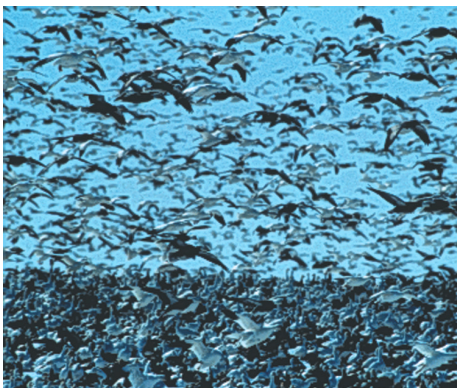


Wetlands, Waterfowl, and Avian Cholera Outbreaks

Biologists from the USGS, in collaboration with other resource agencies, have been working to untangle the ecological complexities of a contagious bacterial disease called avian cholera. Integrated studies on waterfowl and wetland ecosystems have been investigating how avian cholera is maintained and spread across the country. Results implicate birds as the most likely reservoir for perpetuating this deadly disease.



Avian cholera is the most important infectious disease affecting wild North American waterfowl. This disease is the result of infection with the bacterium *Pasteurella multocida*. The bacterium kills swiftly, sometimes in as few as 6-12 hours after infection. Live bacteria released into the environment by dead and dying birds, or by birds carrying the disease, can subsequently infect healthy birds. In addition, dense concentrations of waterfowl can enhance disease transmission to susceptible birds. As a result, avian cholera can spread quickly through a wetland, killing thousands of birds in a single outbreak. Pickup and disposal of carcasses has become the primary management strategy to reduce transmission to susceptible birds.



Avian cholera often affects the same wetlands and bird populations each year. Outbreaks of the disease tend to follow the migration routes of some birds, most notably snow geese in the western and central United States. These disease patterns have caused wildlife biologists to assume the bacterium either lives year round in affected wetlands or is transmitted by carrier birds. To investigate both possibilities, USGS biologists at the National Wildlife Health Center (NWHC) in Madison, Wisconsin, collaborated closely with Federal and State wildlife agencies (USGS, Fish and Wildlife Service, Pacific and Central Flyway states), the Canadian Wildlife Service, Russian nature reserves (Wrangel Island), and non-governmental organizations (Ducks Unlimited, Playa Lakes and Arctic Goose Joint Ventures, British Columbia Waterfowl Society, California Waterfowl Association).

Biologists from NWHC looked for *Pasteurella multocida* in wetlands with avian cholera outbreaks throughout the U.S. In many cases, they were able to isolate the bacterium from samples taken during disease outbreaks. In contrast, samples collected 1-3 months

following winter or spring outbreaks or in the subsequent fall did not contain *P. multocida*. The absence of *P. multocida* in wetland samples collected following outbreaks indicates the bacteria are not likely to survive in the environment long enough to be the source of recurrent annual outbreaks.

Birds that survive infection and become carriers appear to be a more likely source of *P. multocida* for outbreaks and probably play an important role in spreading the disease. To test this carrier hypothesis, biologists initially studied two populations of migratory snow geese that winter in California. The two populations, one that nests on Wrangel Island, Russia, and the other on Banks Island, Canada, both suffer mortality from avian cholera at their wintering grounds in California. Scientists have also reported outbreaks of avian cholera in the nesting colony on Banks Island, but the disease has not been reported on Wrangel Island.

From 1993 through 1996, NWHC researchers collected blood samples from geese nesting at these colonies and tested their sera for antibodies



against *P. multocida*. The presence of antibodies indicated that a bird had been infected with the bacteria, but survived infection. Approximately eight percent of the serum samples collected following outbreaks contained antibodies, compared with three percent of those collected when no outbreaks occurred. Based on results of the serological analysis and other findings from the snow goose research, scientists reached several important conclusions.

The antibody prevalence found following outbreaks indicated that more birds are infected with avian cholera than previously believed and roughly half of the infected birds survive. The birds that survive *P. multocida* infection could be carriers that spread the disease along their migration routes, explaining the tendency of avian cholera to track the movement of migrating waterfowl. However, the presence of antibodies is not conclusive evidence that wild birds are carriers. Antibodies confirm only that these birds were, at one time, infected with the bacteria.

To confirm that carrier birds are important in the transmission of avian cholera, additional research studies were focused on isolating live *P. multocida* from the tissues of healthy birds during the winter. These studies were conducted in the Playa Lakes Region (Texas, Oklahoma, Kansas, Colorado,

and New Mexico) from 2001 through 2002, by testing birds shot during hunting. Serum and swab samples were collected from harvested snow and Ross's geese to test for *P. multocida* antibodies and recover live bacteria. Results confirmed that both species of geese were carriers of the bacterium that causes avian cholera, although prevalence rates were low (< 5%). In addition, these geese had positive antibody tests indicating recent disease infection, with similar prevalence rates for snow (3%) and Ross's (6%) geese.

Another conclusion from this research is that exposure to *P. multocida* can occur in bird populations in seemingly disease-free areas and throughout the year, evidenced by the prevalence of antibodies at non-outbreak nesting areas and on wintering areas. Because antibodies can only be detected for about 3-4 months following infection, we believe that transmission of *P. multocida* among birds occurs during disease outbreaks and as a chronic infection with little visible mortality. These results are significant because experts previously believed almost all infected birds died due to the swift and lethal nature of avian cholera, and that most infection occurred in wintering areas. However, answers are still needed to the pressing questions of when and why low level infection and mortality escalate into mass die-offs in some wetlands and not in others. Future research should focus on carrier birds, their role in disease transmission and outbreaks, and development of strategies that manage birds to reduce disease risks.

The overall results of this collaborative research effort show that snow geese, and probably other species like Ross's geese, are carriers of avian cholera, while providing no evidence to indicate wetlands are the reservoir for *P. multocida* between outbreaks. These results bring the community of wildlife disease researchers and managers closer to understanding the ecology of avian cholera and developing improved strategies to reduce the risk of outbreaks and level of mortality caused by this disease.



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