

# ACUTE LEAD TOXICOSIS AND EXPERIMENTAL LEAD PELLET INGESTION IN MOURNING DOVES

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EXTENDED ABSTRACT.—Mourning Dove (*Zenaidura macroura*) hunting is becoming increasingly popular, especially hunting over managed shooting fields. Given the possible increase in lead shot availability on these areas, our original objective was to estimate the availability and ingestion of spent shot at the Eagle Bluffs Conservation Area (EBCA; hunted with non-toxic shot) and the James A. Reed Memorial Wildlife Area (JARWA; hunted with lead shot) in Missouri (Schulz et al. 2002). During 1998, we collected soil samples one or two weeks prior to the hunting season (pre-hunt) and after four days of dove hunting (post-hunt). We also collected information on the number of doves harvested, number of shots fired, shotgun gauge, and shotshell size used. Dove carcasses were collected on both areas during 1998–99. At EBCA, 60 hunters deposited an estimated 64,775 pellets/ha of non-toxic shot on or around the managed field. At JARWA, approximately 1,086,275 pellets/ha of lead shot were deposited by 728 hunters. Our post-hunt estimates of spent shot availability from soil sampling were 0 pellets/ha for EBCA and 6,342 pellets/ha for JARWA. Our findings suggest that existing soil sampling protocols may not provide accurate estimates of spent shot availability in managed dove shooting fields. During 1998–1999, 15 of 310 (4.8%) Mourning Doves collected from EBCA had ingested non-toxic shot. For doves that ingested shot, 6 (40.0%) contained  $\geq 7$  shot pellets. In comparison, only 2 of 574 (0.3%) doves col-

lected from JARWA had ingested lead shot. Because a greater proportion of doves were found to have ingested multiple steel pellets compared to lead pellets, we suggested that doves feeding in fields hunted with lead shot may succumb to acute lead toxicosis and thus become unavailable to harvest, resulting in an underestimate of lead shot ingestion rates. These findings may partially explain why previous studies have shown relatively few doves with ingested lead shot despite feeding on areas with high lead shot availability (Kendall et al. 1996, Mirarchi and Baskett 1994).

Our next objective was to test the acute lead toxicosis hypothesis, that free-ranging Mourning Doves may ingest spent lead pellets, succumb to lead toxicosis, and die in a relatively short time (Schulz et al. 2006). We tested this hypothesis by administering 157 captive Mourning Doves 2–24 lead pellets, monitoring pellet retention and short-term survival, and measuring related physiological characteristics. During the 19- to 21-day post-treatment period, 104 doves that received lead pellets died (deceased doves) and 53 survived (survivors); all 22 birds in a control group survived. Within 24-h of treatment, blood lead levels increased almost twice as fast for deceased doves compared to survivors ( $F_{1,208} = 55.49$ ;  $P < 0.001$ ). During the first week, heterophil:lymphocyte (H:L) ratios increased twice as fast for deceased doves than with survivors ( $F_{1,198} = 23.14$ ,  $P < 0.001$ ). Post-treatment survival differed

( $\chi^2 = 37.4$ ,  $P = 0.001$ ) among the five groups of doves that retained different numbers of pellets, and survival ranged from 0.57 (95% CI: 0.44–0.74) for doves that retained  $\leq 2$  lead pellets 2-days post-treatment compared to 0.08 (95% CI: 0.022–0.31) for those doves that retained 13–19 lead pellets on 2-days post-treatment; significant differences existed among the five groups. After controlling for dove pretreatment body mass, each additional lead pellet increased the hazard of death by 18.0% (95% CI: 1.132–1.230,  $P < 0.001$ ) and 25.7% (95% CI: 1.175–1.345,  $P < 0.001$ ) for males and females, respectively. For each 1-g increase in pretreatment body mass, the hazard of death decreased 2.5% ( $P = 0.04$ ) for males and 3.8% ( $P = 0.02$ ) for females. Deceased doves had the highest lead levels in liver ( $49.20 \pm 3.23$  ppm) and kidney ( $258.16 \pm 21.85$  ppm) tissues, whereas controls showed the lowest levels (liver,  $0.08 \pm 0.041$  ppm; kidney,  $0.17 \pm 0.10$  ppm). For doves dosed with pellets, we observed simultaneous increases in blood lead levels and H:L ratios, whereas packed-cell volume (PCV) values declined. Our results therefore support an acute lead toxicosis hypothesis.

Next, we conducted an experiment to determine if doves held in captivity freely ingest lead shotgun pellets, investigate the relationship between pellet density and ingestion, and monitor physiological impacts of doves ingesting pellets (Schulz et al. 2007). We conducted two trials of the experiment with 60 doves per trial. We randomly assigned 10 doves to one of six groups per trial; 10, 25, 50, 100, 200 pellets mixed with food and a control group with no pellets. We monitored ingestion by examining x-rays of doves 1-day post-treatment and monitored the effects of lead ingestion by measuring

H:L ratios, PCV, blood lead, liver lead and kidney lead. Pooled data from both trials showed 6 of 117 (5.1%) doves ingested lead pellets. Two Mourning Doves ingested multiple lead pellets in each of the treatments containing a mixture of 25, 100 and 200 lead pellets and food. Doves ingesting lead pellets had higher blood lead levels than before treatment ( $P = 0.031$ ). Post-treatment H:L ratios, however, were not different compared to pre-treatment values ( $P = 0.109$ ). Although post-treatment PCV decreased for four of six doves ingesting lead pellets, overall they were not lower than their pre-treatment values ( $P = 0.344$ ). Liver ( $P < 0.0001$ ) and kidney ( $P = 0.0012$ ) lead levels for doves ingesting pellets were higher than doves without ingested pellets. Our lead pellet ingestion rates were similar to previously reported ingestion rates from hunter-killed doves (Kendall et al. 1996, Otis et al. 2008), and our physiological measurements confirm earlier reports of a rapid and acute lead toxicosis (Schulz et al. 2006). Similar to previous field research (Lewis and Legler 1968, Castrale 1991, Best et al. 1992), we did not observe a relationship between pellet density in the food and ad libitum pellet ingestion.

We recommend that management agencies initiate development of a long-term strategic plan aimed at implementing a nontoxic shot regulation for Mourning Dove hunting. Although one approach would be to ban lead shot for Mourning Dove hunting on managed public hunting areas, we believe it is vitally important to ensure that policy development and implementation have a consensus among stakeholders. *Received 30 April 2008, accepted 8 August 2008.*

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