

WATERFOWL DISEASES --
CHANGING PERSPECTIVES FOR THE FUTURE

Dr. Milton Friend
Director
National Wildlife Health Laboratory
Madison, Wisconsin

Waterfowl, like other birds and animals, are subject to a variety of problems that can be broadly categorized as disease. I'm certain none of you are surprised by this statement, for you have heard about such problems as lead poisoning, avian botulism, avian cholera, DVE (duck virus enteritis), and perhaps other diseases. However, general awareness of the existence of disease and concern for the number of birds being lost is the extent of recognition and perspective usually afforded these problems.

To many waterfowl enthusiasts, disease outbreaks represent random displays of Mother Nature's cussedness. They seem to occur without warning, are often locally devastating, and then vanish like the smoke from a fire. Lost in this perspective is the insidious nature of many diseases and their drain on our waterfowl resource. These outbreaks are not random events; instead they represent the end result of a chain of biological interactions. Stated more simply, disease outbreaks don't just happen! In some instances disease problems are a direct result of man's actions.

Disease problems in waterfowl are no more stable than the world we live in. However, dynamic changes often do not become apparent until they result in a major biological event, such as a catastrophic die-off, or series of die-offs. During the remainder of this presentation the changing role of avian cholera as a disease problem in North American waterfowl will be used to illustrate the transition of a disease from an unknown entity to one of national prominence.

Avian Cholera -- Past, Present and Future

Past. The study of diseases of wildlife is of rather recent origin with the exception of rabies and a small number of other diseases directly affecting man and his domestic animals. Therefore, it is difficult to trace with much certainty the origin of specific disease problems. In the early days of settlement, existing disease problems could have easily been hidden by the vastness of wildlife habitat across the Continent, the sheer numbers of wildlife present, and the relatively small human population available to make observations. Nevertheless, there is a rather rich documentation of historical waterfowl observations that are useful in helping us to reach some conclusions.

History tells us for example, that in my grandfather's lifetime, "wide marshes and uncounted lakes, ponds, potholes, and rivers teemed with ducks, geese, and other fowl. Adventurers and settlers as they moved westward saw great flights of birds, flocks of a size and of kinds beyond the power of most of them to describe but within the power of all to appreciate as sources of meat and pleasure" ... (Briggs, 1964). History also tells us that lead poisoning was known to cause losses among waterfowl in Texas since about 1874, that avian botulism rose to national prominence in 1910 as a cause of waterfowl mortality in the Great Salt Lake Region of Utah, and that aspergillosis was probably responsible for a large die-off of scoters (species unknown) on Brulington Bay, Lake Ontario, in 1875 (Phillips and Lincoln, 1930). Therefore, we can state with certainty that observations of mortality from disease have been reported for more than 100 years in North American waterfowl. We

also know that in many instances investigations were carried out to determine the causes of this mortality and that accurate diagnoses were made.

Avian cholera, fowl cholera, or pasteurellosis has been recognized as a distinct disease for almost 200 years (Rosen, 1971). It was first studied in the United States in 1880, but was described as causing losses of chickens, turkeys, and domestic geese in Iowa as early as 1867 (Heddleston and Rhodes, 1978). We can conclude then, that this disease had been present in the United States for at least three-quarters of a century before the first report of its presence in North American waterfowl in January and February 1944. At that time avian cholera was diagnosed as the cause of mortality in waterfowl wintering in the Texas Panhandle (Quortrup, 1946) and San Francisco Bay area of California (Rosen and Bischoff, 1949).

There is no evidence that avian cholera was present in wild waterfowl at either location before these outbreaks; there are indications, however, that it was not present. Phillips and Lincoln (1930) provide the best compilation of waterfowl disease problems of half-a-century ago in their book, American Waterfowl Their Present Situation and the Outlook for their Future. They noted that although fowl cholera was a common disease in domestic poultry, losses in domestic ducks did not appear to be serious and went on to state that, "We do not have a single well-authenticated case of its occurrence among wild North American waterfowl. It should be watched for, however, as it is a virulent usually fatal and highly infectious disease." Their prophecy has unfortunately come to pass with a vigor that is probably beyond what they anticipated.

Another indication of the absence of avian cholera in wild waterfowl before 1944 is the failure of investigators reporting die-offs during the next few years to report, or make reference to its existence in previous die-offs. Quortrup et al, (1946) stated that their report represented the first authentic record of pasteurellosis in wild ducks.

