National Quail Symposium Proceedings

Volume 2 Article 10

1982

An Overview of Disease and Parasitism in Southeastern Bobwhite Quail

William R. Davidson
University of Georgia

Forest E. Kellogg
University of Georgia

AN OVERVIEW OF DISEASE AND PARASITISM IN SOUTHEASTERN BOBWHITE QUAIL[1]

WILLIAM R. DAVIDSON, Southeastern Cooperative Wildlife Disease Study, Department of Parasitology, College of Veterinary Medicine, The University of Georgia, Athens, GA 30602
FOREST E. KELLOGG, Southeastern Cooperative Wildlife Disease Study, Department of Parasitology, College of Veterinary Medicine, The University of Georgia, Athens, GA 30602
GARY L. DOSTER, Southeastern Cooperative Wildlife Disease Study, Department of Parasitology, College of Veterinary Medicine, The University of Georgia, Athens, GA 30602

Abstract: Salient information on diseases and parasites of bobwhite quail (Colinus virginianus) in the southeastern United States is summarized. Major diagnostic findings on 146 bobwhites submitted to our regional wildlife disease laboratory from 1972 through 1981 included traumatic injuries, various toxicoses, and avian pox. Traumatic injuries were diagnosed frequently throughout the 10-year period, whereas toxicologic problems occurred sporadically. Avian pox emerged in outbreak proportions in the region in 1978 and thereafter has been prevalent in localized areas. Prompted by severe aflatoxin contamination in southeastern corn crops in 1977, studies on aflatoxicosis in bobwhites indicated that risks to wild bobwhite populations were minimal. Serologic, pathologic, and virus isolation studies disclosed infections of quail bronchitis virus and TR-59 adenovirus in bobwhites in northcentral Florida. Extensive studies have revealed only infrequent minor lesions associated with ectoparasites and endoparasites, and it was concluded that parasitism is not an important mortality factor in wild bobwhites. Two diseases encountered in pen-raised bobwhites, avian pox and histomoniasis (blackhead disease), clearly have potential to produce problems in wild bobwhites and wild turkey.

At the First National Bobwhite Quail Symposium in 1972, Kellogg and Doster presented a comprehensive review of diseases and parasites reported from bobwhites. These authors listed 21 infectious agents and 101 parasites that had been reported in 163 published articles. As was noted, most of the information dealt with pen-raised bobwhites, experimental infections, or general reviews of diseases and was relatively limited with regard to specific or detailed information on diseases and parasites of wild bobwhites. Despite these limitations, this review and a companion review (Kellogg and Calpin 1971) still remain entirely adequate as diagnostic or research checklists.

[1]This study was supported by Tall Timbers Research Station, Tallahassee, Florida, and by an appropriation from the Congress of the United States to the Southeastern Cooperative Wildlife Disease Study, The University of Georgia. Funds were administered and research coordinated under the Federal Aid in Wildlife Restoration Act (50 Stat. 917) and through Contract Nos. 14-16-0008-676, 14-16-0008-2029, 14-16-0009-78-024, Fish and Wildlife Service, U.S. Department of the Interior.

Thus, the purpose of the present article is not to provide an updated checklist but rather to provide a synopsis of the most significant or potentially significant diseases in wild bobwhites in the Southeast and to identify those agents which apparently are only rarely the cause of morbidity or mortality in wild bobwhites. Also included is an evaluation of major disease problems in pen-raised bobwhites and an estimate of the risk from these diseases to wild bobwhites where large numbers of pen-raised bobwhites are released into the wild.

METHODS

Information discussed herein originated from three major sources as follows: (1) clinical case records of bobwhites submitted to our regional wildlife disease laboratory (SCWDS) between 1972 and 1981, (2) interim or preliminary information from research projects conducted by SCWDS in collaboration with Tall Timbers Research Station, and (3) published reports.

Clinical case data were compiled from 93 case accessions totaling 127 wild bobwhites and from nine accessions totaling 20 known pen-raised

bobwhites. Data on diseases or parasites in these clinical case accessions generally were limited to those necessary for diagnostic efforts.

Where applicable, data from SCWDS research projects in various stages of completion also were included. These data, cited as SCWDS unpublished research data, should necessarily be considered preliminary findings.

Since the authors' experiences with diseases and parasites of bobwhites have generally been limited to the Southeast, the published data included here have also been restricted to the Southeast. Disease agents often have entirely different epizootiologic patterns or differ in significance in various geographic regions. Extrapolation of findings from outside the Southeast could lead to erroneous conclusions.

