1978 found that nearly 47 percent of hunters questioned thought steel shot would damage their guns. While fears of gun damage may have subsided somewhat since then, many hunters still hesitate to shoot steel in their favorite shotgun. Most of the fears concern bore erosion or choke expansion.

Bore erosion has all but been eliminated in today's steel shotshells. Tough plastic shot cups encase the charge and protect both pellets and barrel as the load is forced ahead of expanding powder gases. Choke expansion, or ring bulge, can occur in some shotguns when steel or magnum lead loads are fired. The expansion is rarely noticeable and usually stabilizes at about two thousandths of an inch. That is about the thickness of two sheets of typing paper. Guns in which ring bulge has occurred are safe to shoot and may, in fact, deliver more effective patterns as a result of the expansion. Ring bulge does not affect the usable life of a gun. Firearms which may develop ring bulge include early Belgian Brownings, Parker and L. C. Smith doubles, and other smoothbores with soft barrel steel or thin barrel walls. Hunters uncertain about the use of steel shot in their gun should contact the manufacturer for information.

What about the high cost of steel shotshells?

The price of steel shotshells is of major concern to sportsmen. Steel loads are presently more expensive than lead. This is particularly noticeable to the many hunters who use "Duck and Pheasant"-type lead loads purchased at discount stores. Still, the 1983 manufacturers' distributor prices and recommended retail prices for steel shotshells were only slightly higher than those for equivalent lead shotshells. The price of steel shotshells to hunters will probably decline as more steel loads come into production and their use becomes more widespread and stable.

Right now the market for steel shotshells is immature. As competition between manufacturers develops, and research and development costs are recovered, we may see the same discounting of steel loads by retail dealers that we presently have with lead shotshells. Even at current prices, however, the cost of ammunition is still very small when compared to the other expenses associated with a hunt.

What kind of steel shotshells are available?

Steel shot is now available in a variety of gauge and load specifications. But not all three of the major ammunition manufacturers sell all the various kinds. Twelve-gauge shotshells are available in 2¾-inch and 3-inch lengths, loaded with shot sizes BB, 1, 2, 4, and 6 in 1⅛-ounce to 1½-ounce loads. Twenty-gauge shotshells are manufactured in 2¾-inch and 3-inch lengths with ⅞- and 1-ounce loads of number 4 shot. Ten-gauge shotshells are also available. As the use of steel shotshells increases, we can expect additional loads to be developed and distributed. The instability and uncertainty of the non-toxic shot program has been the major factor limiting the efficient production and distribution of steel shot ammunition.

Can steel shotshells be reloaded?

The components required for home loading of steel shotshells are

of limited availability. Low demand and product liability concerns have slowed development and testing of steel components. Cases, powder, and wads, as well as shot, differ from those used in standard lead loads, and interchanging components is not a safe practice.

Recent strengthening of state and federal stands on the steel shot issue has prompted some manufacturers to test the water with components for the handloader. Superior Ball (formerly of Lydall, now of Hoover Universal, and supplier of steel pellets for commercial loadings) is starting to market its "Ecoshot" through such firms as NTC (Non-Toxic Components, Inc.) of Portland, OR. NTC is also listing 12-gauge polyethylene wads for both 2¾- and 3-inch steel loads and a handbook detailing steel shotshell reloading procedures.

Why require steel shotshells on upland sites?

Many waterfowl, particularly geese and mallards, regularly feed on waste grain in upland areas. Concentrations of waterfowl attract concentrations of hunters who deposit shot on these choice feeding areas. The spent pellets are available to waterfowl returning to forage after the hunters leave. If the soil is dry or frozen, this shot will remain on the surface for an extended time and is easily picked up by the birds. Geese are particularly susceptible to this type of ingestion. In one instance in South Dakota, approximately 4,000 giant Canada geese were lost to lead poisoning. It was determined that the lead was being picked up by the geese while feeding in corn stubble fields.

Will steel shot increase crippling losses?

The question of increased crippling with steel shot is a valid concern and foremost in many hunters' minds. Opponents of steel argue that, because of its lighter weight, it will cripple more birds than lead.

In carefully designed field tests conducted in eight states, hunters were provided unmarked steel and lead shotshells, and their performance was recorded by trained observers. More than 89,000 shots were fired and over 14,000 ducks and geese were bagged. The results of those tests involving goose hunters showed steel shot to be as effective as lead. There was no significant difference in crippling rates between steel and lead shotshells. In studies involving duck hunters, all but one found no significant difference in ducks crippled or bagged. The lone exception was the Lacassine Study in Louisiana, where lead shotshells crippled significantly fewer ducks than steel loads.

