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Authors: Demarais, Stephen, Everett, Daniel D., and Pons, Maxwell L.

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SEASONAL COMPARISON OF ENDOPARASITES OF NORTHERN BOBWHITES FROM TWO TYPES OF HABITAT IN SOUTHERN TEXAS

Stephen Demarais,[1] Daniel D. Everett,[2] and Maxwell L. Pons[2]

[1] Department of Range and Wildlife Management, Texas Tech University, Lubbock, Texas 79409, USA
[2] Caesar Kleberg Wildlife Research Institute, Texas A&I University, Kingsville, Texas 78363, USA

ABSTRACT: Two nematode species, one acanthocephalan species, and unidentified cestodes were recovered from a total of 481 northern bobwhites (*Colinus virginianus*) collected from January 1982 to December 1983 in southern Texas. The nematodes *Aulonocephalus lindquisti* and *Trichostrongylus tenuis* varied in prevalence with month and locality. *Mediorhynchus papillosis* was recovered from only two birds. Monthly and yearly rainfall patterns were not correlated with endoparasite intensity and prevalence, which indicates that fluctuations of populations of northern bobwhites in Texas may be caused by factors other than changes in prevalence and intensity of endoparasites.

Key words: Northern bobwhite, endoparasites, nematodes, acanthocephala, *Colinus virginianus*, seasonal effects, habitat effects.

INTRODUCTION

Economic return from northern bobwhites in the form of hunting leases is extensive in Texas, but is moderated by radical yearly population fluctuations. Although rainfall is assumed to be the primary cause of these fluctuations (Rosene, 1969), its effects may be indirect. Lehmann (1984) concluded that high intensities of parasites during drought could induce heavier than normal losses among juvenile bobwhites.

In the southeastern United States, Davidson et al. (1982) stated that parasitism in wild bobwhites is almost always subclinical and that the common parasites had limited pathogenicity. They also said that disease agents may have different epizootiologic patterns and significance in different geographic regions. Reports of the helminths of bobwhites in southern Texas during the 1940's (Webster and Addis, 1945; Webster, 1947) did not include epizootiologic variables. This paper examines the effects of locality, season, year, and host sex and age on helminths of northern bobwhites in southern Texas.

MATERIALS AND METHODS

Juvenile and adult birds of both sexes were collected during January–December 1983 on the Welder-McCan Ranch and during February 1982–December 1983 on the Miller Ranch. Carcasses were placed on ice, returned to the lab, and frozen after the crops and reproductive organs were removed. After thawing, the abdominal cavity of each bird was rinsed into a 100-mesh sieve and the rinsed material was stored in 5% formalin. The alimentary tract, excluding crop, was opened and scraped contents were washed through a 100-mesh sieve and stored in 5% formalin. Helminths were located with the aid of a 10–30× dissecting microscope. Nematodes were cleared in ethanol-glycerin and mounted in pure glycerin. Cestodes were stained in Semichon's acetocarmine and mounted in Canada balsam. Representative specimens have been deposited in the U.S. National Parasite Collection (Beltsville, Maryland 20705, USA) as USNM Helm. Coll. Nos. 79277–79280.

The two study areas were chosen because they varied in soil type and average annual rainfall. The 7,416 ha Welder-McCan Ranch in Refugio County, Texas (28°31′N, 98°47′W), has poorly drained, heavy clay soils. The 131 cm of rainfall during 1983 exceeded the longterm average of 88 cm (Table 1). Dominant vegetation is a dense overstory of honey mesquite (*Prosopis glandulosa*) and huisache (*Acacia farnesiana*) (Koerth, 1985). The 1,589 ha Miller Ranch in Brooks County, Texas (27°23′N, 99°51′W), has deep sand and sandy loam soils. Dominant vegetation consists of threeawn (*Aristida* spp.) and Pan American balsamscale (*Elyonurus tripsacoides*) grassland with mottes of honey mesquite and granjeno (*Celtis pallida*) (Wood, 1985). Precipitation was only 40 cm in 1982, but exceeded 67 cm in 1983 (Table 1). The longterm average precipitation for the Miller Ranch area is 61 cm. Livestock grazing was continuous on both

TABLE 1. Total precipitation (cm) at weather stations[a] near the study areas in southern Texas.