RESULTS AND DISCUSSION

Clinical Case Data

Diagnostic findings on 127 wild bobwhites submitted to SCWDS between 1972 and 1981 are presented in Table 1. At least six of the 12 fundamental causes of wildlife morbidity and mortality (Hayes and Prestwood 1969) were represented in these cases. Trauma and viral diseases accounted for 70 percent of the primary diagnostic findings. Toxicoses, bacterial infections, mycotic infections, parasitism, and unclassified miscellaneous findings comprised the remainder.

Although providing insight on factors responsible for annual mortality in bobwhites, these data should not be considered an accurate representation of the fates of individuals in wild bobwhite populations. For example, all but one of the large number of avian pox cases occurred during and subsequent to an outbreak of pox (Davidson et al. 1980a, Davidson et al. 1982). The increased awareness of disease problems in bobwhites as a result of the avian pox outbreak stimulated the rate of all clinical case accessions (four/year prior to the outbreak; 29/year during and afterwards) beyond that attributable to avian pox. Available information suggests that the actual significance of avian pox may have been underestimated prior to the outbreak and overestimated following the outbreak.

Although well represented in these data, traumatic injuries probably account for a higher proportion of annual losses than the data suggest. For example, it is illogical to assume higher losses to crippling from sport hunting (approximately one bird lost to four retrieved-Kellogg and Doster 1971, Doster et al. 1982) than from predation. Most bobwhites succumbing to predators are immediately eaten and obviously would not be accounted for in diagnostic data. Similarly, bobwhites weakened by disease are exceedingly vulnerable to predation and theoretically would also be underrepresented.

Table 1. Primary and secondary diagnostic findings in 127 wild bobwhites submitted to SCWDS for diagnostic purposes between 1972 and 1981.[a]

Category/Agent	Primary Factor		Secondary[b] Factor	
Trauma				
Gunshot	10		24	
Impact	9		0	
Predation	4		0	
Penetrating wounds	3		0	
Undertermined	12		0	
Total	38	(30%)	24	(19%)
Toxicoses				
Azodrin[R]	4		0	
Aflatoxicosis	1		0	
Unconfirmed	9		0	
Total	14	(11%)	0	
Viral Infections				
Avian pox	51		5	
Total	51	(40%)	5	(4%)
Bacterial Infections				
Bumblefoot (*Bacillus* sp.)	1		0	
Undetermined	0		4	
Total	1	(1%)	4	(3%)
Mycotic Infections				
Aspergillosis	1		0	
Airsaculitis (*Mucor* sp.)	1		0	
Undetermined	1		1	
Total	3	(2%)	1	(1%)
Parasitic Infections				
Toxoplasmosis	1		0	
Cyrnea colini, *Cheilospirura spinosa*, *Dispharynx nasuta*	2		0	
Total	3	(2%)	0	
Miscellaneous				
Intrathoracic Hemorrhage	2		0	
Crop Impaction	1		0	
Kidney Dysfunction	1		0	
Malnutrition, Dehydration	1		1	
Degenerative Myopathy	0		1	
Abdominal hernia	0		1	
Normal	9		0	
Undetermined	3		0	
Total	17	(13%)	3	(2%)
Grand Total	127	(100%)	37	(29%)

[a] In some cases diagnostic findings were multiple and were rated as primary or secondary factors.
[b] All secondary gunshot entries involved hunter-killed birds that were submitted due to external lesions or abnormal behavior; all secondary avian pox entries involved detection of pox lesions incidental to other diagnostic findings; all secondary entries under bacterial, mycotic, or miscellaneous headings were a direct result of prior traumatic injuries.

Clinical case data on toxicoses in bobwhites reveal sporadic occurrence and a high percentage of unconfirmed cases. Generally, poisoning is one of the first causes considered when sick or dead wildlife are encountered, but as noted by Hayes and Prestwood (1969), it is not nearly as frequent as commonly thought. Furthermore, toxicoses are difficult to confirm especially when few specimens are found and case histories provide no clues on suspected poisons.

