Will Mourning Dove Crippling Rates Increase With Nontoxic-Shot Regulations?

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Abstract

*Increasing concerns about the exposure of mourning doves (*Zenaida macroura*) to spent lead shot may lead to a review of lead-shot restrictions. Policy reviews regarding current restrictions likely will involve debates about whether nontoxic-shot requirements will result in increased crippling loss of mourning doves. We evaluated waterfowl crippling rates in the United States prior to, during, and after implementation of nontoxic-shot regulations for waterfowl hunting. We use this information to make inferences about mourning dove crippling rates if nontoxic-shot regulations are enacted. We found differences in moving average crippling rates among the 3 treatment periods for ducks ($F = 23.232$, $P < 0.001$, $n = 49$). Prenontoxic-shot-period crippling rates were lower than 5-year phase-in period crippling rates ($P = 0.043$) but higher ($P < 0.001$) than nontoxic-shot-period crippling rates. Similarly, we observed differences in moving average crippling rates among the 3 treatment periods for geese ($F = 9.385$, $P < 0.001$, $n = 49$). Prenontoxic-shot- and 5-year-phase-in-period crippling rates were both greater than ($P < 0.001$) nontoxic-shot-period crippling rates but did not differ from one another ($P = 0.299$). Regardless of why the observed increases occurred in reported waterfowl crippling rates during the phase-in period, we believe the decline that followed full implementation of the nontoxic-shot regulation is of ultimate importance when considering the impacts of lead shot restrictions for mourning doves. We argue that long-term mourning dove crippling rates might not increase as evidenced from historical waterfowl data.* (WILDLIFE SOCIETY BULLETIN 34(3):861–865; 2006)

Key words

crippling rates, lead toxicosis, mourning doves, Pb toxicosis, spent shot, waterfowl, Zenaida macroura

Although lead shot was completely banned for waterfowl hunting in the United States by 1992 (U.S. Fish and Wildlife Service [USFWS] 1988, Belanger and Kinnane 2002), it continues to be used extensively for upland game bird hunting. Despite its continued use, there is growing concern about the risks related to exposure of upland game birds to spent lead shot resulting from hunting activities (Franson 1996, Keel et al. 2002), and much of the concern is focused on mourning doves (Kendall et al. 1996, Schulz et al. 2002, 2006*a*). Given this heightened awareness of lead exposure and toxicosis in mourning doves, further nontoxic-shot regulations will be a contentious policy debate (Franson 1996, Kendall et al. 1996, Belanger and Kinnane 2002).

Unlike other upland-game-bird hunting opportunities, mourning dove hunting can deposit large quantities of lead shot on relatively small areas (e.g., 1.2–4.0 ha). Many wildlife management agencies manipulate upland crop fields annually to provide small grain and weed seeds scattered on relatively bare ground, which in turn results in heavy use by feeding mourning doves (Baskett 1993, Tomlinson et al. 1994, Schulz et al. 2003). Previous research has shown that 860,185 lead pellets/ha were deposited on a managed field in New Mexico (Best et al. 1992), 27,515 pellets/ha in Indiana (Castrale 1989), and 6,342 pellets/ha in Missouri (Schulz et al. 2002). Mourning doves feeding in these managed fields ingest lead shot because the spent shotgun pellets appear similar to weed and grain seeds (Conti 1993, Mirarchi and Baskett 1994). Samples of hunter-killed doves from these popular hunting and feeding areas have shown lead pellet ingestion rates for mourning doves varying from <1% to 6.5%. During 1998–2000, pellet ingestion rates were 2.5% of 4,229 mourning dove carcasses collected from 7 states where lead shot was permitted; ingestion rates among areas ranged 0.0–20.8% with considerable year-to-year variation among areas (Franson 2002). Along with the information on exposure and ingestion of lead shot, there is substantial information documenting the ultimate linkage to lead toxicosis in mourning doves (Kendall et al. 1996, Schulz et al. 2006*a*).

Opposition to nontoxic-shot regulations for waterfowl hunting centered on numerous issues that were often unrelated to the negative population effects of lead toxicosis (Belanger and Kinnane 2002). We believe similar issues will surface when nontoxic-shot regulations are discussed for mourning doves. Historically, concerns have been voiced about the availability of ballistically suitable alternatives to lead shot, availability of shell sizes other than 12-gauge, damage to older firearms, and increased cost of nontoxic shotgun shells (USFWS 1988, Belanger and Kinnane 2002). Many concerns have been addressed with the development and availability of nontoxic-shot alternatives (e.g., iron/steel, bismuth, tungsten, tin, and nickel alloys), increases in production and distribution of nontoxic ammunition, and corresponding decreases in price for some nontoxic-shot alternatives (USFWS 1988).

