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OUTBREAK OF AVIAN CHOLERA ON THE WINTERING GROUNDS OF THE MISSISSIPPI VALLEY CANADA GOOSE FLOCK¹

Ronald M. Windingstad,² Ruth M. Duncan,² and Dennis Thornburg³

ABSTRACT: Avian cholera is reported for the first time in Canada geese, *Branta canadensis*, of the Mississippi Valley population. The disease was detected in weekly surveillance transects and was responsible for the loss of about 850 geese during the winter of 1978-1979 at localized areas in southern Illinois. Necropsies performed on 480 geese that died at Union County Conservation Area and on 133 birds at Horseshoe Lake Conservation Area during January and February 1979 revealed that the majority of losses (64%) were caused by avian cholera. Lead poisoning was responsible for the death of 14% of the geese analyzed and the remaining 22%, most of which were decomposed, were undiagnosed. Lethal lead levels and *Pasteurella multocida* occurred concomitantly in a few instances.

INTRODUCTION

Concern for Canada geese in the Mississippi Valley has resulted in intensive management of this population. The National Wildlife Health Laboratory (NWHL) began surveying this population for early detection of contagious diseases in 1976. Transects for this purpose were established at selected sites in east central Wisconsin and southern Illinois. These areas are used by Canada geese primarily during fall migration and winter (Hanson and Smith, 1950; Craven, 1978). This paper describes an avian cholera outbreak that occurred in January and February 1979 on two areas in southern Illinois. Avian cholera losses were apparently restricted to these two locations and the disease was not found to be a problem in any of the other areas used by these geese.

MATERIALS AND METHODS

During the winter of 1978-1979 selected areas of shoreline were established as disease surveillance transects on three areas used by geese in southern Illinois: Union County Conservation Area, Horseshoe Lake Conservation Area and Crab Orchard National Wildlife Refuge. No diseased birds were found at the latter transect area that winter and it will not be discussed further. Transects at each location consisted of at least 500 m of shoreline that was checked on foot or by canoe at least once each week. Two major lakes, Grassy (140 ha) and Lyerla (110 ha), accounted for most of the wetland on the state-owned

Union County area. These lakes froze by mid-winter, but two smaller ponds, Barker Lake and Alden Pond, were kept open by pumping and were used by geese during the coldest weather. Horseshoe Lake Conservation Area is also state-owned. The lake covers 970 ha with 32 km of shoreline. An artificial pond less than 2 ha in area was maintained in an open field adjacent to the lake to attract geese to a walk-in trap for banding.

Birds found dead were sent to the NWHL for necropsy. After a diagnosis of avian cholera was established and *Pasteurella multocida* was recovered, further diagnoses were made on the basis of field necropsies. A provisional field diagnosis of avian cholera was based on the presence of petechial and/or ecchymotic hemorrhages on the heart surface and/or focal liver necrosis. Carcasses were sent periodically to NWHL to confirm field diagnosis and for detection of other diseases. Geese that were emaciated and/or had proventricular impaction were considered as lead poisoning suspects. Gizzards were saved for later analysis of lead pellet content. Livers were removed from birds with suspected lead toxicosis, placed in individual bags, frozen and returned to the laboratory for lead level analysis by atomic absorption spectrophotometry as described by Locke et al. (1982). Concentrations of lead equal to, or greater than 6 ppm (wet weight) or 18 ppm (dry weight) accompanied by appropriate gross lesions were considered diagnostic of lead poisoning.

RESULTS

Collection of carcasses began along the Union County transects on 14 December 1978; by 15 January 1979, 45 dead Canada geese had been found. Laboratory examination revealed that lead poisoning and gunshot were responsible for most of these losses. At this time, Grassy Lake was entirely frozen and an estimated 40,000 geese were utilizing the area of Barker Lake that remained open because of pumping of ground water. On 16 January 39 dead geese were found on Barker Lake. Thirteen of these were sent to the NWHL, where three were

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TABLE 1. Age and sex of Canada geese trapped at Horseshoe Lake and of geese that died of avian cholera in the trap in 1979.

Age/sex	Live trapped (%) ^a	Dead of avian cholera (%)
Immature males	36 (11)	26 (27)
Immature females	30 (9)	22 (23)
Adult males	139 (43)	26 (27)
Adult females	118 (37)	22 (23)
All geese	323 (100)	96 (100)

^a Geese trapped 1 wk prior to avian cholera die-off (Trost, pers. comm.).

found to have died from avian cholera. From 16 January to 15 February when the die-off ceased, 480 geese from Union County were examined, of which 61% had lesions typical of avian cholera, and 14% were diagnosed as probable cases of lead poisoning. Cause of death was undetermined for 22% because of carcass decomposition. Based upon actual carcass recovery we estimate that about 750 geese died of avian cholera during this epizootic.

