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Authors: Moore, Janice, Freehling, Michael, and Simberloff, Daniel

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GASTROINTESTINAL HELMINTHS OF THE NORTHERN BOBWHITE IN FLORIDA: 1968 AND 1983

Janice Moore,[1] Michael Freehling,[2,4] and Daniel Simberloff[3]

ABSTRACT: We collected 153 northern bobwhites (*Colinus virginianus*) over a 10-mo period from Tall Timbers Research Station near Tallahassee, Florida, USA. Five species of gastrointestinal helminths were encountered commonly (>30% prevalence): *Cyrnea colini, Raillietina cesticillus, R. colinia, Heterakis isolonche*, and *Trichostrongylus tenuis*. Other helminths included *Brachylaima* sp., *Rhabdometra odiosa, Mediorhynchus papillosis, Cheilospirura spinosa, Dispharynx nasuta, Gongylonema ingluvicola*, and *Tetrameres pattersoni*. During the intervening 15 yr since the last year-round study of this population of birds, *C. spinosa* and *T. pattersoni* have declined markedly, and *Strongyloides* sp. probably has become extinct locally. Prevalence and intensity seem more likely to fluctuate in parasite species that have complex life cycles.

INTRODUCTION

The parasites of the northern bobwhite (*Colinus virginianus*) have been studied in many parts of the host's range (Kellogg and Calpin, 1971; Kellogg et al., 1972; Kocan et al., 1979; Davidson et al., 1980, 1982; Forrester et al., 1984; Lehmann, 1984). Most studies are based on single-year surveys (but see Forrester et al., 1984). Davidson and co-workers (1980) reported the results of a year-long monthly collection of parasites from bobwhites during 1968–1969 at Tall Timbers Research Station, Leon County, Florida. (We will refer to this as the 1968 study.) We studied the same population for 10 mo (1983–1984), hereafter called the 1983 study. Here we present our observations of prevalence and intensity and compare them to those of the previous study.

MATERIALS AND METHODS

One hundred fifty-three northern bobwhites were shot and their intestinal tracts were removed quickly and frozen. When the tracts were thawed, helminth recovery methods of Kellogg and Prestwood (1968) were used. Unless otherwise indicated, all reported helminths are adults. In addition, we examined cecal tissue under a dissecting microscope after scraping and washing. This usually yielded additional specimens of *Trichostrongylus* that were embedded in the tissue. We used plumage analysis methods of Haugen (1957) to assign bobwhites to age categories. Data were not appropriate for parametric statistics; intensities were compared with Mann-Whitney U-tests. Prevalences were compared with G-tests. For statistical tests, $\alpha = 0.05$.

Our study differed from that of 1968 in that the number of birds per month was not constant (see Tables 2, 3), the number of males and females was not equal in some months, and our collection time was not limited to the middle of the month. We collected birds in areas immediately adjacent to 1968 collection sites.

Voucher specimens from this study have been deposited in the U.S. National Parasite Collection, Beltsville, Maryland (accession numbers 78976–78981).

RESULTS AND DISCUSSION

We found 12 species of helminths (Table 1). Of these, only five species exceeded 30% prevalence: *Raillietina colinia* and *R. cesticillus* (cestodes) and *Cyrnea colini, Heterakis isolonche* (=*H. bonasae*), and *Trichostrongylus tenuis* (nematodes). The acanthocephalan *Mediorhynchus papillosis* and the trematode *Brachylaima* sp. were rare in both studies. Other parasites that were once common (>30% prevalence) have declined dramatically (e.g.,

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[1] Department of Zoology, Colorado State University, Fort Collins, Colorado 80523, USA.
[2] Tall Timbers Research Station, Route 1, Box 160, Tallahassee, Florida 32312, USA.
[3] Department of Biological Science, Florida State University, Tallahassee, Florida 32306, USA.
[4] Present address: Department of Zoology, Colorado State University, Fort Collins, Colorado 80523, USA.

TABLE 1. Helminths recovered from adult and juvenile northern bobwhites from Tall Timbers Research Station, Leon County, Florida.

