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Serologic Evidence of Newcastle Disease In Captive Mallards and Swans*

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Abstract

Newcastle disease virus (NDV) hemagglutination inhibition (HI) antibody titers of 1:20 or greater were detected in 80 of 200 serums from adult female and 9 of 35 adult male mallard breeders tested from three commercial game farm flocks in Wisconsin and Illinois. Six of 106 serums from mallard ducklings also were considered to be reactors. Almost half (49) of 100 swan serums from five aviculturist flocks in Michigan had HI antibody titers of 1:20 or greater. The possible significance of these findings regarding waterfowl management practices was discussed.

Introduction

Newcastle disease virus (NDV) is widespread geographically, and infects a large number of wild species.[20] Knowledge of Newcastle disease (ND) in wild waterfowl is limited but has been reported for the Canada goose, *Branta canadensis*;[2,17,21] white-fronted goose, *Anser albifrons*;[24] mallard duck, *Anas platyrhynchos*;[2,24] pintail duck, *Anas acuta tzitzihoa*;[22] and American widgeon, *Mareca americana*.[22]

Evidence of ND in wild mallard ducks as well as both wild and captive Canada geese in the Mississippi flyway has been reported.[2] To increase our knowledge of the prevalence of ND in captive waterfowl, mallards from three commercial game farms and swans from five aviculturist flocks were serologically sampled.

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Methods

All waterfowl flocks tested were designated by letter. Serum samples were obtained during the late spring and summer of 1967 from adult mallard breeders on three commercial mallard premises and from 4-8 week old ducklings on one of these. These flocks were located in Wisconsin and Illinois on farms that produce from 10,000 to 100,000 birds annually. A limited number of samples were obtained also from juvenile game farm mallards shot or live-trapped 1-10 weeks following their release into the wild.

Swan serums were collected in Michigan during the winter of 1966 from five aviculturist flocks. Total numbers of all species on these premises ranged from approximately 100 to several thousand birds. The majority of swans were either mutes, *Cygnus olor,* or blacks, *Cygnus atratus,* but lesser numbers of black-necked, *Cygnus melanocorypus,* whooper, *Cygnus cygnus cygnus,* whistling, *Cygnus columbianus columbianus,* and trumpeter swans, *Cygnus cygnus buccinator,* also were sampled.

Approximately 5-8 ml of blood were taken from the brachial veins of adult mallards; 3-5 ml via cardiac puncture from juvenile mallards; and 10 ml from the brachial veins of swans. The blood was allowed to clot at room temperature overnight and serums removed the next day were held at —20C prior to testing.

All serums were heat-inactivated at 56C for 30 minutes in a water bath and tested for NDV antibody with the standard Beta HI test.[16] Doubling serum dilutions of 1:5 to 1:2560 were tested against 10 hemagglutination units of GB-Texas strain of NDV. To avoid hemagglutination of non-homologous erythrocytes, mallard duck and mute swan erythrocytes were substituted for chicken erythrocytes when these respective species were tested. Tests were done in disposable white plastic serologic plates (Linbro Co.) and serums with HI titers of 1:20 or higher were considered reactors. Appropriate positive and negative control serums were included in the test protocol.

Results

HI antibody titers of 1:20 or greater to NDV occurred in 80 of 200 serums from adult female mallards tested from three different commercial game farm flocks. The prevalence of reactors varied from 10 per cent for Farm C to 62 per cent for Farm B. Both male and female breeders were tested on Farm A and the prevalence of reactors was twice as great among females as males (54 to 26 per cent, Table 1).

NDV reactors were detected also among ducklings at Farm A. Both the proportion of reactors and magnitude of the titers among ducklings were lower than that of adults. There were no reactors in one group of 52 4-week-old ducklings tested, while 4 of 42 serums from a second group of similar age ducklings had HI titers of 1:20 - 1:80. Two of twelve 8-week-old ducklings tested had titers of 1:20. Ducklings at 4 weeks of age were released into the wild from Farm A during June and July. Eight of the 37 ducklings subsequently tested (5-12 weeks of age) had NDV HI titers of 1:20 - 1:40. One of seven wild ducklings collected on the release area during this same period had a 1:20 HI titer.