One of the most contentious issues in the waterfowl–lead debate was related to ballistic differences between lead and nontoxic shot (i.e., steel shot at the time). This debate led many stakeholders to believe that mandatory nontoxic-shot regulations would result in increased crippling losses that would be equal or larger than those caused by lead poisoning (Humburg and Babcock 1982, USFWS 1988). This same issue has become a point of discussion with stakeholders reluctant to see further restrictions on lead shot enacted for mourning dove hunting. Our objectives, therefore,

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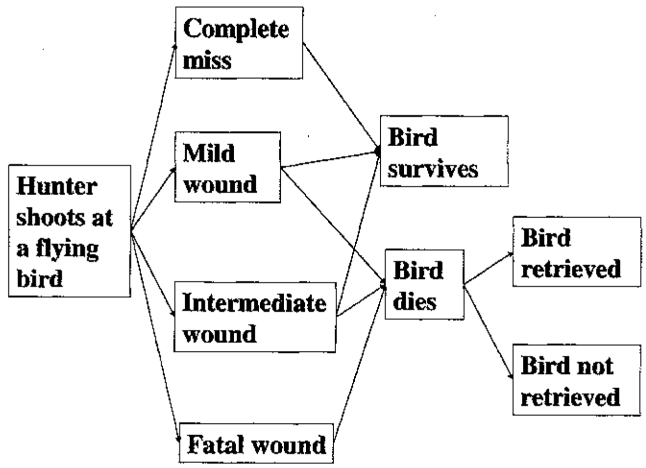

Figure 1. There are several outcomes each time a hunter shoots at a game bird, and not every bird that is perceived to be shot is actually killed. A hunter could miss the bird completely, or provide a mild, intermediate, or fatal wound. Also, not all wounded birds die, and not all dead birds are retrieved. Therefore, we suggest reported crippling rates provide a relative, but consistent, measure of hunters' perceptions of unretrieved kill.

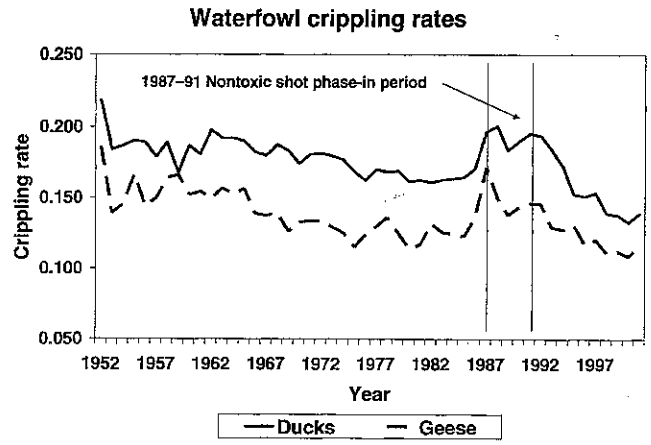

Figure 2. Duck and goose reported crippling rates from the U.S. Fish and Wildlife Service (USFWS) Waterfowl Harvest Survey, 1952–2001.

were to 1) evaluate crippling rates reported by waterfowl hunters prior to the nontoxic-shot requirement (prenontoxic-shot period), during the 5-year period over which all states implemented nontoxic-shot regulations (phase-in period), and after nontoxic shot was required nationwide (nontoxic-shot period), and 2) use this information from waterfowl to make inferences to future mourning dove crippling rates if additional nontoxic-shot regulations are enacted.

Methods

Crippling Rates

Each time a hunter shoots at a flying bird there are several possible outcomes (Fig. 1). Although shots that are complete misses and those that result in retrieved birds have unambiguous outcomes, the fates of birds that are hit but not killed and retrieved are rarely known. The number of birds that are not harvested but die as a result of hunters' shots (hereafter called cripples) is necessary to estimate realized kill rates (Brownie et al. 1985) and may be an important element in understanding the impacts of hunting on game bird populations. Estimating crippling rates, however, is a difficult task due to the numerous outcomes (Fig. 1). Estimates of *actual* crippling rates can be obtained on a local scale by monitoring a sample of radiomarked birds during the hunting season (Berdeen 2004). An alternative is using trained observers (or "spy blinds") to watch hunters to obtain estimates of *observed* crippling rates (Haas 1977), but the ultimate fate of birds that are hit is still unknown. Usually, however, crippling rate estimates are obtained by asking hunters about the number of birds shot but not retrieved. Even when survey or interview questions about crippling are explicitly stated, uncertainty still exists in the interpretation of the data (Fig. 1). Thus, these estimates are routinely known as *reported* crippling rates because they represent what hunters perceived happened in the field rather than objective and empirical data. Nevertheless, we believe that reported crippling rates provide a valid index that accurately reflects trends in actual crippling rates.