Source of Infection. If we accept 1944 as the beginning of avian cholera as a disease problem in wild waterfowl, we might ask, where did it come from? I believe the answer is domestic poultry. The first outbreak in waterfowl in California occurred immediately following an avian cholera die-off of domestic fowl in that area (Rosen and Bischoff, 1949). Investigations in the Texas Panhandle disclosed that avian cholera was of frequent occurrence in chicken flocks in the immediate vicinity of the 1944 outbreak. Further, it was found that instead of burning the diseased carcasses, the usual procedure was to discard them along the highways. This practice provided a potential bridge for disease transmission through contamination of the environment (Petrides and Bryant, 1951). A linkage between infected poultry and wild waterfowl has also been identified in Maine (Korschegan et al., 1978).

The 1940's and 1950's. California Department of Fish and Game records disclose 12 additional outbreaks of avian cholera in that State during the 1940's (Titcher, 1979) with the greatest loss estimated at 40,000 waterfowl during the winter of 1948-49 (Rosen and Bischoff, 1949-1950). The number of outbreaks during the 1950's increased to 23 and the number of counties or other areas involved increased from 9 to 15. The greatest loss reported for any single location during the 1950's was 6,000 birds (Titcher, 1979).

Avian cholera also persisted in the Texas Panhandle during the 1940's and 1950's. When reporting on this disease in 1951, Petrides and Bryant (1951) stated that waterfowl losses in that area had occurred annually since the first loss of 307 ducks in 1944. The heaviest losses during that period was an estimated 36,000 during the winter of 1947-48 (Sperry, 1949). This was exceeded during the 1950's by a loss of more than 50,000 waterfowl at the Muleshoe

National Wildlife Refuge during the winter of 1956-57 (Jensen and Williams, 1964).

There are no reports of avian cholera in wild waterfowl in other areas of North America during this era. The disease appeared to be restricted to California and Texas and to be localized rather than generally distributed within these states. Therefore, avian cholera could not be considered widespread, and was not generally accepted as a major waterfowl disease problem of a national perspective.

The 1960's. In 1963, American eider ducks (Somateria mollissima) breeding off the coast of Maine became the first recognized waterfowl victims of avian cholera in the eastern portion of the United States. More than 70 percent of the 146 nests tallied on Goose Island had failed and a similar proportion of nesting female eiders died from the disease. Losses also occurred on two other nearby islands. Domestic poultry or refuse from international shipping were theories advanced regarding the origin of this outbreak (Ger sham et al., 1964). No linkage between the Texas or California sources of avian cholera are apparent, nor is it likely that there was any. This outbreak off the coast of Camden, Maine, was an unrelated event probably precipitated by exposure to poultry viscera or other tissues containing virulent Pasteurella multocida bacteria.

Later that year avian cholera struck lesser snow geese (Chen caerulescens) and other waterfowl wintering at the Squaw Creek National Wildlife Refuge in Missouri. About 7,000 carcasses were collected and burned during the outbreak which persisted into early 1964 (Vaught et al, 1967). That summer, nesting eider ducks were again victimized, this time on islands in the St. Lawrence River in Quebec (Reed and Cousineau, 1967). The final outbreak occurring outside of California and Texas during the 1960's was in the Florida Everglades. This was also the first avian cholera epizootic recorded in wintering waterfowl along the Atlantic Flyway (Klukas and Locke, 1970).

The 1960's then saw avian cholera appear in both the Mississippi and Atlantic Flyways for the first time in wild waterfowl. Although only a single outbreak was reported in the Mississippi Flyway, the multiple outbreaks in the Atlantic Flyway were an indicator of more to come.

The 1970's. The 1970's were greeted with a major outbreak of avian cholera that struck oldsquaw (Clangula hyemalis), white-winged scoters (Melanitta deglandi), other ducks, Canada geese (Branta canadensis) and whistling swans (Olor columbianus) on Chesapeake Bay. This outbreak began in February 1970 and lasted until April of that year (Locke et al., 1970). The Wildlife Management Institute estimated the loss at 88,000 birds making this the largest avian cholera die-off on record.

That summer, avian cholera reappeared in American eider colonies off the coast of Maine. Dr. Howard Mendall of the Maine Cooperative Wildlife Research Unit when writing about the outbreak in the Maine Units' Quarterly Report indicated that, "total mortality was greater than that of the 1963 occurrence, which was the last recorded evidence of the disease in Maine" (in wild waterfowl). He also noted that eiders and scoters are associated on the Maine coast during spring migration, giving rise to speculation that the disease in eiders that summer may have been related to the Chesapeake Bay outbreak.