It is the consensus among professional wildlife scientists that these shooting tests showed little, if any, difference in the crippling rates of steel and lead shotshells, and that steel is an acceptable substitute for lead. There is also evidence that, as hunters adjust to shooting steel, their killing efficiency increases and the crippling rate declines.

Gene Brehm photos

Damage to shotgun barrels and increased crippling losses are two worries of hunters still opposed to the use of steel shot. Actually, steel shot is unsuited only for a few thin-walled barrels and poses no greater threat to a tight choke than magnum lead loads. Hunters who have practiced with steel shot have found it cripples no more birds than lead.

Shooting Steel

Many hunters express dislike for steel shot after their first trip afield with it. There are a couple of reasons for this. First, studies have shown that a shooter who lacks confidence in the load being used will usually shoot poorly, regardless of the type of load employed. There is no doubt that many hunters going afield with steel shotshells for the first time feel they are at a disadvantage.

The other, and probably more important reason hunters have difficulty hitting and bagging with steel shotshells is that the performance of steel is ballistically different than that of lead, and hunters must adjust their shooting techniques. These adjustments would be relatively easy to accomplish if shooters could see their shot pattern as a quarterback sees the football when he passes it. However, few hunters can determine what they are doing wrong when they miss with a new steel load, so learning must be accomplished through trial and error. Practice helps, of course — as does a knowledge of steel shot ballistics.

Ballistical Comparisons of Lead and Steel

The size of both lead and steel shot is based on American standard shot sizes. Thus, a number 4 steel

pellet is the same diameter as a number 4 lead pellet. Lead is heavier than steel; a lead pellet weighs about one-third more than steel shot of the same size. Since steel shot is lighter that lead it slows down faster after leaving the barrel.

Steel shot is harder and rounder than lead. Lead shot is manufactured by dropping molten lead from a tower, or spinning it in a centrifugal device. Steel shot is produced in a manner similar to the manufacture of ball bearings. Because steel is harder, it deforms less during powder combustion and subsequent travel through the barrel and choke. Deformed pellets have greater air resistance than round pellets, losing velocity and energy quicker. They also diverge from the pattern's center, becoming "flyers." More steel pellets stay inside the effective pattern, and pellet velocities are more consistent within the shot cloud. Consequently, shot strings are shorter, patterns tighter, than with lead. In fact, the pattern diameter of a steel load is usually about 80 percent that of an unbuffered traditional lead pattern, and the shot string is two-thirds to three-fourths as long as one of lead. Buffered lead loads with hardened, high-antimony shot will pattern very much like steel loads.

The shot cup in a steel shell is made of a tougher, thicker plastic than those in lead loads and fully encloses the shot charge to prevent barrel erosion. Since steel does not deform easily, the shot cup has no shock absorber cushion. This provides space to load a significantly greater number of steel pellets.

The velocities of lead and steel shotshells also differ. Steel shot can be driven faster because the pellets deform less readily during the thrust of acceleration. This higher velocity offsets the more rapid deceleration of steel shot in flight.

Adjustments for Shooting Steel

Considering the differences in the ballistic behaviors of lead and steel shotshells, it is not surprising that some hunters have difficulty bagging birds with steel. Many have shot nothing but lead throughout their hunting life, and in doing so have programmed their reflexes to match the ballistics of that shot. However, by making the appro-

COMPARISON OF LEAD VS. STEEL
WHEN COMPENSATION IS MADE BY WEIGHT

Shot Type	*Shot Size*	*Velocity (FPS)*	*Retained Energy (ft. lbs.)* 40 Yds.	60 Yds.
Lead	6	1330	2.3	1.3
Steel	4	1330	2.4	1.3
Lead	4	1330	4.4	2.7
Steel	2	1330	4.3	2.6
Lead	4	1260	4.1	2.6
Steel	2	1275	4.1	2.4
Lead	2	1260	7.0	4.6
Steel	BB	1275	8.3	5.2
Lead	2	1210	6.7	4.4
Steel	BB	1210	7.7	4.9

