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Shot Ingestion by Wintering Female Northern Pintails (*Anas acuta*) in the Texas Coastal Plain, 2012–14

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ABSTRACT: Historically, lead poisoning through lead shot ingestion was one of the largest health issues affecting waterfowl in North America. Lead shot was banned for use in waterfowl hunting in the US in 1991 and was banned in Canada in 1997. However, biologists need to understand how, and if, lead shot remaining in the environment will continue to impact waterfowl. Our goal was to estimate lead and nontoxic shot consumption by female Northern Pintails (*Anas acuta*) wintering along the Texas coast. We found shot or metal fragments (or both) in the gizzards of 39 (17%) of 227 female Northern Pintails collected along the Texas coast. Of these, lead shot was found in seven gizzards, steel shot was found in 24 gizzards, and other metal and fragments were found in 20 gizzards. Some females consumed multiple shot types. Overall, shot (lead and nontoxic combined) ingestion rates were similar to those found prior to the lead shot ban in Texas (14%) and Louisiana (17%); however, lead shot ingestion rates were considerably lower, suggesting that it is becoming less available over time. All Northern Pintails that had lead shot in their gizzards were collected from coastal habitats. While it seems that lead shot ingestion by Northern Pintails has decreased since the ban was put in place, monitoring lead shot ingestion rates from different regions will provide insight into its availability in different habitats and under various environmental conditions.

Key words: Lead poisoning, metal ingestion, Northern Pintail, Texas coast.

Historically, lead poisoning has been a major mortality factor in North American waterfowl populations (Bellrose 1959). Since the first report of lead poisoning in Texas in 1874, large-scale mortality from lead toxicosis has been documented in waterfowl in every North American flyway (Phillips and Lincoln 1930; Bellrose 1959). Twenty-five species of waterfowl have been reported to have experienced lead poisoning, and an estimated 2–3% of all waterfowl died annually from its effects between 1938 and 1954 (Bellrose 1959). Lead shot was banned for waterfowl hunting in many states by 1987 because of relatively high avian mortality, declines in waterfowl populations, and lead poisoning of other species. Lead shot was banned for hunting waterfowl throughout the remainder of the US in 1991 and throughout Canada in 1997.

Lead has a negative impact on most body systems but most-noticeably affects nervous and digestive functions (Wobeser 1997). Consequently, numerous studies measuring the presence of lead shot in waterfowl gizzards were completed prior to the lead shot ban and were summarized by Sanderson and Bellrose (1986). Studies following the lead shot ban have documented declines in exposure of waterfowl to lead (Anderson et al. 2000; Samuel and Bowers 2000); however, lead may persist in the environment for decades (Webb 2009; Flint and Schamber 2010). These studies have indicated the need for continued monitoring of lead shot availability to waterfowl and other wildlife (Webb 2009; Flint and Schamber 2010).

Rates of lead shot ingestion by Mottled Ducks (*Anas fulvigula*) along the Texas coast have been as high or higher than rates of other species of ducks prior to the lead shot ban (Merendino et al. 2002). These high rates of ingestion likely are tied to the large amount of shot deposited in Texas

TABLE 1. Numbers (%) of female Northern Pintails (*Anas acuta*) that had lead or nonlead metal in their gizzards that were collected along the Texas coast, October–March 2012–14.

Year	Age	*n*	Lead	Iron-containing shot	Other metal
2012–13	Juvenile	47	1 (2)	6 (13)	4 (9)
	Adult	54	1 (2)	1 (2)	4 (7)
	Total	101	2 (2)	7 (7)	8 (8)
2013–14	Juvenile	67	2 (3)	11 (16)	6 (9)
	Adult	59	3 (5)	6 (10)	6 (10)
	Total	126	5 (4)	17 (13)	12 (10)
2012–14	Juvenile	114	3 (3)	17 (15)	10 (10)
	Adult	113	4 (4)	7 (6)	10 (9)
	Total	227	7 (3)	24 (11)	20 (9)

coastal marshes (Fisher et al. 1986) and the nonmigratory behavior of Mottled Ducks (Stutzenbaker 1988). Garrison et al. (2011) found that none of 98 Green-winged Teal (*Anas carolinensis*) and one of 84 Northern Shovelers (*Anas clypeata*) sampled along the Texas coast had consumed lead shot. Similarly, Fedynich et al. (2007) found relatively low concentrations of lead (0.12 ± 0.20 [mean $\pm$ SD]; 0.012–1.79 range [μg/g ww]) in livers of Blue-winged Teal (*Anas discors*) migrating through southern Texas.