In all, 49 per cent of the 100 swan serums tested were considered positive reactors (Table 2). Approximately 50 per cent of the 86 mute and black swan serums had HI antibody titers of 1:20 to 1:160. Positive reactors were detected also in 1 of 5 black-necked, 2 of 5 whooper, and 1 of 2 whistling swans, while both trumpeter swans tested were negative (Table 3). The prevalence of reactors among swans varied from 29 per cent (4 of 14) in flock F to 80 per cent (12 of 15) in flock G. The magnitudes of reactors in swan serums (Table 3) are slightly lower than those of mallard serums (Table 1).

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TABLE 1. *HI antibody titers for NDV in male and female mallard breeders from three commercial game farms.*

Reciprocal titer	Females						Total Females		Total Males [1]	
	Farm A		Farm B		Farm C					
	No.	%	No.	%	No.	%	No.	%	No.	%
0	27	24.5	1	4.8	30	43.5	58	29.0	11	32.4
5	7	6.4	2	9.5	21	30.4	30	15.0	4	11.8
10	16	14.5	5	23.8	11	15.9	32	16.0	11	32.4
20	20	18.2	10	47.6	3	4.3	33	16.5	7	20.6
40	18	16.4	3	14.3	3	4.3	24	12.0	1	2.9
80	9	8.2	0	0.0	0	0	9	4.5	0	0.0
160	4	3.6	0	0.0	1	1.4	5	2.5	0	0.0
320	7	6.4	0	0.0	0	0	7	3.5	0	0.0
640	1	0.9	0	0.0	0	0	1	0.5	1	2.9
1280	1	0.9	0	0.0	0	0	1	0.5	0	0.0
Total	60/110 [2]	54.5	13/21	61.9	7/69	10.1	80/200	40.0	9/35	25.7

[1] All samples from one farm.
[2] Number of samples with titers of 1:20 or greater over total samples.

TABLE 2. *A summary of HI reactors to NDV in five flocks of captive swans.*

Species	Flock										Total	
	D		E		F		G		H			
	No. [1]	%	No.	%	No.	%	No.	%	No.	%	No.	%
Mute	6/11	54.5	0/0	—	2/10	20.0	10/13	76.9	16/29	55.2	34/63	54.0
Black	3/10	30.0	4/7	57.1	2/4	50.0	2/2	100.0	0/0	—	11/23	47.8
Black-necked	1/5	20.0	0/0	—	0/0	—	0/0	—	0/0	—	1/5	20.0
Whooper	1/2	50.0	1/2	50.0	0/0	—	0/0	—	0/1	0.0	2/5	40.0
Whistling	0/0	—	0/1	0.0	0/0	—	0/0	—	1/1	100.0	1/2	50.0
Trumpeter	0/0	—	0/2	0.0	0/0	—	0/0	—	0/0	—	0/2	0.0
Total	11/28	39.3	5/12	41.7	4/14	28.6	12/15	80.0	17/31	54.8	49/100	49.0

[1] Number of samples with titers of 1:20 or greater over total samples.

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TABLE 3. *A summary of HI titers to NDV in captive swans.*

Species	Reciprocal of Titer		
	0-10	20-40	80-160
Mute	29	23	11
Black	12	8	3
Black-necked	4	1	0
Whooper	3	2	0
Whistling	1	0	1
Trumpeter	2	0	0
Total	51	34	15

Discussion

Serologic and experimental studies with wild and captive waterfowl suggest that the HI activity being measured represents NDV antibody.[14,18] Assuming specificity of the serology in this study, a large percentage of birds tested had previous exposure to NDV. In many instances domestic and wild waterfowl have been reported to be resistant to clinical ND under natural and experimental conditions.[20] Results of this study might be interpreted to support this view.