VELOCITIES OF POPULAR
FACTORY LEAD WATERFOWL LOADS

Lead Load	*Factory Designation*	*Velocity*
3-1/2", 10 ga., 2-1/4 oz.	MAX	1210 fps
3-1/2", 10 ga., 2 oz.	4-1/4 dram equiv.	1210 fps
3", 12 ga., 1-7/8 oz.	4 dram equiv.	1210 fps
3", 12 ga., 1-5/8 oz.	4 dram equiv.	1280 fps
2-3/4", 12 ga., 1-1/2 oz.	3-3/4 dram equiv.	1260 fps
2-3/4", 12 ga., 1-1/4 oz.	3-3/4 dram equiv.	1330 fps
16 ga., 1-1/4 oz.	3-1/4 dram equiv.	1260 fps
3", 20 ga., 1-1/4 oz.	3 dram equiv.	1185 fps
2-3/4", 20 ga., 1-1/8 oz.	2-3/4 dram equiv.	1175 fps

VELOCITIES OF
FACTORY STEEL LOADS

Steel Load	*Factory Designation*	*Velocity*
3-1/2", 10 ga., 1-3/4 oz.	MAX	1260 fps
3-1/2", 10 ga., 1-5/8 oz.	4-1/4 dram equiv.	1345 fps
3", 12 ga., 1-1/4 oz.	MAX	1375 fps
3", 12 ga., 1-3/8 oz.	3-1/2 dram equiv.	1235 fps
3", 12 ga., 1-1/2 oz.	MAX	1200 fps
2-3/4", 12 ga., 1-1/8 oz.	3-3/4 dram equiv. or MAX	1365 fps
2-3/4", 12 ga., 1-1/4 oz.	3-3/4 dram equiv.	1330 fps
3", 20 ga., 1 oz.	3-1/4 dram equiv.	1335 fps
2-3/4", 20 ga., 3/4 oz.	3-1/4 dram equiv.	1425 fps

PATTERNING: STEEL vs. LEAD
(comparable loads fired in 30-inch full-choke barrels at 30-inch patterning circle; lead loads unbuffered)

Loads	*In-Shell Pellet Count*	*40-Yard Pellet Count*	*60-Yard Pellet Count*
1-1/2 oz. #4 lead	195	70% avg. 135	30% avg. 56
1-1/8 oz. #2 steel	130	82% avg. 107	50% avg. 64
1-1/2 oz. #2 lead	130	74% avg. 100	34% avg. 46
1-1/8 oz. BB steel	82	83% avg. 70	56% avg. 46

priate adjustments in equipment and shooting style — and practicing — any hunter can become proficient at bagging game with steel shot.

