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Authors: Luttrell, M. P., Creekmore, L. H., and Mertins, J. W.

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Avian Tick Paralysis Caused by *Ixodes brunneus* in the Southeastern United States

M. P. Luttrell,[1] L. H. Creekmore,[1,3] and J. W. Mertins,[2] [1] Southeastern Cooperative Wildlife Disease Study, College of Veterinary Medicine, The University of Georgia, Athens, Georgia 30602, USA; [2] U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Veterinary Services, National Veterinary Services Laboratories, 1800 Dayton Road, Ames, Iowa 50010, USA; [3] Current address, National Biological Service, National Wildlife Health Center, 6006 Schroeder Road, Madison, Wisconsin 53711, USA.

ABSTRACT: Between 1988 and 1994, 16 definitive and 26 presumptive cases of tick paralysis were diagnosed in 10 species of birds from five southeastern states in the USA. All birds had engorged adult female *Ixodes brunneus* ticks on the head region and were partially paralyzed or dead. Cases occurred in the winter and early spring months, and most birds were passerines found in private yards or near feeders. All stages of *I. brunneus* feed exclusively on birds, and this species previously has been associated with avian tick paralysis. Little is known concerning the life cycle of this ixodid tick and its impact on wild bird populations.

Key words: *Ixodes brunneus*, Ixodidae, tick paralysis, Passeriformes.

Tick paralysis is a disease caused by neurotoxins associated with 60 species of hard and soft ticks in 10 genera (Gothe and Neitz, 1991). It occurs worldwide in humans, domestic animals, and many wild mammals and birds (Gregson, 1973). Generally, the disease is considered a motor polyneuropathy characterized by a progressive, ascending flaccid motor paralysis. Clinical signs include ataxia, paresis, paralysis, areflexia, hypotonus, and respiratory failure (Oliver and Lorenz, 1993). The toxin seems to be associated with the female tick's salivary glands and probably is secreted during feeding (Gregson, 1973).

Ixodes brunneus has been associated with tick paralysis in wild birds (Bishopp and Trembley, 1945; Gregson, 1973; Schwab, 1987). All three stages of *I. brunneus* feed exclusively on birds (Keirans and Litwak, 1989), particularly passerines and ground-feeding species; 64 species of birds have been reported as hosts for this tick (Boyd, 1951). Adult females are found on adult birds primarily in the colder months of the year, with larvae and nymphs occasionally present at the same time (Nibley, 1962; Sonenshine and Stout, 1970). Bishopp and Tremley (1945) found that the adult female ticks remain attached on their avian hosts for long periods of time. Males have never been found in nature but have been successfully raised under laboratory conditions (Anastos and Smith, 1957). *Ixodes brunneus* has been reported from 22 states, primarily in coastal regions and in the Midwest (Keirans and Clifford, 1978; Brillhart and McKown, 1991).

A definitive diagnosis of tick paralysis can be based only on dramatic clinical improvement and recovery of the host, usually within 24 to 72 hr following removal of the tick (Oliver and Lorenz, 1993). Unfortunately, such confirmation is difficult in wild birds because the condition usually is not noticed until the bird is found dead. In these instances, a presumptive diagnosis of tick paralysis can be based on the presence of a species of tick known to cause paralysis combined with the absence of evidence of any other disease problems.

We report a series of cases of avian tick paralysis with a characteristic pattern over a 6-yr period. From 1988 through 1994, 44 birds with obvious tick infestations were submitted to the Southeastern Cooperative Wildlife Disease Study (SCWDS; College of Veterinary Medicine, The University of Georgia, Athens, Georgia, USA). Species submitted included *Zenaida macroura, Cyanocitta cristata, Sialis sialis, Bombycilla cedrorum, Turdus migratorius, Agelaius phoeniceus, Junco hyemalis, Carduelis tristis, Carpodacus mexicanus, C. purpureus,* and 1 unidentified sparrow. These included 16 partially paralyzed birds and 28 dead birds (Table 1). Birds were submitted from the following areas of the

TABLE 1. Definitive and presumptive cases of avian tick paralysis reported to the Southeastern Cooperative Wildlife Disease Study, The University of Georgia, Athens, Georgia, 1988 through 1994.

