# RABIES ANTIBODIES IN SERA OF WILD BIRDS

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*Abstract:* Three hundred forty-three birds representing six orders and 22 species were examined serologically for antibodies against rabies. Low passive hemagglutination titers were observed in 23 samples. Fifteen of 65 (23.1%) predatory birds and 8 of 278 (2.9%) non-predatory birds were positive. Rabies antibody positive sera from non-predatory species were from species commonly thought to be scavengers suggesting the importance of the oral route for the presentation of rabies virus to birds.

## INTRODUCTION

Although most, if not all, warm-blooded animals are susceptible to infection with rabies virus, rabies generally is not regarded as a disease of avian species. In most cases where the infection has been observed in birds, it was experimentally induced. Because no important public health or economic significance has been established for avian rabies, birds generally have been excluded from studies of this disease.

As a part of an epidemiologic survey for serologic evidence of exposure of wildlife to several infectious agents, 343 birds representing six orders and 22 species were tested for antibodies against rabies antigens. Low serologic titers were observed in 23 samples. These are described in this report.

## MATERIALS AND METHODS

The species of birds from which blood samples were obtained for testing for antibodies against rabies virus are listed in Table 1. Birds of prey generally had been held in captivity for various periods of time prior to bleeding. Seventy barn pigeons, four blue jays, a brown thrasher, a yellow-shafted flicker and a robin were captured in the wild, bled and released. Most pheasants were captured from the wild but were held in captivity for several months prior to bleeding. House sparrows and starlings usually were killed.

Blood samples from pheasants, birds of prey, crows and ravens were obtained by jugular venipuncture. Samples from other birds were obtained by cardiac puncture.

Antibodies against rabies were titrated by the passive hemagglutination (PHA) procedure.[4] The undiluted sera were analyzed in duplicate by the serum neutralization test using the tissue culture plaque reduction technique[11] and reactions of positive or negative for rabies antibodies were recorded. Some sera, including some of those with titers by the PHA method, were also tested by the serum neutralization-mouse inoculation procedure.[1]

## RESULTS

The results of the PHA test are summarized in Table 1. Sera showing a titer of two or greater by the PHA procedure also were positive by the plaque reduction technique. Serologic evidence of reaction with rabies viral antigens was observed in sera from 23 of the 343 birds tested. Fifteen of these were predatory birds; four great-horned owls, two barred owls, one red-tailed hawk, one ferruginous hawk, one rough-legged hawk, four golden eagles and two bald eagles. Non-predatory birds for which specific antibody was identified were five starlings, one crow and two ravens. Antibodies against rabies viral antigens were detected, by the PHA procedure, in the sera of 23.1% of the predatory species and 2.9% of the non-predatory species. No sera were positive for antibodies in the mouse inoculation test.

TABLE 1. Number of birds with titers of antibody against rabies viral antigens, as measured by the passive hemagglutination test.

| Species | Total Number | Rabies viral antibody titer* | | | | |
|---|---|---|---|---|---|---|
| | | Neg. | 2 | 4 | 8 | 16 |
| Predatory Birds | 65 | 50 | 5 | 6 | 3 | 1 |
| Great-horned owl (*Bubo virginianus*) | 15 | 11 | | 2 | 2 | |
| Screech owl (*Otus asio*) | 10 | 10 | | | | |
| Barred owl (*Strix varia*) | 7 | 5 | 1 | 1 | | |
| Short-eared owl (*Asio flammeus*) | 1 | 1 | | | | |
| Snowy owl (*Myctea scandiaca*) | 1 | 1 | | | | |
| Golden eagle (*Aquila chrysaetos*) | 6 | 2 | 1 | 2 | 1 | |
| Bald eagle (*Haliaectus leucocephalus*) | 6 | 4 | 2 | | | |
| Prairie falcon (*Falco mexicanus*) | 3 | 3 | | | | |
| Harris hawk (*Parabuteo unicinctus*) | 3 | 3 | | | | |
| Red-tailed hawk (*Buteo jamaicensis*) | 10 | 9 | 1 | | | |
| Ferruginous hawk (*Buteo regalis*) | 1 | | | 1 | | |
| Rough-legged hawk (*Buteo lagopus*) | 2 | 1 | | | | 1 |
| Non-predatory Birds | 278 | 270 | 3 | 4 | 1 | |
| Barn pigeon (*Columba livia*) | 70 | 70 | | | | |
| Ring-necked pheasant (*Phasianus colchicus*) | 46 | 46 | | | | |
| Starling (*Sturnus vulgaris*) | 125 | 120 | 3 | 1 | 1 | |
| House sparrow (*Passer domesticus*) | 26 | 26 | | | | |
| Blue jay (*Cyanocitta cristata*) | 4 | 4 | | | | |
| Brown thrasher (*Toxostoma rufum*) | 1 | 1 | | | | |
| Yellow-shafted flicker (*Colaptes auratus*) | 1 | 1 | | | | |
| Robin (*Turdus migratorius*) | 1 | 1 | | | | |
| Crow (*Corvus brachyrhynchos*) | 2 | 1 | | 1 | | |
| Raven (*Corvus corax*) | 2 | | | 2 | | |
| Grand Total | 343 | 320 | 8 | 10 | 4 | 1 |

* Titers are the inverse of the greatest dilution to give positive results.

**DISCUSSION**

In controlled studies of rabies, avian species were more resistant to infection than were most other warm-blooded animals. The disease, however, has been experimentally induced in birds including owls,[5] hawks,[10] falcons,[5] ravens[5] songbirds,[7] pigeons,[5,10] geese,[5,7] ducks[7] chickens,[3,5,7,8,10] and peafowl.[8] Many experimentally inoculated birds do not develop clinical rabies and recovery from infection by those which do is frequently observed.[5,6,9,10] The incubation period varies widely from 2 weeks to 40 days or longer.[5] A regressive infection following experimental inoculation of rabies virus has been observed at 233 days.[9]

The refractoriness of birds to infection with rabies virus has been attributed to a rapidly developing, active immune system that includes antibody bound to cells of the central nervous system as well as serum antibody.[9] The central nervous system-bound antibody generally was detected earlier and was of greater titer than was circulating antibody. No attempt was made to evaluate bound antibody in this survey.

Natural transmission of rabies virus from bird to bird probably is rare. Most observed infections in avian species are believed to be the result of exposure to a rabid mammal.[2] Therefore birds of prey likely would have greater potential for infection. Von Lote[10] has presented data to suggest certain avian species are more susceptible to infection with rabies virus than are others. He reported that predatory birds were more susceptible to experimental infection than were chickens and pigeons. In our study the prevalence of serum antibodies reacting with rabies viral antigens was greater among the predatory species than among the passerine birds.

The serum antibody titers, as detected by the PHA test in this survey, were low. This may reflect the time interval between antigenic stimulation of the immune system and the acquisition of the blood sample. Titers also are dependent upon the antigenicity of the virion, dose of antigen stimulating the response, route of challenge and inherent ability of a particular host to respond immunologically to a specific substance. No data are available for estimation of either the magnitude of the immune response in birds as measured by this technique or the persistance of serum antibody titers against rabies virus following challenge in avian species. The fact that these sera were negative for antibodies directed against other viral antigens, using the same serologic technique, indicates specific antibodies were detected. Positive results by the plaque reduction test substantiate the credibility of the observed titers. The absence of antibodies detectable by the mouse inoculation-serum neutralization test may reflect a relative insensitivity to very low concentrations of antibody directed against only those antigens of the rabies virion that are associated with infectivity.

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