The Shotgun Choke

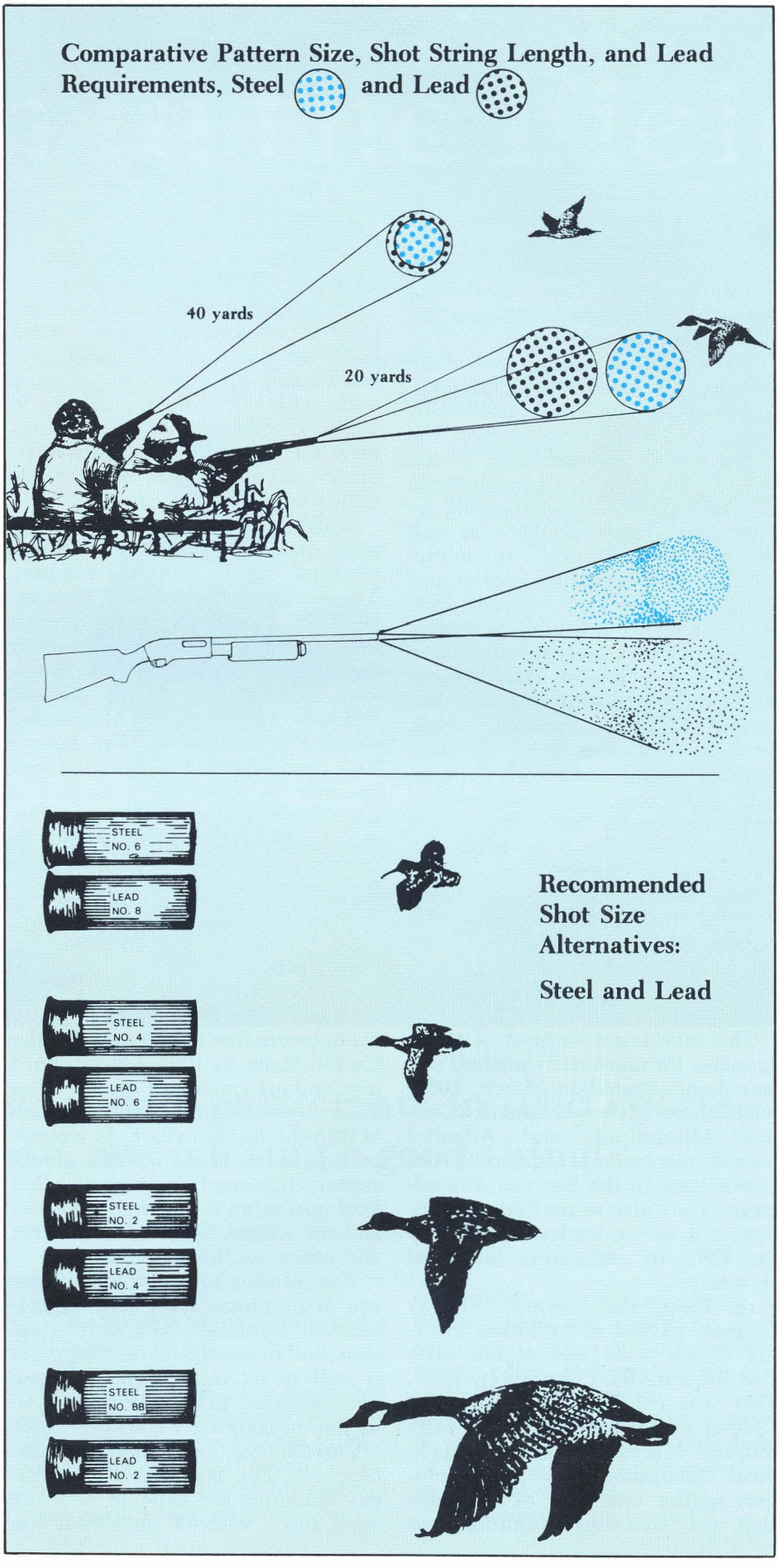
The full choke has been the traditional choice of waterfowl hunters. But, with modern shotshells, most hunters would probably bag more birds if they used less restrictive chokes. This is particularly true when hunting with steel. The tight pattern and short shot string produced by steel shotshells leave little margin for aim error, particularly at the closer ranges where a majority of waterfowl are shot. Depending on the type of hunt and the ranges at which most shots are taken, an improved cylinder or modified choke is usually the best choice when shooting steel.

Shot Size

To compensate for the lighter weight of steel and obtain similiar performance at longer ranges, hunters shooting steel should use shot two sizes larger than they would if shooting lead. For instance, if number 4 lead is normally used, number 2 steel is recommended. By doing this, the steel shot will provide retained energy very similiar to lead out to 60 yards, as shown in the table. Again, because steel is lighter, more pellets can be loaded per ounce of load than in a lead-charged shell. So number 2 steel provides a pattern very similar in pellet count to that of a number 4 lead load of the same weight.

Leading the Target

Steel leaves the muzzle faster, has a shorter shot string, and slows down quicker than lead. Consequently, adjustments in lead are necessary when shooting steel. At ranges up to 30 yards, less lead is required with steel than with lead. At ranges of 30 to 50 yards the proper lead is about the same for both lead and steel, and at ranges greater than 50 yards more lead is required with steel than with lead. Shooting at distances beyond 50 to 55 yards is not recommended, regardless of shot type. Numerous studies have shown that crippling losses increase dramatically at these longer ranges.



Mike Miller illustrations

Non-Toxic Shotshell Regulations: Past, Present, and Future

The ultimate responsibility for the management and protection of migratory birds lies with the U.S. Fish and Wildlife Service (FWS). In the late 1970's, the FWS recognized that reducing lead poisoning in waterfowl was part of this responsibility and implemented a non-toxic shot conversion program on a flyway-by-flyway basis, beginning with the Atlantic Flyway and expanding westward.

Unfortunately, during the early part of this program, many biologists, sportsmen, and politicians were not totally convinced of the magnitude of the problem or the need for steel shot. As a result, there was considerable foot-dragging by state conservation agencies, as well as waterfowl hunters, in implementing steel shotshell regulations. Despite this lack of support, progress was made in establishing non-toxic shot zones, and as studies were completed and more data became available, the majority of state waterfowl biologists became strong advocates of non-toxic shotshell regulations for waterfowl hunting.

In 1979, the FWS program was halted by the Stevens Amendment which forbids the FWS from enforcing federal non-toxic shot regulations unless permission to do so is granted by the state conservation agency involved. Since then, state conservation agencies have been the leaders in solving the lead poisoning problem.

