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Effects of Lead Shot Ingestion on Free-ranging Mourning Doves

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Mourning doves (Zenaida macroura) may develop Pb toxicosis from ingesting spent Pb shot from hunted fields in which they feed. One to 6.5 percent of the dove population may ingest Pb shot based on analysis of gizzard contents (Locke and Bagley 1967, Lewis and Legler 1968, Buerger et al. 1983).

No Pb shot toxicity studies have been conducted on free-ranging mourning doves. Mortality data for Pb-dosed, free-ranging doves would help determine the actual effects of Pb shot ingestion on the mourning dove population. Causes of death of Pb-treated doves also could help to estimate exposure of predators and scavengers to secondary Pb toxicosis. The objectives of this study were to compare mortality and causes of death of free-ranging Pb-treated and untreated mourning doves.

MATERIALS AND METHODS

Field work was started in early August and completed by mid-November, 1986. Baiting with wheat commenced on the selected trapping and release site in early August and was continued throughout the study. Results from a pilot study conducted in January and February, 1986 indicated that baiting was necessary to keep an adequate number of doves in the study area during the sample period. Wheat was selected for baiting because it is an important mourning dove food in the southeastern United States (Cummings and Quay 1953), and often is planted in Alabama to attract doves for fall hunting (Davis 1977).

Doves were trapped from early September to late October with modified Kniffen funnel traps baited with wheat. All doves were trapped on 5 trapping days,

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approximately a week apart, during this period. They then were transported to a laboratory on the Auburn University campus and held in captivity for 24 hours. During this time, any previous exposure to Pb was quantified by conducting a modified (George 1987) delta aminolevulinic acid dehydratase (δ-ALAD) assay (Granick et al. 1972) on each dove. Approximately 13 birds with δ-ALAD values over 1100, indicative of no recent Pb exposure (George 1987), were chosen for use in the study each time the assay was conducted. The remaining birds were banded with U.S. Fish and Wildlife Service bands and released.

Experimental doves were randomly separated into 2 treatment groups. Doves in 1 group (treated) were force-fed 1, #8 commercial Pb shot, and those in the other group (control) were force-fed a millet seed. Each dove then was fitted with a radio transmitter (3 g, 38-ma and 1.5-V battery, epoxy coated; Wildlife Materials Inc., Carbondale, Ill.) with a 15 cm antenna, banded with a U.S. Fish and Wildlife Service band, and released at the trapping site. Transmitters were attached using harnesses constructed of latex surgical tubing (Godfrey 1970) instead of direct attachment with cyanoacrylate-base glue (Perry et al. 1981) because of difficulty maintaining such radio attachments on experimental birds during the pilot study. Radio signals were received from the ground using a hand-held Yagi antenna attached to a scanning receiver (Advanced Telemetry Systems, Inc., Bethel, Minn.). Doves also were located from the air at least twice a week using a fix-winged aircraft with 2 Yagi antennae attached to the wing struts.

Each bird's location was determined by triangulation twice daily, when possible, for 21 days. If a bird's location remained the same between successive checks, it was located visually. Each cause of death was recorded as avian, mammalian, or other. Usually, no remains other than feathers and occasional bones were found. Cause of death was determined after interpreting several factors alone or in conjunction. These included 1) marks on radio or harness, i.e., sharply cut portions of the harness and/or a spirally-twisted antenna indicated avian predation, while tooth marks on the radio indicated mammalian predation/scavenging; 2) pattern of feathers on ground or surrounding vegetation, i.e., feathers which were scattered in a wide circle or had fallen from a nearby limb indicated avian predation, while feathers close together or forming a straight trail indicated mammalian predation/scavenging; 3) scat and tracks, i.e., locations of radios and remains were searched for mammalian scat and/or tracks. Mammalian predation and mammalian scavenging were pooled, because it was impossible to distinguish between them.