The reported crippling rates used were derived from the USFWS mail questionnaire survey conducted annually from 1952 to 2001 to estimate the harvest of waterfowl and other migratory game birds. Each year, the USFWS randomly selected a sample of post offices that sold federal duck stamps and asked them to give each duck stamp purchaser a postage-paid name and address postcard. We sent the potential waterfowl hunters who filled out and returned the postcards a harvest questionnaire at the close of the hunting season (Martin and Carney 1977, Voelzer et al. 1982). We asked sampled hunters to report the number of ducks and geese they killed and retrieved, from which the USFWS estimated *retrieved kill*, and also how many birds they *knocked down in sight but could not retrieve*, from which the USFWS estimated *unretrieved kill*. About 40,000–60,000 waterfowl hunters were sampled in most years, and the questionnaire response rates averaged about 65–70%.

Data Analysis

We computed crippling rates (CR) as:

$$CR = \left(\frac{UK}{UK + RK}\right)$$

where UK = unretrieved kill and RK = retrieved kill. We compared duck and goose crippling rates during the prenontoxic-shot (1952–1986), the 5-year phase-in (1987–1991), and the nontoxic-shot (1992–2001) periods (Fig. 2). We assumed that crippling rates were similar among flyways and computed overall U.S. crippling rates.

We computed simple 3-year moving averages (A) of the crippling rates to smooth the trend lines. The n year simple moving average for year Y was computed as:

$$A_Y = \frac{\sum_{i=1}^{n} CR_{(Y-i)+1}}{n} \quad n \leq Y$$

That is, a 3-year moving average value for year 3 was computed as $A_3 = (CR_3 + CR_2 + CR_1)/3$. We transformed the moving average data using an arcsine transformation and used analysis of variance to compare transformed crippling-rate data among the 3 treat-

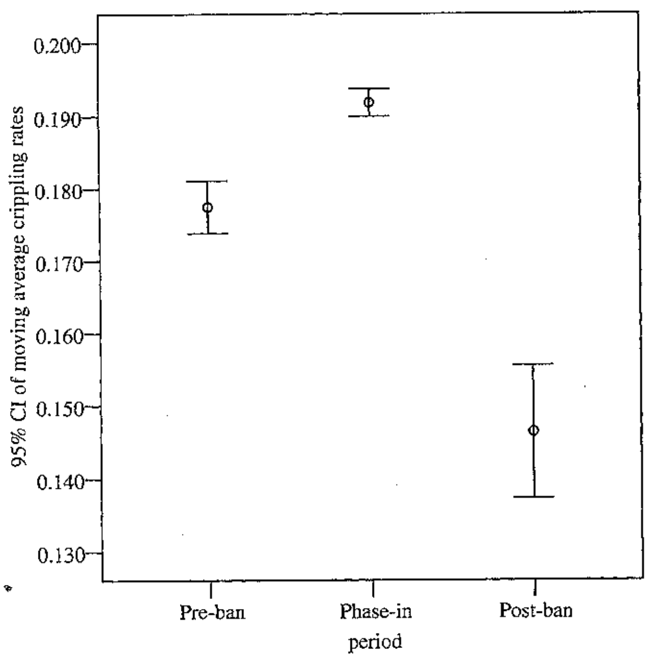

Figure 3. The 95% confidence intervals of untransformed moving average crippling-rate values for ducks during prenontoxic-shot (1952–1986), phase-in (1987–1991), and nontoxic-shot (1992–2001) periods.