Transects were initiated at Horseshoe Lake on 19 December. By 5 February, 27 carcasses had been found and submitted to NWHL for necropsy. Lead poisoning (11), emaciation (7), and gunshot (4) were the major causes of mortality. On 1 February, an estimated 25,000 Canada geese were on the area, with 2,000 at or near the walk-in trap. Temperatures were sub-freezing and on 5 February, 10 geese were found dead at the trap site. Their deaths were attributed to exposure and lead poisoning. On 8 February an estimated 7,000 geese were concentrated on less than 1 ha of water surrounding the traps, and 20 dead geese were collected. On 9 February, 38 carcasses were retrieved, 33 of which were from inside the trap. The majority of birds were frozen for shipment to the NWHL for necropsy and laboratory tests. Four birds recovered from the trap were examined in the field and a provisional diagnosis of avian cholera made. Between 1 and 15 February, 119 geese died in the area. Of the 103 necropsied from 8 to 15 February, 98 were provisionally diagnosed as avian cholera. The remaining five were diagnosed as lead poisoning. About 85% of the birds that died during the epizootic were from within the trap itself. The only geese found dead after the trap was closed were three birds picked up the day after release. One of these

was a neckbanded bird that had been observed inside the trap on 14 February.

Canada geese constituted over 90% of those birds retrieved in the die-off areas. This is indicative of the high proportion of geese using the area as compared to other species of waterfowl. Other species that died from avian cholera included three mallards, *Anas platyrhynchos*, two black ducks, *Anas rubripes*, and one snow goose, *Anser caerulescens*, all from Union County. The earliest recovery of waterfowl other than a Canada goose was a mallard found on 25 January.

Bacteriological examination of the livers of 16 geese collected before the outbreak failed to yield *P. multocida*, whereas the organism was isolated from each of 20 livers examined after onset of the epizootic. No other pathogenic organisms were recovered from these livers or from any of the spleens, intestines, and hearts examined. Heart blood from one goose that was injected intraperitoneally into two Swiss mice killed both within 24 hr and *P. multocida* was isolated from the livers. This organism as well as all other isolates were serologically typed as Heddleston's serotype 1 (Heddleston et al., 1972).

Cloacal swabs (17) were negative for avian influenza and Newcastle disease viruses. Tissues (7) examined for duck viral enteritis (duck plague) virus also were negative.

Lead analysis of 168 livers of geese believed to have died from lead poisoning revealed 101 of these to have levels suggesting lethal exposure. The gizzards of 75 of the birds with lethal levels contained one or more lead shot.

Sex and age of all geese examined were determined when possible (Hanson, 1967). The proportion of immatures that died of avian cholera in the trap was significantly greater than the proportion of young trapped just previous to the beginning of die-off ($\chi^2 = 73.45$, $df = 1$, $P < 0.001$) (Table 1).

DISCUSSION

Avian cholera has been reported in North American wild waterfowl since the 1940's. This is the first recorded occurrence of this disease in the Mississippi Valley Canada goose population. Previous exposure to *P. multocida* among other waterfowl using the area was demonstrated when Donahue and Olson (1969) found that

one of 76 mallards surveyed at Union County exhibited antibodies to *P. multocida* antigens. This mallard, however, was serologically positive to serotype 3 and not to serotype 1, the strain most often involved in outbreaks of avian cholera among waterfowl. The 131 waterfowl examined at Horseshoe Lake in the same year were serologically negative.

Concomitant occurrences of avian cholera and lethal lead levels were found in three instances. One of the first two geese found to have *P. multocida* infection was a bird that had near lethal levels of lead in the liver. Isolation of avian cholera organisms from tissues of birds examined in the field was not attempted; however, lesions indicative of both avian cholera and lead poisoning were rare.

No losses are known to have occurred from avian cholera in this area before 1979, but banding returns indicate that this is not a sympatric population and infection might be introduced from other areas. Squaw Creek National Wildlife Refuge, Missouri, has not experienced heavy losses since 1964 (Vaught et al., 1967), but minimal losses have occurred there as recently as 1976 when avian cholera was diagnosed in 17 snow geese. This could be a possible focus of infection, with the organism being carried over to the Mississippi Valley population by migrating birds. Banding returns on 43 geese that died during this avian cholera epizootic confirmed that interchange occurred between Horseshoe Lake and Union County and that there was mixing of birds from the Eastern Prairie and Mississippi Valley populations.

The avian cholera epizootic may have been the result of several factors: Concentration of birds at the sites involved, trapping stress and/or the severe weather conditions that existed during the period. During the height of the outbreak, the average maximum temperature was -2°C , with the average low temperature being -12°C . In addition, 5 cm or more of snow covered the ground on all but 3 days from 28 January to 11 February making food less available. Aerial surveys on 20 February showed that the Horseshoe Lake area had 35,000 geese present

and Union County was being used by 45,000 birds. More geese were present on 20 February than during the previous few weeks, but warmer temperatures had opened up new water areas, allowing the geese to disperse. After 15 February, no additional losses attributable to avian cholera were found on either of the two study sites or anywhere on this population's migration route to their nesting grounds.

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