

# Lead Shot Consequences: Environmental Issue Changes Legislation



**SUGGESTED GRADE LEVELS:** MS, HS

**SUBJECTS:** Science

**SKILLS:** analysis, computation, graphing

**CORRELATION TO NEXT GENERATION SCIENCE**

**STANDARDS:** MS-LS2-1, MS-LS2-4, HS-LS2-2, HS-LS4-5

## Objectives

Students will: 1) understand that changes occur in waterfowl population numbers; and 2) comprehend how an environmental contaminant, lead shot, may have contributed to a decline in waterfowl population numbers.

## Method

Using long-term data sets collected by the Illinois Department of Natural Resources, students will graph population changes in fall waterfowl populations and percent of ducks that contain lead shot pellets.

## Background

Lead is a highly toxic environmental pollutant. Effects range from developmental and cognitive problems to death. Lead, in the form of shotgun shot and fishing sinkers, contributes to lead poisoning of wildlife, especially waterfowl (ducks, geese and swans), loons and raptors (hawks and owls).

How do birds ingest lead? Tiny lead shots that miss their target fall into waterways or are scattered across the land. The shots are picked up by waterfowl as they dive or graze for food. Larger birds, such as diving ducks and loons, are more likely to swallow lead sinkers. In the acidic stomach, the lead is released from the shot/sinkers, enters the bloodstream and is transported throughout the body.

Lead poisoning is debilitating, slow and painful. Lead interferes with the central nervous system, even at low levels. Lead is held in the bird's gizzard and is slowly absorbed into the blood. Lead poisoning causes deterioration of voluntary muscle tissues, the liver and kidneys, distension of the gall bladder, erosion of the gizzard's grinding surface and anemia, a medical condition that weakens the animal due to a lack of oxygen reaching cells. Affected birds often

seek to be alone and find cover to hide in. It may take weeks for a bird to die from lead poisoning, and its weakened condition makes it easy prey for predators.

Secondary poisoning of birds of prey can occur far from the original site of lead contamination. Even if lead ingestion does not directly cause death, it can affect survival by altering normal behavior and reproductive viability and by promoting susceptibility to disease.

A phased plan designed to reduce use of lead shot in the United States was initiated in 1986 and completed in 1991. Before the 1991 ban on lead shot, it was estimated that two to three percent of the waterfowl population (1.5 to 3 million birds) in the United States died each year from lead poisoning. Nontoxic alternatives to lead shot include steel and bismuth. Steel and bismuth have different ballistic characteristics (effects, firing and flight of shells) than lead, and training hunters in their use is essential to avoid equipment damage and crippling of target species.

In Illinois, lead poisoning did not cause a large decline in waterfowl populations. Die-offs were documented, but they were local phenomena that did not have a large impact.

## Literature Cited

Anderson, W. L. and S. P. Havera. 1989. Lead poisoning in Illinois waterfowl (1977-1988) and the implementation of nontoxic shot regulations. *Illinois Natural History Survey biological notes no. 133*. Champaign, Illinois. 37 pp.

Mills, H. B., Starrett, W. C. and F. C. Bellrose. 1966. Man's effect on the fish and wildlife of the Illinois River. *Illinois Natural History Survey biological notes no. 57*. Urbana, Illinois. 24 pp.

Pain, D. J., ed. 1992. *Lead poisoning in waterfowl*. Proceedings of an International Waterfowl and Wetland Research Bureau Workshop, Brussels, Belgium, 13-15 June 1991.

Robinson, W. L. and E. G. Bohlen. 1984. *Wildlife ecology and management*. Macmillan Publishing, New York. 478 pp.

Sanderson, G. C. and F. C. Bellrose. 1986. A review of the problem of lead poisoning in waterfowl. *Illinois Natural History Survey special publication 4*. Champaign, Illinois. 34 pp.

## Materials

copies of “Lead Shot Data” student activity page; graph paper; calculator; colored pencils or markers