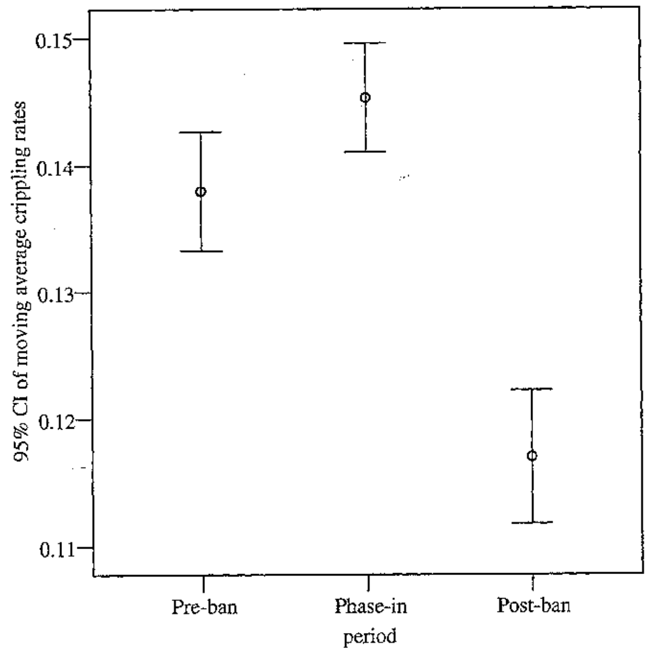

Figure 4. The 95% confidence intervals of untransformed moving average crippling-rate values for geese during prenontoxic-shot (1952–1986), phase-in (1987–1991), and nontoxic-shot (1992–2001) periods.

ment periods. We used Tukey's honestly significant difference test to discern differences by treatment period (Zar 1996). All tests were considered significant at $P < 0.05$.

Results

We found differences in moving average crippling rate among the 3 treatment periods for ducks ($F = 23.232$, $P < 0.001$, $n = 49$). Prenontoxic-shot crippling rates were lower than 5-year phase-in crippling rates ($P = 0.043$) but higher ($P < 0.001$) than nontoxic-shot crippling rates (Fig. 3). Moreover, 5-year phase-in crippling rates were higher than nontoxic-shot crippling rates ($P < 0.001$; Fig. 3).

Similarly, we observed differences in moving average crippling rates among the 3 treatment periods for geese ($F = 9.385$, $P < 0.001$, $n = 49$). Prenontoxic-shot crippling rates and 5-year phase-in crippling rates were greater than ($P < 0.001$) nontoxic-shot crippling rates (Fig. 4) but did not differ from one another ($P = 0.299$).

Discussion

Nontoxic Shot and Increased Crippling?

We believe several possible explanations exist for the observed increases in reported duck and goose crippling rates during the 5-year nontoxic-shot phase-in period and the subsequent decline after the regulations became fully implemented (Fig. 2). One possibility is that the ammunition available during implementation of nontoxic-shot regulations may have been so ballistically different from traditional lead shotgun shell loads that hunters were indeed shooting differently and crippling more ducks and geese. If this scenario is correct, we believe waterfowl hunters likely learned to adjust their shooting, and apparently became better shooters and hunters after implementation of the nontoxic regulation. Alternatively, waterfowl hunters may have developed a self-fulfilling prophesy in their own minds (Freedman et al. 1978, Burke 1982, Myers 1996) where they expected to cripple more birds and, thus, reported crippling more birds. If so, then hunters may have forgotten about the "increased crippling" prophesy after full implementation of the nontoxic-shot regulation, and reported crippling rates dropped to previous or lower levels.

Regardless of the explanation for the observed increases in reported crippling rates by waterfowl hunters, we argue the decline that followed full implementation of the nontoxic-shot regulation is of ultimate importance when considering further lead-shot restrictions for mourning dove hunting. In other words, we might not expect increases in reported mourning dove crippling rates if a nontoxic-shot regulation is implemented. We acknowledge the connection between historical waterfowl and anticipated mourning dove crippling rates has not been tested. However, we believe the inference is reasonable because it is based upon the best available data. Given more time and funding, an alternative approach would be a series of experiments measuring lethality differences among currently available shotgun pellet types. These experiments will be costly and current animal care and use protocols may be difficult (if not impossible) to obtain.

Historically, one of the earliest estimates of mourning dove crippling rates reported by hunters was 32% (Southeastern Association of Game and Fish Commissioners 1957). In South Carolina, estimated crippling rates ranged 27–41%, based on the observations of trained observers in the field and exit interviews (Haas 1977). We believe these rates are overestimated because not all birds thought to be shot and not retrieved are actually killed (Fig. 1). Furthermore, modern estimates of retrieved and unretrieved kill from the Harvest Information Program (HIP; Ver Steeg and Elden 2002) result in reported mourning dove crippling rates of 10–14% across the 3 mourning dove management units (USFWS Division of Migratory Bird Management, unpublished data).

Lead Shot versus Increased Crippling: Which Is The Lesser of 2 Evils?