Another major avian cholera outbreak occurred in the Atlantic Flyway in February, 1975. This time the location was Back Bay, Virginia (Pursglove et al., 1975). However, perhaps the most significant outbreak since those of 1944 took place in Nebraska's Rainwater Basin where an estimated 25,000 waterfowl died (Zinkl et al., 1975). It is the location of this outbreak, rather than the number

of birds lost that is of significance. South-central Nebraska is a major staging area for spring migrants including most of the mid-continent population of white-fronted geese (Anser albifrons). This species suffered the greatest loss, making up about 35 percent of the total.

This was the first confirmed outbreak of avian cholera in wild waterfowl in Nebraska despite speculation in the literature that previous waterfowl die-offs along the Platte River in 1950 and 1964 might have been due to this disease (Rosen, 1971). A review of correspondence between individuals involved in these outbreaks provides strong evidence that the 1964 die-off was not avian cholera and creates serious doubt that this was the cause of the 1950 die-off. Dr. Louis Locke of the Patuxent Wildlife Research Center in Laurel, Maryland, concluded from his examination of birds submitted for necropsy that,

"In view of our inability to recover the bacteria of fowl cholera by mouse inoculation; our failure to demonstrate fowl cholera organisms in blood smears; and, the lack of typical cholera lesions, I believe that cholera was NOT responsible for these losses" (Locke, 1964).

Dr. Wayne Jensen of the Bear River Wildlife Disease Laboratory at Brigham City, Utah, had also examined specimens from the 1964 and other waterfowl die-offs in Nebraska. He noted that no isolation of Pasteurella multocida had been made by anyone despite the fact that, "We had a considerable amount of experience with the disease in Texas by that time, so I don't believe we were unsuccessful simply because we didn't know how to go about it" (Jensen, 1978).

Outbreaks of avian cholera have occurred in the Rainwater Basin each spring since 1975. This area, the Central Valley of California, and the Texas Panhandle must now be considered as focal points for this disease. Next on the list of important events in the progression of this disease was diagnosis of its occurrence in lesser snow geese, Ross' geese (Anser rossii) and other waterfowl in Saskatchewan (Wobeser, et al., 1979). This problem has also reappeared in the same general spring staging area each year since then (Wobeser, personal communication).

The final phase for completing the disease cycle occurred during the summer of 1979 when a massive outbreak of avian cholera occurred in lesser snow goose breeding colonies along the west shore of Hudson Bay. Estimates of mortality are highly variable depending on the source but most likely were in the tens of thousands of geese. Information provided by Dr. Ken Brace of the Canadian Wildlife Service disclosed losses occurring in the vicinity of the Maguse River, Eskimo Point, McConnell River, and Wolf Creek, NWT. The die-off was described as being "extensive and widespread". Eskimos reported, "dead geese all over the land," and elder Eskimos were reported saying "that the dead geese at McConnell River have brought arctic fox all the way from Baker Lake", a direct line distance of approximately 200 miles (Brace, 1979).

Our perspective of avian cholera as a disease of waterfowl changed drastically during the 1970's, especially during the second half of the decade. No longer could this disease be viewed as a problem primarily restricted to California and Texas. It now had to be viewed as a disease on the march, one that was expanding its distribution and its impact.

Present. The present situation is best summarized by examining the known distribution of this disease in North American waterfowl. It is readily apparent that much of this distribution is of recent origin (Fig. 1), and occurred during the period of July 1979 through

spring of 1980 (Fig. 2). The avian cholera outbreak in snow geese on the breeding grounds appeared to perpetuate itself through a series of additional outbreaks in the Mississippi and Central Flyways from Manitoba south to Texas. Interactions with snow geese may have been responsible for the first reported epizootic of avian cholera in Canada geese at the Horicon National Wildlife Refuge in east-central Wisconsin.

The 1980 March-April outbreak in the Rainwater basin was the largest ever occurring in that area. Estimates of waterfowl loss ranged between 70,000 and 100,000, thereby, establishing this outbreak as one of the largest, if not largest avian cholera die-off ever recorded. Nearly 31,000 carcasses were picked up and burned. White-fronted geese made up 21 percent of this mortality.

Avian cholera has now succeeded in establishing itself as a significant disease problem of North American waterfowl. It is widely distributed, occurs during all seasons of the year, is killing greater numbers of waterfowl than ever before and it is a reoccurring problem in all four flyways. It has taken less than 40 years for this disease to change in perspective from an unknown problem in North American waterfowl to one of the more devastating diseases we are currently faced with, and will continue to be faced with in the future.