Habitats that doves frequented, and those in which remains were found, were visually categorized as dense (rank vegetation indicative of early successional stages), open (little or no vegetation other than ground cover and scattered trees), or intermediate (had characteristics indicative of both categories).

A survival function, or the probability that a dove survives longer than time "t," was calculated for each treatment group by the product limit method (Cox and Oakes 1984), using the LIFETEST procedure of SAS (SAS Institute Inc. 1985). The corresponding survival curves then were plotted. Gehan's Wilcoxon test was used to compare the survival functions (Gehan 1965).

RESULTS AND DISCUSSION

One hundred and thirty-three male and female doves of various ages were trapped, and 61 were used in the study. Two control birds and 4 treated birds lost their radios before the tracking period ended. These 6 birds were not included in analyses because, unlike the other birds, observation stopped because of problems in the experimental design rather than Pb toxicity or environmental factors. Adequate survival data were collected from 55 doves, which included 29 control and 26 treated birds. Eighty-seven percent (n=48) were hatching year (HY) birds, and sex often could not be determined (n=26). Data from all aged and sexed doves were pooled to obtain adequate sample sizes for analysis (Table 1). All doves remained primarily on Auburn University land where no hunting is allowed. Consequently, the probability that experimental doves ingested additional Pb shot was low.

Thirteen control birds died during the study, 13 survived, and radio signals of 3 birds were lost before the 3-week tracking period ended. Fifteen treated birds died, 7 survived, and radio signals of 4 were lost within the same time frame.

No significant difference ($0.100 < \underline{P} < 0.150$; $\underline{z} = 1.23$) occurred between the 2 calculated survival functions, but survival rates of the treated doves tended to be lower (Fig. 1). One ingested Pb shot apparently did not cause mortality great enough for statistical detection over the high mortality normally occurring in the mostly HY doves. In a study on mallards (<u>Anas platyrhynchos</u>), mortality resulting from ingestion of 1 Pb shot also was masked by high normal mortality (Bellrose 1959).

Table 1. Age and sex composition of Pb-treated and control, free-ranging mourning doves, Lee Co., Alabama, 1986.

Sex	Pb-treated AHY[a]	Pb-treated HY	Control AHY	Control HY
Male	1	3	4	2
Female	1	8	1	9
Unknown	0	13	0	13
Totals	26		29	

[a] AHY= after hatching year; HY= hatching year

The 52%, 3-week mortality rate for control HY and AHY doves in this study was high compared to average annual mortality rates of unradioed HY and AHY doves in the southeastern United States (Hayne 1975). This high rate may have been caused by avian predators "keying in" on the radioed birds. Increased avian predation has not been documented for radio-tagged mourning doves; however, ruffed grouse (Bonasa umbellus) with back tags similar to the harnesses used in this study had lower survival rates than marked grouse without back tags (Gullion et al. 1962).

The high mortality caused by predators in this study also may have masked any effect of the Pb shot because birds may have been killed by a predator before Pb toxicosis developed. A best estimate of the cause of death was determined for 53% of control birds and 73% of treated birds (Table 2); all likely causes of death were due to predation. Causes of death were usually avian or mammalian related; however, one dove was eaten by a snake.

One could argue that the tendency for higher survival in the control group was related to the higher proportion of AHY doves (normally have higher survival rates than HYs) in that group. However, the types of mortality, and the locations where doves were killed/scavenged suggest the PB-treated doves were not behaving normally and that the Pb treatment was affecting them. Avian predation accounted for 86% of the likely causes of death of control doves and no mammalian predation/scavenging was detected in that group. Conversely, avian predation accounted for only 36% of the likely causes of death in the treated group while mammals accounted for 64% of the likely causes of death/scavenging (Table 2). Additionally, remains of