In addition to the 127 wild bobwhites in Table 1, nine case accessions totaling 20 pen-raised bobwhites were examined. The diagnoses for these accessions were gunshot--one accession; malnutrition--one accession; stress (probably suffocation and heat prostration)--one accession; avian pox--three accessions; blackhead--two accessions; and pneumonia/sinusitis--one accession. In addition, one of the blackhead cases had a secondary factor of crop capillariasis. With the exception of the diagnoses of gunshot and avian pox, the diseases and conditions observed in pen-raised bobwhites are most often considered "diseases of confinement." They were not encountered in wild bobwhites.

Avian Pox

Information on avian pox in wild southeastern bobwhites has been summarized in detail (Davidson et al. 1980a, 1982). Briefly, avian pox is entrenched in wild bobwhites in the Southeast and in 1978 occurred in outbreak proportions. Following the outbreak, pox has been detected annually and has been an important disease of bobwhites in local areas. Avian pox is the only infectious disease (Table 2) of wild bobwhites that has been directly associated with significant annual mortality. Gross lesions of pox infection typically are proliferative lesions on epithelial tissues of the skin, nares, and oral cavity. Lesions can cause fatalities by impairing vision, respiration, or feeding, or they can result in death indirectly by increasing vulnerability to predation.

Table 2. Infectious agents encountered in wild bobwhites in the Southeast (compiled from Davidson et al. 1980, Wiseman 1979, King et al. 1981, SCWDS, unpubl. data).

Viral agents[a]	Quail bronchitis virus (QBV), TR-59 adenovirus, avian pox virus
Bacterial agents	*Bacillus* sp.
Mycotic agents	*Aspergillus* sp., *Mucor* sp., *Candida albicans*

[a]Serologic tests for Newcastle disease virus and isolation attempts for influenza A viruses were uniformly negative.

Aflatoxicosis

A three-year study was completed on Tall Timbers Research Station (1) to determine whether mycotoxins occur in grain crops (corn primarily) used by wild bobwhites for feed, (2) to determine whether these mycotoxins (aflatoxins) were ingested by bobwhites, and (3) to evaluate whether ingested levels had caused any pathologic changes in the animal. Aflatoxins were cyclically present in these crops, were ingested by bobwhites, and on occasion did produce slight to moderate pathologic processes. A range of levels of aflatoxins found to normally occur in corn (0.5, 1.0, 2.0, and 4.0 ppm) was fed to fourth generation-removed pen-raised bobwhites, and physiochemical and pathophysiologic parameters were measured. No significant abnormalities were noted until the level of aflatoxin in the feed equalled or exceeded the highest level found to naturally occur in field corn. Analysis of tissues from birds also yielded active aflatoxins in various forms. The abnormalities noted in physiochemical parameters loosely paralleled those documented in other gallinaceous birds (Peckham 1978). In the experimental birds, egg production also was significantly affected. The relationship between aflatoxicosis and protein synthesis inhibition, especially in the globulin components, deserves further study since immunosuppression is a consistent effect of aflatoxicosis in commercial poultry. This study suggests that aflatoxicosis alone probably is not a regular or major mortality factor in wild bobwhites (SCWDS, unpubl. data).

Avian Adenoviruses

Quail bronchitis, caused by an avian adenovirus (quail bronchitus virus-QBV), is an acute respiratory disease characterized by rapid spread and high mortality (DuBose 1978). Clinical disease has been described only in young (< 8 week old) pen-raised bobwhites, and experimental transmission studies most often fail to reproduce clinical disease (DuBose 1978). Recent studies suggest that an additional viral agent (avian adenovirus-associated virus--A-AV) may be required for the production of clinical disease (Bagshaw et al. 1980).

During studies on diseases and parasites of bobwhites at Tall Timbers Research Station in February 1975, intranuclear inclusion bodies were detected in the livers of many bobwhites. Since that time, a series of studies has been conducted to identify the agent (presumed to be a virus) responsible for these inclusion bodies. Serologic tests and virus isolation attempts on bobwhites from Tall Timbers and two nearby bobwhite populations in Georgia revealed infections of avian adenoviruses (Table 2). Two related viruses, QBV and TR-59 adenovirus, were isolated (Wiseman 1979, King et al. 1981). Either one or both viruses are considered to be the etiologic agent(s) of the inclusion bodies (King et al. 1981).