Future. The prospect for future generations of waterfowl is not bright considering the track record of this disease, both in wild and domestic birds. Three separate pathways appear to be operating in the spread of avian cholera among wild waterfowl (Fig. 3). In the west, California is the focal point and movement of waterfowl northward through Freezeout Lake, Montana, is the apparent route involved in the spread of avian cholera to spring staging grounds in Saskatchewan. Ross' goose is at high risk because of losses occurring in California now being compounded by the presence of avian cholera on its spring staging grounds. The progressive southward movement of avian cholera in California is expected to continue and will undoubtedly result in future epizootics from this disease on wintering grounds in Mexico.

At least two separate pathways are involved in the central and Mississippi Flyways. Lesser snow geese appear to be important in the spread of this disease along the Missouri River. Further west, there may be an interrelationship between avian cholera in the Texas Panhandle and its occurrence in Nebraska's Rainwater Basin. The mid-continent population of white-fronted geese is at high risk in Nebraska because of continued shrinkage of habitat in this important spring staging area. The resulting dense goose concentrations are especially vulnerable due to the ease with which avian cholera is transmitted from one individual to another. We are virtually in a position of "having all our eggs in one basket." Unless this situation can be alleviated, catastrophic losses from avian cholera are likely.

The spread of avian cholera within the Atlantic Flyway is not as easily visualized, nor does the disease appear to be as firmly established in wild waterfowl in that portion of the country. The role of domestic poultry as a source for outbreaks cannot be ignored, and was suggested as the initial source of the disease in eider colonies off the coast of Maine (Gersham et al., 1964; Korschgen et al., 1978). This disease is common in domestic waterfowl being raised on Long Island, New York. White Pekin flocks are often visited by their wild "cousins", thereby providing a suitable pathway for exposure to avian cholera and the initiation of future outbreaks. It is likely that the frequency of this disease in the Atlantic Flyway will continue to increase.

Conclusions. Disease is a growing menace for our waterfowl resource. It is increasing in importance, diversity, and distribution and if current trends continue, disease is likely to become a limiting factor for populations of some of our more popular waterfowl species. The preceding discussion traced the evolution of just one disease problem, avian cholera. Many others exist. Duck plague, or duck virus enteritis (DVE), and other diseases yet to be discovered are "waiting in the wings" for their chance at "center stage". Therefore, it behooves all of us to reflect on a statement appearing in Waterfowl Tomorrow 16 years ago (Briggs, 1964):

"If we really want to save our waterfowl, we must prepare now. We must expand and use fully our experience and knowledge of ways to manage waterfowl. We need new, imaginative approaches to preservation, utilization, and management. Yesterday's answers may not meet the problems and requirements of tomorrow."

We are all aware of some general prospects for the future of waterfowl. Among them looms continued losses of habitat and increased demands for utilization of the waterfowl resource that is dependent upon this ever diminishing habitat. "Once there were about 127 million acres of wetlands in the United States. Drainage had reduced our area of wetlands to about 82 million acres in the 1950's" (Briggs, 1964). Accelerated drainage since that time has reduced this figure even further. In the prairie pothole country alone, more than a million acres were drained between 1943 and 1961 (Briggs, 1964).

No longer are we likely to record observations such as were made by Capt. Howard Stansbury on the Bear River Marshes of Utah in 1849 when he described waterfowl concentrations before him (Briggs, 1964).

"Thousands of acres, as far as the eye could reach, seemed literally covered with them, presenting a scene of busy animated cheerfulness, in most graceful contrast with the dreary, silent solitudes by which we were immediately surrounded."

Unless, as Briggs observed, we "expand and use fully our experience and knowledge of ways to manage waterfowl" the "scene of busy animated cheerfulness" described by Capt. Stansbury is likely to be replaced with frequently reoccurring masses of dead and dying waterfowl due to disease. We will never eliminate disease, however, it is within our power to prevent losses from being excessive. This can only be done by addressing the problems head-on. It cannot be accomplished by letting Mother Nature take care of these problems for us.