The increasing support of these agencies for non-toxic shotshell use was demonstrated in March, 1984, when three Flyway Councils (Central, Mississippi, and Atlantic) passed resolutions requesting the termination of the Stevens Amendment. They also requested resumption of a strong leadership role by the FWS in addressing the steel shot issue.

In 1980, the Central Flyway Council passed a resolution favoring flyway-wide use of non-toxic shot for waterfowl hunting by 1987. This was reinforced in March of 1984 at a joint meeting of the Central and Mississippi Flyway Technical Committees, when a resolution urging total use of non-toxic shot for waterfowl hunting was passed unanimously by the waterfowl biologists representing the 24 states of these two Flyways. The Wildlife Society, an organization composed of wildlife professionals, and the Association of Avian Veterinarians have also recently adopted positions calling for the use of non-toxic shot for all waterfowl hunting.

In January, 1983, 33 states had non-toxic shot zones, including 12 states (70%) in the Atlantic Flyway, 11 states (79%) in the Mississippi Flyway, seven states (70%) in the Central Flyway, and three states (27%) in the Pacific Flyway. Nebraska and Iowa plan to go statewide with non-toxic regulations in 1985, New Mexico in 1987. Texas presently harvests 50 percent of its ducks and 90 percent of its geese within non-toxic zones.

Since 1978, Kansas has had six areas under non-toxic shotshell regulations for waterfowl hunting. These are: Cheyenne Bottoms Wildlife Area, Quivira National Wildlife Refuge, Cheney Reservoir and Wildlife Area, Elk City Reservoir and Wildlife Area, Neosho Wildlife Area, and the Marais des Cygnes Wildlife Area. The Kansas Fish and Game Commission encourages all waterfowl hunters to use non-toxic steel shot so that they may become more familiar with its performance as an alternative for toxic lead.

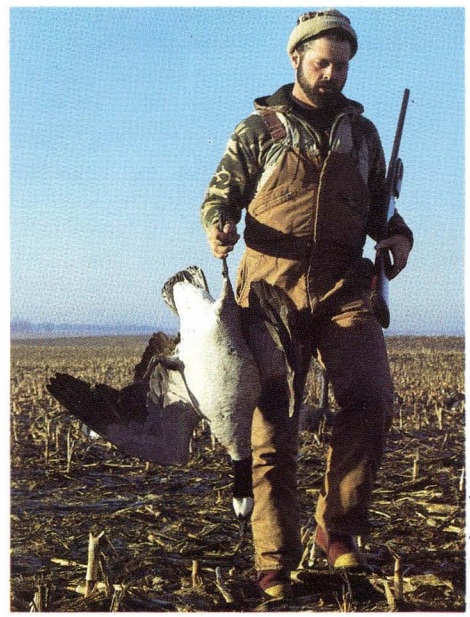
Summary

Losses of waterfowl to lead poisoning were first documented in the United States in 1894. Since then, a tremendous amount of research has been devoted to this problem, much of it in the last ten years. As a result of this work there is little doubt among informed individuals that lead posioning is a serious problem and an annual drain on waterfowl and other wildlife populations.

The solution to the problem is the use of non-toxic steel shot for waterfowl hunting. Although steel shotshell research and development is still in its infancy, it has been demonstrated that steel shot is effective in bagging waterfowl. Fears of gun damage, for the most part, are baseless. The majority of modern-day shotguns are capable of firing steel loads without problems. Exceptions are older, thin-walled double-barrels and a few imported single-barrelled shotguns. The cost and availability problems of steel shotshells are minor when compared to the overall benefits accrued from their use. The question of increased crippling with steel has been the focus of considerable attention and has been clouded by the use of different measures to compare effectiveness. But shooting tests show little difference in the performance of steel and lead loads, and the alleged increased crippling with steel shot does not constitute a valid argument against its use for waterfowl hunting.

The continued loss of wetland habitat will make it increasingly difficult to maintain waterfowl populations. Duck and goose hunting as we know it depends on an abundant resource — and on the attitude the non-hunting public takes toward field sports. The steel shot issue looms large on both fronts. Waterfowlers, traditionally leaders in protecting the wildlife they value so highly, now have an excellent opportunity to contribute to the future of their quarry and their sport. By learning the facts about steel shot and developing the skills to use it effectively, they can alleviate lead poisoning in ducks and geese, demonstrate a willingness to protect the resource, and ensure a future for traditional waterfowling.

The future of waterfowling depends on a healthy resource and the image of the hunter. Both would be served by the use of steel in heavily-shot areas.



Gene Brehm photo