Sample period	Miller Ranch (1982)	Miller Ranch (1983)	Welder-McCan Ranch (1983)
January	0.1	2.3	2.3
February	15.8	9.6	8.2
March	0.5	3.7	7.9
April	1.8	0	0.1
May	6.6	6.2	7.0
June	1.8	N.D.	7.8
July	0.4	14.0	31.1
August	3.1	6.2	8.8
September	1.2	8.3	21.7
October	4.2	12.3	30.1
November	3.2	3.0	5.1
December	1.5	1.4	1.4
Annual	40.1	>67.0	131.5
Long-term average	61.0	61.0	88.0

[a] National Oceanic and Atmospheric Administration weather stations.

ranches with a stocking rate of about 4 ha per animal unit.

Data on intensity and prevalence were analyzed statistically only when the total prevalence on an area exceeded 10%. Intensity data for each parasite species were independently rank-transformed (Conover and Inman, 1981) and subjected to two-way analysis of variance using the GLM procedure of SAS (SAS Institute Inc., 1982). Initial analyses using two-way analysis of variance tested effects of month and age for each sex and effects of month and sex for each age. Birds of all sexes and ages were combined for additional two-way analyses of month and year effects and month and locality effects because there were no significant treatment effects and interactions. Prevalence data were analyzed in a similar manner with a chi-square test using the FREQ procedure of SAS. Spearman's correlation coefficients were used to quantify the association of monthly prevalence and mean intensity with total monthly rainfall for the month prior to collection using the CORR procedure of SAS. The terms intensity and prevalence follow Margolis et al. (1982).

RESULTS AND DISCUSSION

Two nematode species, one acanthocephalan species, and unidentified cestodes were recovered from 481 bobwhites sampled on the two study areas from January 1982 through December 1983. The nematodes *Trichostrongylus tenuis* (Mehlis, 1846) Railliet and Henry, 1909 and *Aulonocephalus lindquisti* Chandler, 1935 were the most prevalent helminths (Tables 2, 3). The acanthocephalan *Mediorhyn-*

TABLE 2. Prevalence (%) and intensity of *Trichostrongylus tenuis* and *Aulonocephalus lindquisti* in northern bobwhites collected on the Welder-McCan Ranch, Refugio County, Texas, during 1983.

Sample period	n	*Trichostrongylus tenuis* Prevalence[a] (%)	Intensity $\bar{x} \pm$ SE	Range	*Aulonocephalus lindquisti* Prevalence[a] (%)	Intensity[b] $\bar{x} \pm$ SE	Range
January	2	0	0 ± 0	0	0	0 ± 0	0
February	11	73	31 ± 10	1–93	9	1 ± 0	1
March	0	—	—	—	—	—	—
April	7	43	7 ± 3	3–12	0	0 ± 0	0
May	0	—	—	—	—	—	—
June	4	25	5 ± 0	5	25	1 ± 0	1
July	14	64	12 ± 6	1–55	14	1 ± 0	1
August	13	31	35 ± 32	1–131	8	2 ± 0	2
September	11	27	3 ± 1	1–5	9	1 ± 0	1
October	7	0	0 ± 0	0	0	0 ± 0	0
November	18	0	0 ± 0	0	0	1 ± 0	1
December	22	0	0 ± 0	0	0	0 ± 0	0
Totals	109	26	19 ± 6	1–131	6	1 ± 1	1–2

[a] Effect of month ($P < 0.05$) on prevalence.

[b] Significance of month on prevalence and intensity not tested because of low prevalence.

TABLE 3. Prevalence (%) and intensity of infection by *Aulonocephalus lindquisti* in northern bobwhites collected on the Miller Ranch, Brooks County, Texas, during 1982–1983.