The sources of exposure for these study flocks were not determined, but the opportunities for acquiring ND are multiple including the possibility that it is enzootic in wild waterfowl populations. Wild waterfowl mix freely with all the flocks sampled in this study. A carrier state has been reported in adult domestic ducks,[15,25] a swan,[23] and suspected in geese.[12]

Ring-neck pheasants, *Phasianus colchicus,* are often raised with mallards in commercial game farm operations and aviculturists often maintain various exotic species of pheasants in their collections. Pheasants were present in the collections of all aviculturists in this study and in some instances occupied the same pens as the swans. Pheasants were raised also on mallard Farms B and C but not on A. ND has been diagnosed in pheasants of various species from many areas of the world on numerous occasions[20] and wild pheasants have been implicated in the spread of ND during poultry epizootics.[3,13]

Other wild birds such as the English sparrow, *Passer domesticus,* have also been incriminated in the transmission of ND.[8,9,10,11] It is generally felt that ND is not an important cause of mortality in most wild avian populations, but the role of these populations in the epizootiology of the disease is of potential importance, as is illustrated by the frequent transfer of NDV over long distances in shipments of infected game birds and live zoological specimens.[20]

In this limited study, an interesting statistic is the apparent difference in reactor rates between adult male and female mallards (Table 1). There were more than twice as many female reactors in Flock A as there were male reactors. The significance or cause of this is unknown, but is not without parallel. A similar situation was observed in wild mallards by Bradshaw and Trainer,[2] and among adult Canada geese by Palmer.[18] Whether this sex differential is an artifact of sampling or a real phenomenon is subject to conjecture.

HI titers were generally higher in ducks than in swans (Tables 1 and 3) and may merely reflect time since exposure.

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The duck sampling was done during the summer months, a period when the occurrence of ND is more common than during the late winter sampling period of swans. Transmission opportunities are greater during the summer period due to the variety and numbers of wild birds present and the activities of these birds. Peak HI titers in experimental mallards exposed to GB-Texas strain of NDV occurred in 10-15 days and declined rapidly by the 40th day post exposure.[7] The high titers observed for some mallards in this study are, therefore, suggestive of recent infections.

An interesting and potentially significant aspect of these and other serologic studies is the relatively high prevalence of reactors to ND as well as other avian disease agents in both captive and wild waterfowl.[2,4,5,6,18,19] There has been a recent increase in the utilization of game farm grown waterfowl to supplement the supply of wild populations following the trend established for pheasants and quail. Large numbers of game farm mallards have been released in past decades and current demands appear to be accelerating and expanding this practice. It has been estimated that since 1940 as many as 40,000 game farm mallards have been released annually into the Atlantic Flyway.[1] In the past 29 years this totals over a million birds in that flyway alone. Releases of game farm mallards also occur in other flyways. This increase in demand for mallards has often resulted in commercial raising operations growing from small operations of hundreds or a few thousand birds to larger operations producing tens of thousands to several hundred thousand birds a year. This increased production has not always been accompanied by a corresponding increase in the physical plant, but more generally is accomplished through producing more birds per unit area, often resulting in increased crowding and less time and space devoted to sanitation and good management practices.

Examination for evidence of disease of breeding stock and birds prior to release into the wild is not done, nor is there any restriction on where birds may be shipped within the United States. Regulations governing the release of migratory waterfowl into the wild are management oriented rather than motivated from a disease viewpoint.

Serious consideration should be given to a disease surveillance and certification system for raisers of wild game species, especially when these species possess the high mobility of migratory waterfowl. Our threatened waterfowl resources should not be jeopardized by releases of game farm birds intended as buffers against overharvest or as additional breeding stock but which potentially may reduce these resources through the mechanism of disease. It would be a poor management program that permits the establishment of new diseases or continued perpetuation of existing ones by this means.

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