Histopathologic studies also have revealed small, inconspicuous lesions (microfocal necrosis, lymphocytic infiltration, microgranulomas) in the

livers of bobwhites. These lesions, many of which are not visible grossly but are detected histologically, are associated ($P < 0.05$) with the presence of viral inclusion bodies (SCWDS, unpubl. data). Juvenile birds had higher ($P < 0.01$) prevalences of inclusion bodies than adults (46 percent vs 27 percent) (SCWDS, unpubl. data), but adult birds more frequently had antibodies (King et al. 1981). Differences in the prevalence of inclusion bodies or antibodies were not noted between sexes ($P > 0.05$). Bobwhites sampled annually in February from 1975 through 1980 on each of two 200 ha study areas on Tall Timbers Research Station had identical trends in the prevalence of intranuclear inclusion bodies. The trend comprised a steady rise in prevalence (except for a slight decline in 1978) from $\leq$ 10 percent in 1975 to a peak (45 and 60 percent) in 1979, then an abrupt decline in 1980 ($\leq$ 9 percent).

These findings indicate that wild bobwhites in at least some locales are naturally infected with QBV and TR-59 adenoviruses; however, clinical disease in wild bobwhites has not been attributed to these infections. Further, the significance of intranuclear inclusion bodies in hepatocytes is unknown (i.e., do they represent active infections, latent viral particles, an immune host, etc.). The potential of these viruses to produce clinical disease in wild bobwhites and possibly influence bobwhite population levels deserves clarification.

Parasitism

Since 1963, the SCWDS has conducted various research projects on parasitism in bobwhites on an annual basis, and most of these studies have been reported elsewhere (Kellogg and Prestwood 1968; Kellogg and Reid 1970; Palermo and Doster 1970; Davidson et al. 1978, 1980b; Doster et al. 1980). In addition to the above reports, SCWDS has monitored parasitism in bobwhites (N=600) at known densities on two study areas on Tall Timbers Research Station for 12 consecutive years (1971-1982) as part of a long-term study of bobwhite population dynamics. Species of parasites found in these studies and an assessment of their pathogenic potentials are summarized in Tables 3-5.

An overview of these data reveals that parasitism in bobwhites is almost invariably subclinical and that parasites which occur frequently in wild bobwhites have limited pathogenicity. These studies suggest that parasitism is not an important regulator of bobwhite populations.

Disease Risks from Pen-raised Bobwhites

The practice of releasing pen-raised bobwhites for sporting purposes (i.e., hunting, dog training, field trials) is common in many areas and often is controversial because of concern for disease risks and other reasons. We have had numerous occasions to study the potential disease problems that could arise from this practice, and the following is a synopsis of our view on the

Table 3. Protozoan parasites found in wild bobwhites from the Southeast (compiled from checklist by Kellogg and Doster 1972).

Organism/Group	Location	Pathogenicity
Coccidia		
Eimeria spp.	Intestine	None reported
Eimeria dispersa	Intestine	None reported
Blood Parasites		
Haemoproteus sp.	Erythrocytes	None reported
Plasmodium spp.	Erythrocytes	None reported
Flagellates		
Trichomonas spp.	Ceca	None reported
Histomonas meleagridis[a]	Ceca, Liver	Moderately severe--30-70% mortality

[a]Reports in wild bobwhites are extremely infrequent; rather frequent in pen-raised bobwhites.

disease risks from this practice. We realize that releases of pen-raised bobwhites often are mandated by the objectives of some landowners, particularly commercial shooting preserves. Our position is that it is in the best interest of the landowner from an economic standpoint and the wildlife resources from a biologic standpoint that only healthy bobwhites are used.

Significant diseases and parasites of pen-raised bobwhites are tabulated in Table 6. Also included in the table are our assessments of the risk each agent poses to wild bobwhites or other wild game birds. Most of these diseases or parasites appear to reach problem levels only under pen-raised conditions and can be categorized as "diseases of confinement." Only two diseases, avian pox and histomoniasis (blackhead disease), are presently considered to have substantial risks to wild game birds. A high risk rating was applied to these two diseases because (1) they produce high morbidity and mortality rates, (2) they are capable of persisting under field conditions, (3) they have been detected under natural conditions, and (4) their occurrence in the wild occasionally has been associated with releases of bobwhites. The cecal worm, *Heterakis gallinarum*, also is listed as a high risk since it is the vector for histomoniasis.

