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Waterfowl Lead Poisoning Studies at Forney's Lake, Iowa¹RICHARD A. BISHOP²

RICHARD A. BISHOP. Waterfowl Lead Poisoning Studies at Forney's Lake, Iowa. *Proc. Iowa Acad. Sci.*, 79(1):12-13, 1972.

SYNOPSIS: Forney's Lake in Fremont County is a popular waterfowl concentration area along the Missouri River with a history of lead poisoning of mallards. About 1,500 mallards died from lead poisoning in 1960 and about 2,500 in the winter of 1965 and 1966. A total of 143 bottom samples taken in 1966 and 1967

indicated an average of 1.6 pellets per square foot were available to waterfowl. Lead poisoning losses on this area can be minimized by regulating water levels after the hunting season to move the birds elsewhere.

INDEX DESCRIPTORS: Waterfowl, lead poisoning, Forney's Lake, lead deposits, waterfowl management.

Forney's Lake, located in the northwest corner of Fremont county, has been a favorite stop-over area for many years for snow geese (*Chen hyperborea*) and mallards (*Anas platyrhynchos*) on their spring and fall migrations. Thousands of mallards stop at Forney's Lake in the fall and many remain in the vicinity all winter. During the past 5 years, peak fall populations of 200,000 mallards and 65,000 geese have been reached. Two mild winters induced geese to stay until early January and up to 70,000 mallards to winter on an open water ditch south of the lake. Mallards numbering 25,000 to 70,000 annually winter in southwest Iowa.

Forney's Lake is a shallow 800-acre marsh in the Missouri River flood plain which has traditionally been hunted heavily. The center of the area is refuge and the periphery is open to hunting. Large amounts of lead are deposited annually in the refuge portion. This area has had a history of waterfowl lead poisoning when conditions are ideal. High mallard concentrations on areas with dense lead deposits can create very serious problems. It was deemed important that more information on waterfowl losses, lead deposition, and conditions surrounding the times of losses be collected for documentation and possible management implications.

The problem of lead poisoning is widespread and considered quite important in the Mississippi Flyway. As high as 4% of the flyway's mallard population is lost annually to lead poisoning (Bellrose, 1964).

PROCEDURE

Waterfowl populations were monitored annually from the winter of 1965-66 through 1968. Waterfowl losses, habitat conditions and weather conditions were also documented.

Thirty ailing mallards were collected and analyzed in 1965 and 20 sick mallards and 90 geese were collected in December, 1967 to determine the cause of abnormal behavior. The mallards were examined at the Iowa State University Veterinary Diagnostic Lab and the geese were checked for gizzard shot and lead poisoning symptoms by Iowa State University students under the direction of Dr. Milton Welser.

¹ This research project was initiated due to losses of ducks and geese that occurred at Forney's Lake. The project was sponsored by the State Conservation Commission and funds were provided from fish and game license fees.

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Tissue analysis for lead, arsenic and thallium was made by atomic absorption using a model 303 Perkin-Elmer Spectrophotometer. Geese analyzed at Iowa State were checked primarily for gizzard shot.

Stratified random bottom samples were collected during 1967 and 1968. The samples were randomly selected from 50 yard concentric strips reaching from the shooting area to the middle of the marsh. Samples 1 ft. square and 2 in. and 4 in. deep were taken from the dry lake bed, using a 1 ft. square frame, a ruler, and a small shovel. The dirt was placed in numbered plastic bags. The samples were washed through a screen and the number of lead pellets recorded.

RESULTS AND DISCUSSION

Waterfowl losses amounting to 1,500 birds were reported in 1948 and in 1960 at Forney's Lake. Between these years several other instances of sick and dying waterfowl were observed. During the winter of 1965 and 1966 approximately 2,500 mallards died, and in 1967 about 1,000 mallards and about 200 geese were believed to have died in Fremont County from lead poisoning. At least a few hundred birds have died annually in this area since 1965 due to lead poisoning.

Lead poisoning is not an infrequent situation. Documented cases of lead poisoning are fairly common across the country. Cases of over 5,000 birds dying at one time have been reported from Chautauqua National Wildlife Refuge in Illinois, Squaw Creek Refuge in Missouri, Claypool Reservoir in Arkansas, Catahoula Lake in Louisiana, Sand Lake Refuge in South Dakota, Lubbock County in Texas, and Suisun Bay and San Francisco areas in California (Bellrose, 1959). Many other less dramatic cases of die-offs have been reported.

Most attention on waterfowl losses from lead poisoning has centered around local areas where large numbers of ducks and geese have died in a relatively short time. However, many more birds die a few at a time and go undetected. Losses due to spent lead are quite impressive and are considered a major mortality factor on waterfowl.

Factors that influence large die-offs include availability and amount of lead deposited, soil structure of marsh or lake bottoms, depth of water, temperature, number of birds present and diet of the birds (Bellrose, 1959).

Conditions for lead poisoning were ideal in years when big losses occurred at Forney's Lake. Large numbers of mallards were present in 1965 and 1967, temperatures were mild enough to allow open water, a large amount of lead was available, and the birds were on an all-corn diet.