As previously noted, waterfowl hunters generally believed that crippling rates would increase with the mandatory use of nontoxic-shot ammunition (Humburg and Babcock 1982) and that the number of waterfowl saved from lead poisoning would likely be no greater than the increased number of crippled ducks and geese resulting from the use of nontoxic shot (USFWS 1988). Stakeholders framed the nontoxic-shot discussions as a *lesser of 2 evils* point of debate (i.e., which negative impact is more palatable?). Our review of the historical waterfowl harvest data showed that, although reported crippling rates did actually increase at first, the rates returned to levels similar to or lower than prenontoxic-shot estimates.

Hunters, however, are not the only constituency group with a stake in the nontoxic-shot debate. Nonhunting stakeholders have drawn attention to the toxic effects of lead shot and have taken advantage of its continued use to attempt to ban dove hunting altogether in some states. For example, since dove hunting was approved in Michigan in 2004, several groups (e.g., Humane Society of the United States, Michigan Audubon Society, and Fund for Animals) have obtained >275,000 voter signatures for a ballot initiative in the November 2006 election to stop dove hunting (http://www.savethedoves.org/news/news_033005.html and http://www.stopshootingdoves.org/). The most effective and compelling arguments in press releases from these groups have suggested that Michigan voters should support the referendum to protect the environment from dangerous amounts of lead resulting from dove hunting. Peggy Ridgway, president of the Michigan Audubon Society, stated, "We have gone to great lengths to remove this environmental toxin from our gasoline, paint, solder, and even shotguns when shooting near wetlands. Our stewardship of Michigan's land and water resources necessitates the elimination of further use of lead, and the continued effort to clean up what remains" (http://www.savethedoves.org/news/news_080504.html).

Historical estimates place mourning dove autumn populations at 350–600 million doves (Dunks et al. 1982); recent estimates are 475 million birds (Tomlinson et al. 1988, 1994). Summary data show that lead-pellet ingestion rates for mourning doves have been reported at <1.0–6.5% (Conti 1993, Mirarchi and Baskett 1994). During 1998–2000, pellet ingestion rates were 2.5% of 4,229 carcasses collected from 7 states where the use of lead shot was permitted (Franson 2002). In combination with these existing ingestion rates, evidence from wild mourning doves held in captivity (Schulz et al. 2006*a*) showed that virtually all mourning doves ingesting lead pellets eventually succumb to the direct or indirect effects of lead toxicosis. Given the range of 350–600 million mourning doves in North America (Dunks et al. 1982) and multiplying the lower and upper estimates by Franson's (2002) reported 2.5% ingestion rate, it may be possible that roughly 8.8–15.0 million mourning doves are dying from lead poisoning annually. For comparison, mourning dove harvest estimates from the HIP survey were 18.2 million in 2003, and 20.0 million in 2004 (Dolton and Rau 2005). Given the range of these data, it appears that hunters may be poisoning a significant number of mourning doves with lead pellets each year.

Available information indicates that most dove hunters would not favor additional lead shot restrictions for dove hunting (Levengood et al. 1999, Schulz et al. 2006*b*). We contend the continued use of lead shot may be indefensible from an increased crippling rate argument. Therefore, we suggest that the first step in contemplating nontoxic-shot restrictions for mourning dove hunting should be a detailed strategic plan for outlining the development and implementation of the policy and a detailed and reasonable timetable. The planning process must include participation by all stakeholders for the ultimate outcome to be successful.

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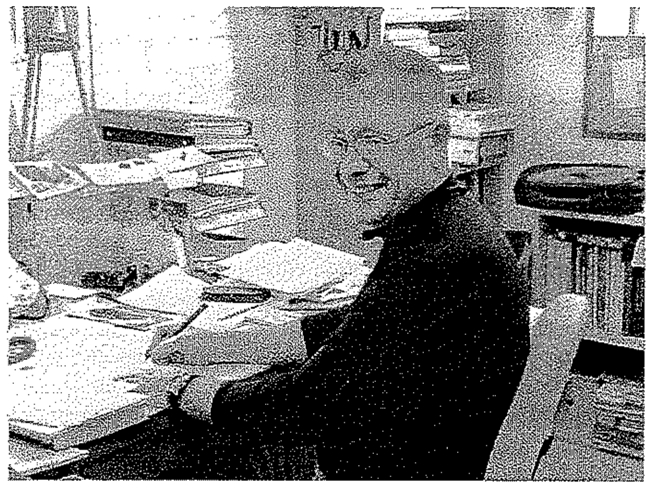

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