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Lead Poisoning of Spectacled Eiders (*Somateria fischeri*) and of a Common Eider (*Somateria mollissima*) in Alaska

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ABSTRACT: Lead poisoning was diagnosed in four spectacled eiders (*Somateria fischeri*) and one common eider (*Somateria mollissima*) found dead or moribund at the Yukon Delta National Wildlife Refuge, Alaska (USA) in 1992, 1993, and 1994. Ingested lead shot was found in the lower esophagus of one spectacled eider and in the gizzard of the common eider. Lead concentrations in the livers of the spectacled eiders were 26 to 38 ppm wet weight, and 52 ppm wet weight in the liver of the common eider. A blood sample collected from one of the spectacled eiders before it was euthanized had a lead concentration of 8.5 ppm wet weight. This is the first known report of lead poisoning in the spectacled eider, recently listed as a threatened species by the U.S. Fish and Wildlife Service.

Key words: Lead poisoning, eider, *Somateria fischeri*, *Somateria mollissima*, Alaska.

Lead poisoning has been a cause of mortality in many species of waterfowl; it is due primarily to ingestion of spent lead shot (Bellrose, 1959; Sanderson and Bellrose, 1986; Pain, 1992). Although reports of lead shot ingestion in sea ducks are rare, Clausen and Wolstrup (1979) diagnosed lead poisoning in a common eider (*Somateria mollissima*) from Denmark. Here, we report lead poisoning of a common eider and of four spectacled eiders (*Somateria fischeri*) collected at the Yukon-Kuskokwim (Y-K) Delta in Alaska (USA). Although ingested lead shot were observed in one black turnstone (*Arenaria melanocephala*) and one spectacled eider found on the Y-K Delta in 1978 (C. Dau, pers. comm.), little is known regarding shot availability and ingestion in this region. This is the first published account of lead poisoning for the spectacled eider, listed as a threatened species by the U.S. Fish and Wildlife Service in 1993.

Three moribund spectacled eiders and one dead common eider were found near the Kashunuk River (61°17′N, 165°37′W) on the Yukon Delta National Wildlife Refuge (Refuge), Alaska. The common eider was collected on 8 July 1992 and the spectacled eiders were found on 6 July 1992, 21 July 1993, and 16 July 1994, respectively. On 12 June 1994, a dead spectacled eider was found on Kigigak Island (60°50′N, 165°00′W), also within the Refuge. Blood (2 ml) was collected from the sick spectacled eider found in 1994 in a sodium heparinized evacuated glass tube (Becton Dickinson, Rutherford, New Jersey, USA). The moribund spectacled eiders were euthanized by cervical dislocation and all five carcasses and the blood sample were sent to the National Wildlife Health Center, Madison, Wisconsin (USA).

The three spectacled eiders found near the Kashunuk River were in poor body condition with only trace amounts of subcutaneous and coronary fat and weighed 1,025 g, 1,050 g, and 1,350 g, respectively. The spectacled eider found on Kigigak Island had moderate fat reserves and weighed 1,260 g. Seven pieces of lead shot (2 to 4 mm in diameter) were present in the lower esophagus of the spectacled eider found in 1993 and its liver was bile stained. No ingested shot or metal was found in the other spectacled eiders, but the gizzard lining of the bird from Kigigak Island was bile stained. No gross lesions, other than emaciation, were observed in the other two spectacled eiders. The common eider weighed 1,540 g and had no fat reserves. Its esophagus was impacted with tubers and mussel shells and two pieces of lead shot (each 3 mm in diameter) were

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recovered from gizzard contents. All five birds were adult females.

Livers from the spectacled eider and common eider collected in 1992 were analyzed for lead as described by Locke et al. (1991). The livers from the spectacled eiders collected in 1993 and 1994 were analyzed similarly, but with the addition of the following microwave digestion procedure. Livers were partially thawed and diced into small sections with a stainless steel scalpel blade. A 2 g sample was weighed into a microwave vessel with 5 ml of concentrated nitric acid. The sample was digested in an MDS-2000 microwave oven (CEM Corporation, Matthews, North Carolina, USA) in two stages to 7.0 kg/cm^2 over a period of 15 min. The digested sample was diluted to 10 ml with deionized water. Standards containing lead in concentrations of 1.0, 2.5, and 5.0 μg/ml were prepared and analyzed with the sample at 217 nm on a Model 2380 Perkin Elmer atomic absorption spectrophotometer (Perkin Elmer Corporation, Norwalk, Connecticut, USA). The blood sample collected from the spectacled eider found at the Kashunuk River in 1994 was analyzed according to DeStefano et al. (1991). The lower limit of detectable lead residue was 0.25 ppm wet weight for liver and 0.02 ppm wet weight for blood. The mean recovery of lead from control samples of liver and blood was 97% and 100%, respectively, of known concentrations.