Birds on a straight corn diet are more susceptible to poisoning due to increased action of the gizzard. The grinding of the gizzard erodes away the shot pellet, freeing the lead to pass into the digestive tract. Jordan and Bellrose (1951) pointed out the importance of diet in lead poisoning. Ducks eating green vegetation, small seeds and duck pellets suffered lower mortality rates than those on corn.

Mallards and geese checked in the field demonstrated many lead poisoning symptoms. The birds were emaciated, quite weak, dehydrated, showed greenish stain on the vent, and some contained remnants of eroded lead shot in the gizzard.

Birds collected in 1965 and 1967 were examined and tested for lead. All mallards collected were termed positive for lead poisoning by the Iowa State University Diagnostic Laboratory. Liver tissue was negative for arsenic and thallium but averaged 14.4 ppm of lead. Gizzard contents analyzed had 2.75 ppm lead. Post-mortem examination observed no specific lesions and cultures for *Salmonella* were negative. The Toxicology report stated that tissue level of lead was significantly high to incriminate lead as the toxicant.

Most mallards which tested positive for lead in body organs did not have pellets in the gizzard. Approximately 20 dead and dying mallards checked for shot in the field in 1965 contained no lead in the gizzard. Gizzard analyses of 76 geese indicated that 23 birds (30%) were carrying shot in the gizzard. The number of shot ranged from 1 to 23 pellets with an average of 3.3 pellets per bird. Many geese also did not have lead pellets in the gizzard, but were believed to be suffering from lead poisoning. At the time of death or late stages of sickness, many of the pellets that caused the damage have been completely eroded away or down to thin plates which go undetected. Bellrose (1959) reported that James S. Jordon found 21% of captive mallards dosed with one to four No. 6 shot had no pellets in their gizzards at time of death. Work by other authors indicates that this situation is quite common.

Sixty-three bottom samples were collected in the spring of 1967 and 80 samples in the spring of 1968 to measure shot-pellet density. Twenty 4 in. deep samples averaged 2.6 pellets per square foot and 123 2 in. samples averaged 1.4 pellets per square foot as shown in Table 1. Average pellets per square foot using all 143 samples was 1.6. There was no clear-cut relationship between distance from the shooting line and pellet density.

Bottom samples indicate that a large amount of lead is available to waterfowl at Forney's Lake. A total of 123 samples taken at a 2 in. depth indicated about 50,984 shot pellets per acre and 4 in. deep samples averaged 113,256 pellets per acre. Lake Puckaway in Wisconsin had lead deposits of 118,048 pellets per acre and Heron Lake in Minnesota had 64,000 shot per acre (Bellrose, 1964). These areas also have records of lead poisoning losses. Bellrose (1959) cited 22 areas where bottom samples have been collected and only four had pellet densities of over 50,000 shot per acre. These samples were taken from 0.5 in. to 10 in. in depth.

The deposit of lead is not a random system but occurs in clusters. Hunter concentrations and the range of the shot patterns determine areas of high lead deposition. Due to these conditions, the data cannot be analyzed on a random basis. Sampling problems resulting from weather conditions prevented a uniform sampling coverage. Thus, the comparisons of each 50 yard strip may not be totally accurate.

Soil types of lake and marsh bottoms influence the rate and depth that lead will settle. Peat and muck bottoms have less lead accumulation because the lead settles below the area where ducks and geese generally feed. Ducks feed mostly in the top 2 in. but frequently sift through bottom debris up to 4 in. Bottoms consisting of sand, gravel or clay do not allow lead to sink away, and lead is built up to very high levels. One such area was found off a point in Black Duck Lake in Minnesota. Biologists found 10 shot per square foot off this gravelly point and one lesser scaup was found that had 112 shot in its gizzard (Bob Jessen, personal communication). The bottom of Forney's Lake is a silty-loam muck type but is much firmer than peat soils found in many marshes. Lead gradually settles out of this structure but not as rapidly as on less compacted bottoms.

Management to reduce waterfowl losses has been employed during the last few years. At the close of the hunting season the area is dewatered, which forces the ducks and geese to leave the lake proper. This procedure reduces the amount of lead picked up and the number of ducks lost. Water levels are held down through the spring of some years and portions of the lake are disked with farm machinery which tends to settle out the lead at a much faster rate.

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TABLE 1. LEAD SHOT OCCURENCE IN BOTTOM SAMPLES TAKEN IN 1967 AND 1968, FORNEY'S LAKE, IOWA. STANDARD ERROR IS IN PARENTHESIS.

Yards from Shooting Line	No. of 2" Samples	Pellets/2" Sample	No. of 4" Samples	Pellets/4" Sample
70-120	18	1.5 (0.41)	4	2.0 (2.12)
120-170	34	1.3 (0.64)	6	4.7 (3.17)
170-220	16	1.0 (0.81)	6	1.2 (0.17)
220-270	18	0.4 (0.11)	2	2.0 (1.0)
270-320	20	1.5 (2.72)	2	2.0 (1.0)
320-370	17	3.1 (2.57)	0	0.0
Average pellets/square foot sample		1.4		2.6