## Procedure

1. Discuss the lead shot problem with students, emphasizing how birds acquire lead shot pellets and what lead poisoning does to the birds. You may want to review the structure of a bird’s digestive tract as well. Distribute copies of the “Lead Shot Data” student activity page. Have students calculate the percent of gizzards containing lead shot for each year and the totals. Each student will prepare a bar graph that compares the percent of gizzards containing lead each year for each river. The birds from which river seem to have a greater ingestion rate of lead over this time period? Have students postulate why these results may have occurred.
2. Data collected nationwide in the period 1939-1984 show that mallards (*Anas platyrhynchos*), Canada geese (*Branta canadensis*), snow geese (*Chen caerulescens*) and northern pintails (*Anas acuta*) were the waterfowl species most likely to suffer large die-offs due to lead poisoning. Research the behaviors of these species (feeding, resting and others) to try to develop an explanation for this phenomenon. You may want students to also research the behaviors of other common waterfowl species to see how they differ from the four species listed above.
3. One study of the top five centimeters of tilled soil near duck blinds (places where hunters hide to shoot ducks) found an average of 0.61 lead shot pellets per plot (using 100 plots, each 930 centimeters square). How many pellets could be expected to be found in one square mile?
4. Give students the fall peak populations of canvasbacks (*Aythya valisineria*) and lesser scaups (*Aythya affinis*) along the Illinois and Mississippi rivers from the period 1950-1995 that is shown in Table 1. Have students prepare a graph for each species that depicts the changing population numbers over this time period and then answer these questions.
  - Which river seems to be supporting the most canvasbacks? Lesser scaups?
  - Historically, the Illinois River was the migratory route for both of these species, providing a resting area and tremendous food supply. Your graph shows a switch to the Mississippi River. At approximately what year did this switch occur?

- At the beginning of the twentieth century many changes began occurring in the Illinois River. Industrial and residential sewage from the Chicago and Peoria/Pekin areas was dumped into the river. Increased use of row crop agriculture and construction practices contributed to the addition of tons of silt in the water. A system of locks and dams was constructed that slowed water flow in the river and allowed silt loads to drop out along the banks. By the late 1940s through the mid-1950s many aquatic plant species and many invertebrate species, particularly fingernail clams and snails were rarely found in the river north from Beardstown. Research the preferred diet of canvasbacks and lesser scaups. Could this change in flora and fauna in the river have contributed to the shift in location of the migrating birds? Explain.
- The graph indicates that even though the species have switched locations, they are declining in numbers. What factors could contribute to the continued population losses of these species? (depending on food source that is not preferred, depending on declining food source, movement of flocks to areas where more food is available, problems on the breeding or wintering grounds, habitat loss)
- Researchers have estimated that two to three percent of waterfowl died each year as a result of lead poisoning. Using the population counts for canvasbacks and lesser scaups, have students calculate the loss of three percent from each year for the period 1950-1990. What would the combined total loss of these ducks have been at the three percent level?

## Extensions

1. Have the students research the effects of lead on both humans and wildlife. What are the similarities in symptoms and side effects?
2. Research the legislation and policies that lead to a ban on lead shot.
3. Have students research the legislation and policies concerning lead fishing sinkers. Ask them to write an opinion paper in regard to this issue.
4. Ask students to research how the development of the Emiquon National Wildlife Refuge has affected the numbers and species of waterfowl using the Illinois River.

## Evaluations

1. Students should describe why lead shot and lead sinkers are problems and how lead poisoning affects waterfowl.
2. Students should complete the graph and summarize their findings in one paragraph. They should include a statement about how the reduced numbers of birds many years ago can affect population sizes now.



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**Table 1**

canvasback			lesser scaup		
Year	Illinois River Population	Mississippi River Population	Year	Illinois River Population	Mississippi River Population
1950	81,090	2,710	1950	184,020	155,720
1955	15,240	12,500	1955	78,150	310,750
1960	2,320	22,075	1960	14,250	247,525
1965	1,825	51,000	1965	6,660	265,460
1970	770	168,355	1970	3,815	198,800
1975	1,225	105,780	1975	8,665	152,360
1980	2,895	147,190	1980	13,775	313,635
1985	6,720	77,855	1985	34,405	219,700
1990	3,330	56,845	1990	12,925	35,690
1995	900	49,500	1995	500	22,250

Name: \_\_\_\_\_

**Incidence of Ingested Lead Shot Pellets in Mallards Harvested along the Mississippi River in Illinois, 1979-1985**

Year	Number of Gizzards	Gizzards with Lead Shot Present	Percent of Birds Containing Lead Shot
1979	288	23	
1980	915	23	
1981	985	31	
1982	1,060	26	
1983	145	1	
1985	103	8	
<b>Total</b>			

**Incidence of Ingested Lead Shot Pellets in Mallards Harvested along the Illinois River in Illinois, 1979-1985**

Year	Number of Gizzards	Gizzards with Lead Shot Present	Percent of Birds Containing Lead Shot
1979	2,484	195	
1980	2,183	129	
1981	724	27	
1982	259	7	
1983	315	12	
1985	250	13	
<b>Total</b>			