Samples of liver and intestine from the common and spectacled eiders collected in 1992 and liver from the spectacled eiders collected in 1994 were inoculated onto 5% sheep blood agar plates and into selenite broth (Difco Laboratories, Incorporated, Detroit, Michigan, USA) and incubated at 37 C for 72 hr. Bacterial isolates were identified by biochemical characteristics with the API-20E system (Analytab Products, Plainview, New York, USA). Liver and intestine from both birds collected in 1992 and from one bird collected in 1994 were inoculated onto duck embryo fibroblasts (Docherty and Slota, 1988) and embryonating chicken eggs (Senne, 1989) for virus isolation attempts. Heart blood from the spectacled eider collected in 1992 was tested for avian botulism with the mouse protection test (Quortrup and Sudheimer, 1943). Liver, kidney, lung, heart, and skeletal muscle from the spectacled eiders collected in 1992 and 1994 were fixed in 10% neutral buffered formalin for 24 hr and embedded in paraffin. Sections 5 μm thick were stained with hematoxylin and eosin for light microscopy. Sections of heart muscle were stained with Masson's trichrome (Masson, 1929) to characterize the extent of fibrosis. Tissues from the other eiders were too autolyzed for microscopic evaluation.

The liver lead concentrations of the two birds with ingested shot, the common eider found near the Kashunuk River in 1992 and the spectacled eider found in the same area in 1993, were 52 and 38 ppm wet weight, respectively. The spectacled eider collected at the Kashunuk River in 1992 had a liver lead concentration of 29 ppm wet weight. Blood and liver lead concentrations from the spectacled eider found at the Kashunuk River in 1994 were 8.5 and 36 ppm wet weight, respectively, and the spectacled eider found on Kigigak Island in 1994 had 26 ppm wet weight lead in its liver. On microscopic examination of tissues, there were no significant changes except within cardiac muscle from the spectacled eider collected in 1992. Noninflammatory changes were found throughout the heart of this bird; these were characterized by replacement of muscle fibers with bands of collagen and large areas of fibrosis that entrapped small cardiac myofibers. More acutely affected myocardium exhibited loss of cross striations. Occasional vessels had hypertrophy of the tunica media and endothelial cells were prominent. The endocardium was thickened and subendocardial veins were dilated. Fibrinoid necrosis of the media of arterial walls, a lesion often associated with lead poisoning in waterfowl (Karstad, 1971), was absent in this case. However,

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chronic exposure to lead may have contributed to the chronic fibrosing cardiomyopathy that was observed.

Heart blood from the spectacled eider collected in 1992 was negative for avian botulism toxin. *Escherichia coli* was recovered only from the intestine of the common eider and was considered an incidental finding. No bacteria or viruses were isolated from the other tissues tested.

Except for emaciation in four carcasses and bile staining of the liver or gizzard lining in two carcasses, gross lesions typical of lead poisoning in waterfowl (Clemens et al., 1975; Coburn et al., 1951; Cook and Trainer, 1966) were absent. The diagnosis of lead poisoning in these eiders was based on the poor body condition, the presence of ingested lead shot in two of the birds, and liver lead concentrations well above 8 ppm wet weight; such high levels in the liver are consistent with lead poisoning in waterfowl (Friend, 1985). Although no ingested shot was found in the spectacled eiders collected in 1992 and 1994, the high liver lead concentrations in both birds and the elevated blood lead concentration in the bird collected in 1994 were evidence of metallic lead exposure. The diagnosis was further supported by the histologic observation of cardiac muscle fibrosis in one bird. These spectacled eiders may have ingested shot or metallic lead that was dissolved by the grinding action of the gizzard or was passed through the intestinal tract (Franson et al., 1986).

In 1992, common and spectacled eiders arrived at the Y-K Delta on 21 May and were common by 30 May; thus, we believe that the two eiders found that year had been in the area about 5 to 6 wk before they were collected. The spectacled eider found in 1993 was a marked bird that nested and raised a brood on the Refuge. She was observed on 25 May, and thus was in the area at least 8 wk before she was found moribund. Mortality of waterfowl from lead poisoning often occurs within 3 wk of exposure to lead shot (Franson et al., 1986; Friend, 1985). We propose, therefore, that the eiders ingested the lead shot after their arrival on the Y-K Delta, but the source of the shot is unknown.

Waterfowl traditionally are taken by subsistence hunters in the vicinity of the Y-K Delta, historically by various aboriginal methods and more recently with modern firearms (Klein, 1966). The most intensive hunting occurs during the early spring immediately after the birds start arriving on the tundra and Klein (1966) estimated that a total of 126,500 waterfowl was taken during the spring and fall hunting periods in 1964. Although additional species are included in current estimates, precluding absolute comparison with Klein (1966), evidence for continued hunting is provided by the mean annual estimated take of 71,700 waterfowl from 1985 to 1993 (C. Wentworth, pers. comm.).

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