The Northern Pintail (*Anas acuta*) is a common dabbling duck that winters along the Texas coast (Bellrose 1980). Recent research along the Texas coast has indicated that Northern Pintails exhibit lower body mass and lower survival rates compared to Northern Pintails wintering in other areas (Ballard et al. 2006; Anderson 2008). As part of a larger study investigating several aspects of nutritional ecology of female Northern Pintails wintering along the Texas coast, we estimated lead ingestion rates to assess the potential for lead poisoning as a possible cause for low body condition and low survival of Northern Pintails.

We collected female Northern Pintails by shooting 15 October–15 March in 2012–13 and 2013–14 in 12 counties within the Texas Coastal Plain. The Texas Coastal Plain includes 26 counties and is roughly 580 km long with bays and estuaries covering 1.05 million ha (Brown et al. 1980). Freshwater habitats (e.g., freshwater marsh and rice fields) also are included in the Texas Coastal Plain. Age and gender of each individual were determined by inspection of wing plumage (Carney 1992). The gizzard was removed during necropsy, and contents were emptied into 70% ethyl alcohol in plastic storage bottles labeled with the identification number of each individual. Given our method of collection, gizzards with pellet entry wounds were excluded from our analysis. Contents of each gizzard were separately emptied onto a 600-μm mesh screen, rinsed, and all metal shot and fragments were removed for identification. Iron-containing shot and fragments were removed with a magnet. To separate other nontoxic shot and fragments from lead, each pellet or fragment was individually placed in a glass vial containing 6M HCl and placed in a hot water bath for 3 h until all metal was dissolved. Then, 1 M K_2CrO_4 was added; a yellow precipitate formed if lead was present (Garrison et al. 2011). Fragments not positive for lead were classified as 'other metal'. We assumed that metal fragments were fragments of shot that were partially broken down by the grinding action of the gizzard or by weathering from the environment.

We found shot or metal fragments in 39 (17%) gizzards of the 227 female Northern Pintails collected. Of these, seven (3%) females contained lead shot (Table 1). Twenty-four (11%) gizzards had steel-containing nontoxic shot and 20 gizzards (9%) contained other metal (other nontoxic shot and metal fragments). Other metal was found in eight (8%) individuals in 2012–13 and 12 (10%) in 2013–14 (Table 1).

Ingestion of shot in Northern Pintails remained similar to rates documented prior to the lead shot ban; however, ingestion of lead shot has declined to ~30% of rates prior to the ban. Before the ban on lead shot, 9% to 10% of Northern Pintails sampled in various areas of North America contained lead (Bellrose 1959; Sanderson and Bellrose 1986).

Although rates of lead shot consumption have declined, lead can remain available in the environment for many years. Flint and Schamber (2010) found that it may take >25 yr for lead shot to settle out of reach of waterfowl in tundra wetlands. These findings were consistent with Webb (2009), who found similar amounts of lead available on Halowell Reservoir, Arkansas, 17 yr after the ban of lead shot. We found that lead still remains available to migratory waterfowl that winter in Texas coastal wetlands 23 yr after the lead shot ban. This may be partly due to lead continuing to be deposited in the environment through other means. Upland game bird hunting and fishing tackle are both potential contributors to the continued availability of lead in the environment (Castrale 1989; Franson et al. 2003).

Based on our sampling protocol, we were unable to determine where Northern Pintails were obtaining lead shot. However, our findings that juveniles had similar ingestion rates as adults suggest that lead consumption occurred along the Texas coast or areas to the north, as juveniles have only made a single trip from temperate breeding areas to winter in Texas. This is similar to findings by Fedynich et al. (2007) that juvenile Blue-winged Teal making their first migration through southern Texas had low concentrations of lead in their livers, suggesting that lead was acquired in regions that are north of southern Texas. Regardless of where this exposure occurred, some lead shot is still being acquired by Northern Pintails. Although lead shot continues to be consumed by Northern Pintails, consumption is considerably lower than it was prior to the lead shot ban. The 3% ingestion rate of lead shot we found for female Northern Pintails does not appear to be sufficient to explain lower survival rates for Northern Pintails along the Texas coast. However, continued monitoring of Northern Pintails and other species of waterfowl is necessary to understand the prevalence and availability of lead shot in the environment.