LITERATURE CITED

- Brace, R.K. 1979. Memorandum to files, Canadian Wildlife Service, November, 1979.
- Briggs, F.P. 1964. Waterfowl in a changing continent. In: Waterfowl Tomorrow. Linduska, J.P. (ed.) U.S. Govt. Print. Office, Washington, D.C., p. 3-11.
- Gershman, M., Witter, J.F., Spencer, H.E., Jr., and Kalvaitis, A. 1964. Case report: Epizootic of fowl cholera in the common eider duck. *J. Wildl. Mgmt.* 28:587-589.
- Heddleston, K.L., and Rhoades, K.R. 1978. Avian pasteurellosis. In: Diseases of Poultry. Hofstad, M.S., Calnek, B.W., Helmboldt, C.F., Reid, W.M., and Yoder, H.W., Jr. (eds.) Iowa State Univ. Press, Ames, Iowa, p. 181-199.
- Jensen, W.I. 1978. Personal correspondence to Dr. Sarah B. Hurley, National Wildlife Health Laboratory, Madison, Wisconsin, December 27, 1978.
- Jensen, W.I., and Williams, C.S. 1964. Botulism and fowl cholera. In: Waterfowl Tomorrow. Linduska, J.P. (ed.) U.S. Govt. Printing Office, Washington, D.C., p. 333-341.
- Klukas, R.W., and Locke, L.N. 1970. An outbreak of fowl cholera in Everglades National Park. *J. Wildl. Dis.* 6:77-79.
- Korschgen, C.E., Gibbs, H.C., and Mendall, H.L. 1978. Avian cholera in eider ducks in Maine. *J. Wildl. Dis.* 14:254-258.
- Locke, L.N. 1964. Memorandum to Robert Wheeler, Nebraska Game Fish and Parks, North Platte, Nebraska, April 13, 1964.
- Locke, L.N., Stotts, V., and Wolfhard, G. 1970. An outbreak of fowl cholera in waterfowl on the Chesapeake Bay. *J. Wildl. Dis.* 6:404-407.
- Petrides, G.A. 1951. An analysis of the 1940-50 fowl cholera epizootic in Texas Panhandle waterfowl. *Trans. Am. Wildl. Conf.* 16:193-216.
- Phillips, J.C., and Lincoln, F.C. 1930. American waterfowl. Their present situation and the outlook for their future. Houghton Mifflin, Boston.
- Pursglove, S.R. Jr., Holland, D.F., Settle, F.H., and Gnegy, D.C. 1976. Control of a fowl cholera outbreak among coots in Virginia. 30th Annual Meeting Southeastern Assoc. Game and Fish Commissioners Jackson, Mississippi, Oct. 24-27, 1976.
- Quortrup, E.R., Queen, F.B., and Merouka, L.J. 1946. An outbreak of pasteurellosis in wild ducks. *J. Am. Vet. Med. Assoc.* 108:94-100.
- Reed, A., and Cousineau, J. G. 1967. Epidemics involving the common eider (Somateria mollissima) at Ile Blance, Quebec. *Naturaliste Can.* 94:327-334.

- Rosen, M.N. 1971. Avian cholera. In: Infectious and Parasitic Diseases of Wild Birds. Davis, J.W., Anderson, R.C., Karstad, L., and Trainer, D.O. (eds.) Iowa State Univ. Press, Ames, Iowa, p. 59-74.
- Rosen, M.N., and Bischoff, A.I. 1949. The 1948-49 outbreak of fowl cholera in birds in the San Francisco Bay Area and surrounding counties. Calif. Fish and Game. 35:185-192.
- Rosen, M.N., and Bischoff, A.I. 1950. The epidemiology of fowl cholera as it occurs in the wild. Trans. N. Am. Wildl. Conf. 15:147-154.
- Sperry, C.C. 1949. Fowl cholera among waterfowl in the Texas Panhandle. Winter of 1948-49. Spec. Rpt., March 2, 1949, Wildl. Res. Lab., USFWS, Denver, Colorado, Mimeo.
- Titche, A.R. 1979. Avian cholera in California. Wildl. Mgmt. Branch Admin. Rpt. 79-2 (November, 1979) Calif. Dept. Fish and Game, Sacramento.
- Vaught, R.W., McDougale, H.C., and Burgess, H.H. 1967. Fowl cholera in waterfowl at Squaw Creek National Wildlife Refuge, Missouri. J. Wildl. Mgmt 31:248-253.
- Wobeser, G., Hunter, D.B., Wright, B., Nieman, D.J., and Isbister, R. 1979. Avian cholera in waterfowl in Saskatchewan, spring 1977. J. Wildl. Dis. 15:19-24.
- Zinkl, J.G., Dey, N., Hyland, J.M. Hurt, J.J., and Heddleston, K.L. 1975. An epornitic of avian cholera in waterfowl and common crows in Phelps County, Nebraska in the spring, 1975. J. Wildl. Dis. 13:194-198.