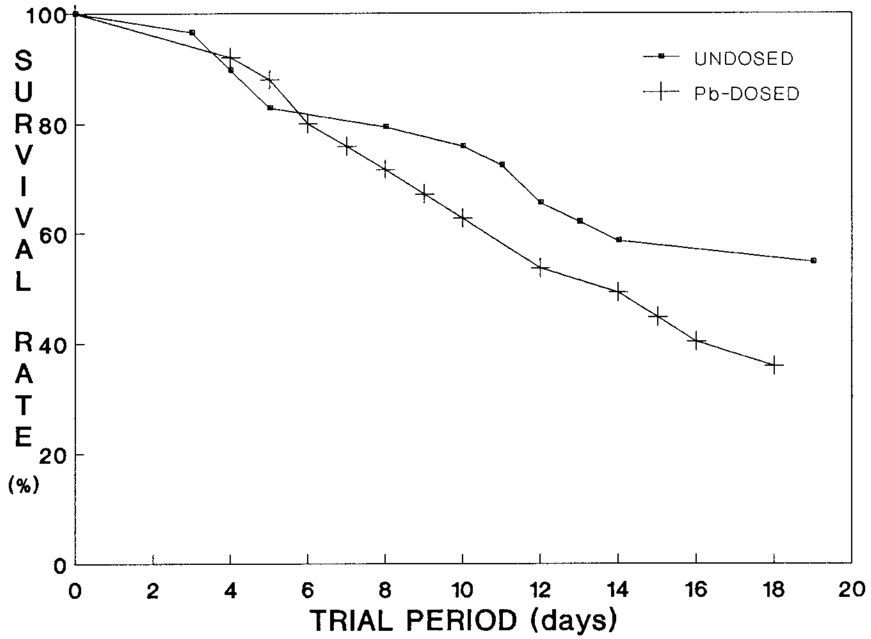

Figure 1. Survival estimates of Pb-treated and control, free-ranging mourning doves, Lee Co., Alabama, 1986.

avian-killed doves were usually found in open areas (8/10), whereas remains of most doves killed/scavenged by mammals were found in denser cover (7/7). The use of dense cover by the treated doves indicates they may have been sick and susceptible to mammalian predation/scavenging. Dense cover is used by Pb-intoxicated waterfowl (U.S. Fish and Wildlife Service 1986). Mammals may have killed some of the sick doves in the dense cover, or scavenged those that died there from Pb poisoning. The disproportionate mammalian predation/scavenging of the treated doves and the trend of lower survival rates in this group suggest that the adverse effects of Pb shot ingestion observed in captive mourning doves (Buerger et al. 1986) may carry over into a sizeable proportion of the wild population.

Secondary poisoning of mammals and birds by mourning doves containing Pb shot seems less likely. While mammals ingested most of the Pb-dosed doves in this study, their poisoning by Pb shot has not been documented and they probably excrete Pb shot intact. Also, while most secondary poisoning of raptors occurs from eating crippled birds rather than Pb-poisoned birds, it is less likely that small birds like mourning doves could provide a massive dose of Pb shot to a

Table 2. Cause of death of Pb-treated and control, free-ranging mourning doves, Lee Co., Alabama, 1986.

	Cause of Death/Scavenging				
Treatment	Avian	Mammalian	Other	Total	Unknown
Pb-treated	4	7	0	11	4
Control	6	0	1[a]	7	6

[a] Eaten by snake

raptor via their body or digestive tract (Pattee and Hennes 1983).

More study is needed to clarify the consequences and prevalence of ingested Pb shot in the free-ranging mourning dove population. A long-term banding study comparing survival rates of Pb-treated and control doves should be initiated. Although mourning dove gizzard analyses have been conducted in several states to quantify the prevalence of ingested Pb shot, similar studies should be conducted in additional locations. These studies, together with fluoroscopic examinations of live-trapped doves, could refine estimates of the prevalence of Pb shot ingestion. Such studies also would quantify the amount of Pb shot carried in the flesh of mourning doves that could potentially be ingested by avian predators.

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