Species	Number	Year	State
Definitive Cases			
Bombycilla cedrorum	1	1988	Georgia
Carpodacus purpureus	1	1991	Arkansas
C. mexicanus	14	1991	Georgia
Presumptive Cases			
Sialis sialis	1	1988	Georgia
	1	1988	Tennessee
B. cedrorum	2	1988	Georgia
Cyanocitta cristata	1	1988	Georgia
Unidentified sparrow	1	1990	Georgia
C. purpureus	1	1994	Virginia
C. mexicanus	4	1990	North Carolina
	4	1991	Georgia
	1	1994	Georgia
	1	1994	North Carolina
	2	1994	Virginia
Carduelis tristis	1	1991	Georgia
Agelaius phoeniceus	2	1991	Georgia
Junco hyemalis	2	1991	Georgia
	1	1991	Arkansas
Zenaida macroura	1	1993	Georgia

USA: Faulkner (35°15′N, 92°20′W) and Saline (34°35′N, 92°45′W) Counties, Arkansas; Clarke (33°58′N, 83°20′W), Forsyth (34°20′N, 84°15′W), Gordon (34°30′N, 84°50′W), Gwinnett (34°00′N, 84°00′W), Madison (34°10′N, 83°15′W), Murray (34°50′N, 84°50′W), Oconee (33°50′N, 83°20′W), Stephens (34°30′N, 83°20′W), Walton (33°45′N, 83°45′W), and White (34°40′N, 83°50′W) Counties, Georgia; Davie (35°55′N, 80°40′W), Guilford (36°10′N, 79°50′W), Iredell (35°55′N, 80°45′W), Wake (35°40′N, 78°50′W), and Wilkes (36°20′N, 81°10′W) Counties, North Carolina; Weakley County (36°30′N, 88°50′W), Tennessee; and Chesterfield (37°50′N, 77°35′W) and Goochland (37°45′N, 78°00′W) Counties, Virginia.

Typically, single birds or small groups of two to four birds were reported; several cases involved larger groups of passerines found dead or paralyzed. Three submitted birds died in captivity after ticks were removed. Individuals commonly had one to two attached ticks; however, several had six to 14 ticks. Ticks always were attached to the head or neck, and six birds specifically had ticks attached around their eyes. All ticks were identified as adult female *I. brunneus* based on the taxonomic criteria outlined by Cooley and Kohls (1945), Keirans and Clifford (1978), and Keirans and Litwak (1989).

Sixteen paralyzed birds recovered sufficiently for release after their ticks were removed. A definitive diagnosis of tick paralysis was made for these birds. Twenty-eight dead birds submitted for necropsy were determined by gross examination to be in fair to good physical condition. Gross lesions were limited to subcutaneous hemorrhage and edema at the tick attachment sites. Histopathologic examination of tissues was performed on 18 birds, with no significant lesions observed. Cultures of liver tissue for *Salmonella* spp. were done as described by Mallinson and Snoeyenbos (1989) for 10 birds found under feeders; all cultures were negative. Brain cholinesterase activity levels (Hill, 1988) were measured in four additional cases, and all were normal. Two birds were part of a

group that had been exposed to diazinon, and organophosphate toxicosis was diagnosed as the cause of death in these birds (SCWDS, unpublished case report). Presumptive diagnoses of tick paralysis due to *I. brunneus* were made on the remaining 26 birds.

The submission of cases was strongly seasonal, with most occurring during the cooler months of the year (November through April). This seasonality coincided with previously reported occurrences of adult *I. brunneus* on birds (Nibley, 1962; Sonenshine and Stout, 1970). Because tick paralysis is usually associated with parasitism by adult female ticks (Gregson, 1973), the seasonality observed may be related to the phenology of *I. brunneus*.

Prior to 1988, only one instance of tick paralysis had been diagnosed at SCWDS in 21 yr of clinical case accessions, and the diagnosis was presumptive. The recent cases of avian tick paralysis over the past six years may reflect either an actual increase in the occurrence of this disease or a broadened awareness of it. All cases were reported by bird watchers, bird banders, or wildlife biologists, and most affected birds were passerines found in association with residential bird feeders. Feeders concentrate birds artificially so that disease problems either may be exacerbated by increased densities of birds or simply may be more noticeable (Brittingham and Temple, 1986). Due to many unknown factors that influence case submissions and unknown characteristics of the *I. brunneus* life cycle, actual variations in incidence cannot be confirmed with the current data.

Although there have been occasional reports of tick paralysis in birds caused by *I. brunneus,* the epizootiology of the disease has not been investigated. The impact on wild bird populations is difficult to assess, but it is possible that avian tick paralysis may contribute to songbird mortality in some regions during the winter months. Affected birds are likely to die unnoticed, and our case histories are evidence that there may be secondary mortality factors involved such as accidents or predation. In addition to potential paralysis, ticks also may cause physical impairment from their attachment over the eyes (Thomas, 1941) or anemia due to blood loss (Boyd, 1951).

Tick paralysis may be influenced by many different host- and tick-dependent factors, such as host immunity or sensitivity, tick toxin virulence, or tick population dynamics (Gregson, 1973; Gothe and Neitz, 1991). Environmental factors such as meteorological fluctuations also may play a role. These variables, which may interact to influence seasonal occurrence, geographic distribution, and severity of disease, are unknown for *I. brunneus* and should be the focus of future research on avian paralysis caused by this tick.

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