Sample period	1982				1983			
	n	Prevalence[a] (%)	Intensity $\bar{x} \pm SE$	Intensity Range	*n*	Prevalence[a] (%)	Intensity $\bar{x} \pm SE$	Intensity Range
January	—	—	—	—	2	100	7 ± 5	2–11
February	18	83	9 ± 3	1–31	14	14	49 ± 44	5–92
March	16	56	8 ± 4	1–40	17	47	2 ± 1	1–7
April	17	6	12 ± 6	1–66	13	46	2 ± 1	1–3
May	16	38	3 ± 1	1–9	12	58	2 ± 1	1–3
June	30	70	6 ± 2	1–30	24	42	4 ± 1	1–11
July	18	17	8 ± 4	1–16	20	50	7 ± 3	1–26
August	21	43	12 ± 9	1–84	15	40	15 ± 6	1–31
September	19	26	5 ± 4	1–19	12	17	2 ± 1	1–2
October	14	21	3 ± 2	1–7	13	39	7 ± 5	1–25
November	16	56	9 ± 6	1–50	12	58	8 ± 4	1–30
December	18	50	4 ± 2	1–15	15	67	7 ± 3	1–22
Totals	203	49	8 ± 1	1–84	169	44	7 ± 1	1–92

[a] Effect of month ($P < 0.001$) on prevalence.

chus papillosis Van Cleave, 1916 was recovered from only one bird on each of the study areas.

The parasite fauna of northern bobwhites in southern Texas appears not to be as distinct as concluded by Parmalee (1952). New range records for Texas include *Trichostrongylus tenuis* and *Mediorhynchus papillosis*. Lehmann (1984) reported single specimens of *Mediorhynchus* sp. in four of 113 bobwhites from southern Texas. *Aulonocephalus lindquisti* has been reported from Texas (Webster and Addis, 1945; Webster, 1947; Lehmann, 1953; Gruver, 1984) and Oklahoma (Rollins, 1980).

Cestodes were recovered from 13% and 12% of birds on the Welder-McCan and Miller ranches, respectively, with highest prevalence from March to August. Cestode identification and numbers were not determined due to the condition of the specimens, so no statistical analysis was conducted. Lehmann (1984) considered the effect of cestodes on bobwhites to be negligible because of their low prevalence and intensity.

Host age and sex did not affect ($P <$ 0.05) parasite intensity and prevalence. Similar results were reported for *A. lindquisti* in southern Texas (Lehmann, 1953, 1984), for six species of helminths in east-central Texas (Parmalee, 1952), and for four of five nematode species in Florida (Forrester et al., 1984). Parasitism of juvenile bobwhites approached the intensity of adults by mid-winter in another study in Florida (Davidson et al., 1980).

Month of collection influenced ($P <$ 0.05) prevalence of *T. tenuis* on the Welder-McCan Ranch (Table 2). Prevalence and intensity of *T. tenuis* on the Welder-McCan Ranch were similar to values reported from six locations throughout Florida by Forrester et al. (1984) but well below the values of 98% prevalence and 59 worms/infected adult bird in a high-density population in Florida (Davidson et al., 1980). Prevalence and intensity of *A. lindquisti* (Tables 2, 3) were approximately one-half of previously reported values, but the seasonal pattern during 1983 on the Miller Ranch was similar to that detailed by Lehmann (1953, 1984).

Intensity and prevalence of *A. lindquisti* were higher ($P < 0.01$) on the Miller Ranch than on the Welder-McCan Ranch. *Trichostrongylus tenuis* occurred only on the Welder-McCan Ranch. The well drained soils and 25% lower long-term average rainfall probably reduced the survival of infective larvae on the Miller Ranch.