We have observed instances where both avian pox and blackhead disease have been present in pen-raised bobwhites destined for release, and we also have found both diseases in clinical case accessions of pen-raised bobwhites from the field following release. The potential for bobwhites to serve as disseminators of blackhead disease among wild turkeys (*Meleagris gallopavo*) has been evaluated by various researchers (Davidson et al. 1978, Kellogg and Reid 1970, Lund and Chute 1971). Clearly pen-raised bobwhites pose a greater risk as blackhead carriers than wild bobwhites

Table 4. Helminth parasites found in 937 wild bobwhites from the Southeast (compiled from Davidson et al. 1980b, Kellogg and Prestwood 1968, Palermo and Doster 1970, and SCWDS, unpubl. data).[a]

Group/Location	Species	Pathogenicity
Trematodes		
Intestine	Brachylaima sp.	None reported
Liver	Brachylecithum nanum	None reported
Cestodes		
Intestine	Hymenolepis sp., Raillietina cesticillus, R. colinia, Rhabdometra odiosa	Mild-occasional intestinal obstruction
Acanthocephalans		
Intestine	Mediorhynchus papillosis	None reported
Nematodes		
Eye	Oxyspirura matogrosensis	None reported
Air sacs	Aproctella stoddardi	Mild inflammation
Crop	Capillaria contorta	None reported
Esophagus	Gongylonema ingluvicola	None reported
Proventriculus	Cyrnea colini, Dispharynx nasuta,	
	Tetrameres pattersoni	Mild inflammation
Gizzard	Cheilospirura spinosa	Mild inflammation
Intestine	Ascaridia lineata, Capillaria sp.,	
	Strongyloides avium,	None reported
Ceca	Heterakis bonasae, H. gallinarum, Subulura sp., S. brumpti,	
	Trichostrongylus tenuis	None reported

[a]SCWDS unpublished data include bobwhites from the following locations: 500-Tall Timbers Research Station, Leon Co., FL; 62-Corbett Wildlife Management Area, Palm Beach Co., FL; 44-Catfish Point. Bolivar Co., MS; 25-Quantico Marine Corps Base Prince William/Stafford counties, VA; 20-Pulaski, Prairie, and Lonoke counties, AR; and 10-Charlotte Co., FL.

Table 5. Arthropod parasites collected from 481 wild bobwhites from the Southeast (adapted from Doster et al. 1980)[a]

Ticks	Amblyomma americanum, A. maculatum, Haemaphysalis chordeilis, H. leporispalustris, Ixodes minor
Chiggers	Eutrombicula alfreddugesi, Neoschoengastia americana, Neotrombicula whartoni
Nasal mites	Boydaia colini, Colinoptes cubanensis
Feather mites	Pterolichus sp., Megninia sp.
Shaft mites	Coliniphilus wilsoni, Dermoglyphus sp., Apionacarus wilsoni
Skin mites	Microlichus sp., Rivoltasia sp.
Lice	Menacanthus pricei, Colinicola numidiana, Gonoides ortygis, Oxylipeurus clavatus

[a]Significant lesions were not associated with any species.

Table 6. Important infectious agents and parasites often encountered in pen-raised bobwhites and their significance to wild bobwhites and other game birds.[a]

Etiologic Agent	Disease Produced	Risks to Wild Bobwhites
Infectious Agents		
Quail bronchitis virus (QBV)	Quail bronchitis	Unknown--occurs naturally in wild bobwhites in some areas
Avian pox virus	Avian pox	High risk--can initiate or exacerbate the occurrence of pox in wild bobwhites and possibly other game birds
Clostridium colini	Ulcerative enteritis	Apparently low risk--never reported from wild bobwhites
Aspergillus fumigatus	Aspergillosis	Low risk--organism is ubiquitous
Candida albicans	Crop mycosis	Low risk--organism is ubiquitous
Parasites		
Histomonas meleagridis	Histomoniasis (blackhead disease)	High risk--pathogenic to wild bobwhites and wild turkeys
Capillaria contorta	Crop capillariasis	Low risk--extremely rare in wild birds
Dispharynx nasuta	Dispharynxosis	Low risk--parasite is ubiquitous
Heterakis gallinarum	None (blackhead vector)	High risk--important as vector for blackhead disease

[a]Information in this table is derived from the authors' experiences with bobwhite diseases, and conclusions are based on their assessments of disease risks.

(Davidson et al. 1978). Initiation or exacerbation of avian pox problems by the release of pen-raised bobwhites has not been definitely proved, but we have noted situations where this was strongly suspected.

The best precaution for minimizing risks from these diseases is to examine by necropsy a sample of bobwhites prior to release. There are prevention and control measures (basically sanitation and the judicious use of vaccination and medication) available to producers of pen-raised bobwhites that will help ensure minimal disease problems. These procedures should be conducted with the supervision of a poultry diagnostic laboratory or other qualified professional.