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LITERATURE CITED

Anderson JT. 2008. Survival, habitat use, and movements of female Northern Pintails wintering along the Texas coast. MSc Thesis, Texas A&M University-Kingsville, Kingsville, Texas, 130 pp.

Anderson WL, Havera SP, Zercher BW. 2000. Ingestion of lead and nontoxic shotgun pellets by ducks in the Mississippi Flyway. *J Wildl Manage* 64:848–857.

Ballard BM, Thompson JE, Petrie MJ. 2006. Carcass composition and digestive tract dynamics of Northern Pintails wintering along the lower Texas coast. *J Wildl Manage* 70:1316–1324.

Bellrose FC. 1959. Lead poisoning as a mortality factor in waterfowl populations. *Ill Nat Hist Sur Bull* 27:235–288.

Bellrose FC.1980. *Ducks, geese and swans of North America*, 3rd Ed. Stackpole Books, Harrisburg, Pennsylvania, 540 pp.

Brown LF Jr, Brewton JL, Evans TT, McGowen JH, White WA, Groat CG, Fisher WL. 1980. *Environmental geologic atlas of the Texas coastal zone*. The University of Texas at Austin, Bureau of Economic Geology, 7 atlases, 783 pp.

Carney SM. 1992. *Species, age and sex identification of ducks using wing plumage*. US Department of the Interior, US Fish and Wildlife Service, Washington, DC, 144 pp.

Castrale JS. 1989. Availability of spent shot in fields managed for dove hunting. *Wildl Soc Bull* 17:184–189.

Fedynich AM, Ballard BM, McBride TJ, Estrella JA, Garvon JM, Hooper MJ. 2007. Arsenic, cadmium, copper, lead, and selenium in migrating Blue-winged Teal (*Anas discors* L.). *Arch Environ Contam Toxicol* 55:662–666.

Fisher FM Jr, Hall SL, Welder WR, Robinson BC, Lobpries DS. 1986. An analysis of spent shot in Upper Texas coastal waterfowl wintering habitats. In: *Lead poisoning in wild waterfowl*, Feierabend JS, Russell AB, editors. National Wildlife Federation, Washington, DC, pp. 50–60.

Flint PL, Schamber JL. 2010. Long-term persistence of spent lead shot in tundra wetlands. *J Wildl Manage* 74:148–151.

Franson JC, Hansen SP, Creekmore TE, Brand CJ, Evers DC, Duerr AE, DeStefano S. 2003. Lead fishing weights and other fishing tackle in selected waterbirds. *Waterbirds* 26:345–352.

Garrison DA, Fedynich AM, Smith AJ, Ferro PJ, Butler DA, Peterson MJ, Lupiani B. 2011. Ingestion of lead and nontoxic shot by Green-winged Teal (*Anas crecca*) and Northern Shovelers (*Anas clypeata*) from the mid-Gulf coast of Texas, USA. *J Wildl Dis* 47:784–786.

Merendino MT, Lobpries DS, Neaville JE, Ortego JD, Johnson WP. 2002. Regional differences and long-term trends in lead exposure in Mottled Ducks. *Wildl Soc Bull* 33:1002–1008.

Phillips JC, Lincoln FC. 1930. *American waterfowl: Their present situation and outlook for their future*. Houghton Mifflin Company, Boston, Massachusetts, and New York, New York, 312 pp.

Samuel MD, Bowers EF. 2000. Lead exposure in American Black Ducks after implementation of non-toxic shot. *J Wildl Manage* 64:947–953.

Sanderson GC, Bellrose FC. 1986. A review of the problem of lead poisoning in waterfowl. *Ill Nat Hist Surv Spec Publ* 4:1–34.

Stutzenbaker CD. 1988. *The Mottled Duck: Its life history, ecology and management*. Texas Parks and Wildlife Department, Austin, Texas, 209 pp.

Webb E. 2009. Effect of soil disturbance on lead shot available to waterfowl. *Faculty Research Grant Report, Arkansas Tech University*. Arkansas Tech University, Russellville, Arkansas, 10 pp.

Wobeser GA. 1997. *Diseases of wild waterfowl*, 2nd Ed. Plenum Press, New York, New York, 324 pp.

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