Lehmann (1984) hypothesized that high parasite intensity may have been involved in drought-related mortality of young bobwhites during the winter of 1951–1952. Data from our study do not support Lehmann's theory. Juvenile birds had the same intensity and prevalence of parasites as adult birds. Monthly intensity and prevalence were not correlated ($P > 0.05$) with total rainfall for the month prior to collection of the birds. Additionally, intensity and prevalence did not differ between 1982 and 1983 even though 1982 was much drier than 1983 (Table 1). Lehmann's high wintertime counts of *A. lindquisti* may have been merely the normal seasonal changes for this parasite. It should be noted, however, that the drought of 1982 was not as extensive as the drought of the 1950's (Lehmann, 1984). Additionally, the effect of drought on populations of bobwhites could be related more to age-related differential pathogenicity than to differential susceptibility to infection. A long-term study utilizing diagnostic criteria which are sensitive to helminth pathogenicity would more fully test the effect of helminths on drought-related population fluctuations of northern bobwhites in southern Texas.

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Journal of Wildlife Diseases, 23(2), 1987, p. 260

BOOK REVIEW . . .

Rabies in Florida, Michael J. Burridge, Leigh A. Sawyer, and William J. Bigler. Department of Health and Rehabilitative Services, State of Florida, 1317 Winewood Boulevard, Tallahassee, Florida 32301, USA. 1986. 147 pp. $6.83 US.

This monograph on rabies in Florida is a revision of an earlier edition. It is well organized; nine chapters discuss both rabies in general and the disease in various mammalian species of Florida in specific. Although summaries of reported rabies cases by species and some epidemiologic information on rabies in Florida are emphasized, relationships to reported rabies in the rest of the United States are also provided.

The authors have extracted from the extensive literature on rabies the relevant information on the virus, the disease, laboratory diagnosis, and prevention and control of rabies in animals. Temporal and geographic information on rabies reported during the last decade in each wild, domestic, and exotic animal species in Florida are presented in three chapters. In addition, information on incubation periods, behavioral changes, and clinical symptoms due to rabies for each of the important species are provided. There are chapters on reported cases and the disease in humans and on pre- and postexposure prophylaxis and treatment of exposed persons. The appendices contain tables of reported cases of rabies in the important animal species by county in Florida for 1947–1983, a summary of human cases in Florida, copies of animal bite evaluation forms and specimen submission and testing forms, and sources of human vaccine and antiserum.

The publication is well written and has very few typographical errors. The only serious error is a misplacement in Chapter 3 of several paragraphs on rodent rabies in the section on bobcats. Several tables and a few figures are included in the chapters; they are clear, concise, and quite helpful to the reader. Many of the tables, particularly in the appendices, are quite lengthy, but the information provided justifies their size. The photographs are unnecessary to the text, but do add to the visual appeal of the chapters. An extensive list of references is provided for each chapter. The references are comprehensive, current, and quite useful.

The monograph is written as a reference for the disease specialist. It contains pertinent information on vaccines, risk evaluation, diagnosis, and treatment for the veterinary and medical practitioner and local public health officials. It may be frustrating for some readers to not find information about local animal vaccination requirements or animal control procedures, but this omission appears to be due to the lack of appropriate laws in Florida and not to a deficiency in the publication.

The monograph does not put rabies in perspective for the wildlife biologist. It provides information on wildlife species in which rabies has been reported but does not give information on the impact of rabies on wildlife populations. Wildlife biologists frequently ignore disease as a factor affecting the wildlife populations they manage; they deal with diseases generally only during the crisis of an epizootic. Some limited information on rabies in raccoon populations is included, but a separate chapter on the ecology of rabies in wildlife populations of Florida would have helped to inform wildlife managers about expected prevalences of rabies in various species and about the dynamics of the disease in a population.

Overall, the monograph is concise, informative, and invaluable for professionals dealing with rabies in Florida. The general chapters on rabies would be a handy reference for the disease specialist in other states. The style and quality of the monograph could serve as a model for other states to use in summarizing their information on and procedures for rabies.

Robert G. McLean, Division of Vector-Borne Viral Diseases, Center for Infectious Diseases, Centers for Disease Control, Fort Collins, Colorado 80522, USA.