LITERATURE CITED

Bagshaw, C., V. J. Yates, A. D. Pronovost, and P. W. Chang. 1980. Enhancement and inhibition of CELO virus pathogenicity in quail by avian adenovirus-associated virus. J. Wildl. Dis. 16:287-291.

Davidson, W. R., G. L. Doster, and M. B. McGhee. 1978. Failure of *Heterakis bonasae* to transmit *Histomonas meleagridis*. Avian Dis. 22:627-632.

_____, F. E. Kellogg, and G. L. Doster. 1980a. An epornitic of avian pox in wild bobwhite quail. J. Wildl. Dis. 16:293-298.

_____, _____, and _____. 1980b. Seasonal trends of helminth parasites of bobwhite quail. J. Wildl. Dis. 16:367-375.

_____, _____, and _____. 1982. Avian pox infections in southeastern bobwhites: historical and recent information. Pages 64-68 in F. Schitoskey, Jr., E. C. Schitoskey, and L. G. Talent, eds. Proc. 2nd Natl. Bobwhite Quail Symp. Okla. State Univ., Stillwater.

Doster, G. L., F. E. Kellogg, W. R. Davidson, and W. M. Martin. 1982. Hunter success and crippling losses for bobwhite quail. Pages 45-47 in F. Schitoskey, Jr., E. C. Schitoskey, and L. G. Talent, eds. Proc. 2nd Natl. Bobwhite Quail Symp. Okla. State Univ., Stillwater.

_____, N. Wilson, and F. E. Kellogg. 1980. Ectoparasites collected from bobwhite quail in the southeastern United States. J. Wildl. Dis. 16:515-520.

DuBose, R. T. 1978. Quail bronchitis. Pages 587-590 in M. S. Hofstad, B. W. Calnek, C. F. Helmboldt, W. M. Reid, and H. W. Yoder, Jr., eds. Diseases of poultry, 7th ed. Iowa State Univ. Press, Ames.

Hayes, F. A., and A. K. Prestwood. 1969. Some considerations for diseases and parasites of white-tailed deer in the southeastern United States. Proc. Symp. White-tailed Deer in the Southern Forest Habitat, Nacogdoches, Texas. pp. 32-36.

Kellogg, F. E., and J. P. Calpin. 1971. A checklist of parasites and diseases reported from the bobwhite quail. Avian Dis. 15:704-715.

_____, and G. L. Doster. 1971. Bobwhite quail: Total hunter kill compared to number retrieved. Proc. Ann. Conf. Southeast. Assoc. Game and Fish. Comm. 25:147-149.

_____, and _____. 1972. Diseases and parasites of the bobwhite. Pages 233-267 in J. A. Morrison and J. C. Lewis, eds. Proc. 1st Natl. Bobwhite Quail Symp. Okla. State Univ., Stillwater.

_____, and A. K. Prestwood. 1968. Gastrointestinal helminths from wild and pen-raised bobwhites. J. Wildl. Manage. 32:468-475.

_____, and W. M. Reid. 1970. Bobwhites as possible reservoir hosts for blackhead in wild turkeys. J. Wildl. Manage. 34:155-159.

King, D. J., S. R. Pursglove, Jr., and W. R. Davidson. 1981. Adenovirus isolation and serology from wild bobwhite quail (Colinus virginianus). Avian Dis. 25:678-682.

Lund, E. E., and A. M. Chute. 1971. Bobwhite, Colinus virginianus, as host for Heterakis and Histomonas. J. Wildl. Dis. 7:70-75.

Palermo, R. J., and G. L. Doster. 1970. A comparison of the late winter foods and parasites of bobwhite quail and black francolins in southwestern Louisiana. Proc. Ann. Conf. Southeast. Assoc. Game and Fish Comm. 24:206-212.

Peckham, M. C. 1978. Poisons and toxins. Pages 895-933 in M. S. Hofstad, B. W. Calnek, C. F. Helmboldt, W. M. Reid, and H. W. Yoder, Jr., eds. Diseases of poultry, 7th ed. Iowa State Univ. Press, Ames.

Wiseman, S. P. 1979. Isolation, characterization, and distribution of an adenovirus of wild bobwhite quail. M.S. Thesis, The University of Georgia, Athens. 59pp.