Helminth	Bobwhites, 1983–1984 Adults (n = 44)	Bobwhites, 1983–1984 Juveniles (n = 109)	Bobwhites, 1968–1969[a] Adults (n = 120)	Bobwhites, 1968–1969[a] Juveniles (n = 65)
Trematoda				
Brachylaima sp.	0	3.7 (1.5) 0–2[b]	0	0
Cestoda				
Hymenolepis sp.	0	0	1 (1) 1	0
Raillietina cesticillus	31.8 (10.2) 1–86	17.4 (17.6) 1–51	32 (14) 1–37	32 (20) 1–124
Raillietina colinia	54.6 (11.8) 1–40	82.6 (9.5) 1–59	43 (8) 1–98	52 (6) 1–40
Rhabdometra odiosa	0	0.9 (1.0) 1	3 (4) 2–8	8 (3) 1–8
Acanthocephala				
Mediorhynchus papillosis	0	0.9 (1.0) 1	1 (2) 2	0
Nematoda				
Cheilospirura spinosa	2.3 (1.0) 1	0	72 (5) 1–35	45 (3) 1–26
Cyrnea colini	100 (4.9) 1–19	97.3 (5.0) 1–19	72 (4) 1–21	85 (5) 1–18
Dispharynx nasuta	11.4 (2.8) 1–8	19.3 (1.4) 1–3	2 (1) 1	9 (1) 1
Gongylonema ingluvicola	0	0.9 (1.0) 1	2 (1) 1	0
Heterakis isolonche	100 (50.4) 1–186	99.1 (25.0) 1–125	100 (47) 3–198	97 (20) 1–86
Strongyloides sp.	0	0	22 (5) 1–17	5 (5) 1–10
Subulura sp.	0	0	1 (1) 1	2 (1) 1
Tetrameres pattersoni	4.6 (1.5) 1–2	0	78 (7) 1–58	71 (10) 1–65
Trichostrongylus tenuis	95.5 (51.6) 1–290	75.9 (72.1) 1–470	98 (59) 1–361	42 (16) 1–123

[a] 1968–1969 data from Davidson et al. (1980).
[b] Percent prevalence (average/infected bird) range.

Cheilospirura spinosa and *Tetrameres pattersoni*). This was probably not an artifact of disparate monthly sample sizes. Our largest sample was from February, when all common adult parasites were well-represented in the 1968 study. *Strongyloides* sp. appears to have become locally extinct in bobwhites from Tall Timbers.

Prevalence and intensity of the common species of helminths and comparable data from 1968 are shown in Figure 1 and

TABLE 2. Helminth parasitism in juvenile northern bobwhites from Tall Timbers Research Station, Leon County, Florida.

Helminth[a]	October (n = 15)	November (n = 9)	December (n = 5)	January (n = 9)	February (n = 49)
Dispharynx nasuta	7 (2.0) 2[b]	0 (0) 0	20 (2.0) 2	33 (1.7) 1–2	20 (1.4) 1–3
Raillietina cesticillus	27 (15.3) 1–36 40 (5)	11 (51.0) 51 40 (6)	20 (1.0) 1 40 (46)	0 (0) 0 20 (20)	23 (15.2) 1–50
Raillietina colinia	40 (5.5) 1–26 80 (6)	89 (4.0) 2–8 30 (17)	40 (9.5) 1–18 40 (3)	89 (9.0) 2–27 40 (6)	96 (13.1) 2–59
Cyrnea colini	100 (6.8) 1–19 60 (8)	89 (4.4) 1–10 90 (3)	80 (5.0) 2–11 90 (4)	100 (6.1) 1–10 100 (3)	100 (4.5) 1–12

[a] For *Heterakis* and *Trichostrongylus*, see Figure 1.
[b] Percent prevalence (average/infected bird) range—1983–1984. When two lines of data are displayed, the lower line is from the 1968 study and represents percent prevalence (average/infected bird), n = 10. 1983–1984 sample sizes are indicated under the month.

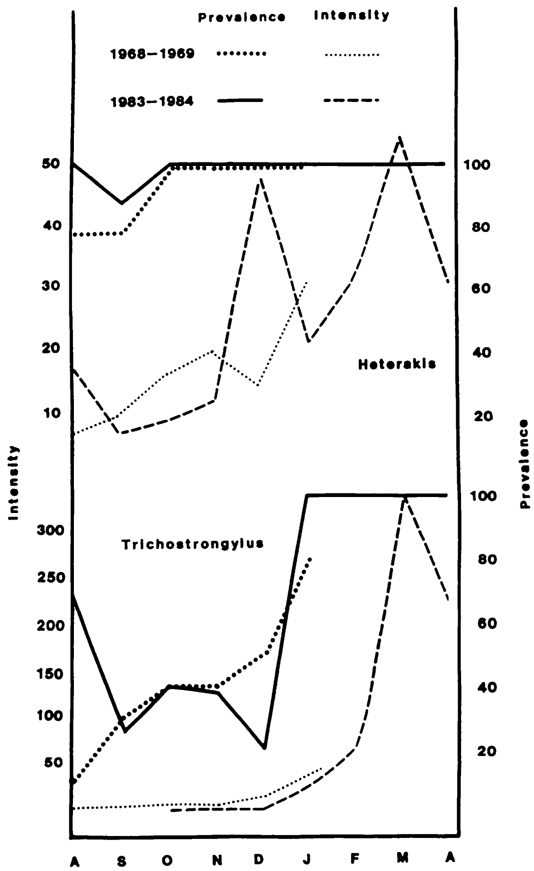

FIGURE 1. Prevalence and intensity of adult *Heterakis isolonche* and *Trichostrongylus tenuis* in juvenile northern bobwhites for 9 consecutive mo, 1968–1969 and 1983–1984. In 1968–1969, n = 10 quail/mo. In 1983–1984, n = 3 (August), 8 (September), 4 (March), 6 (April); see also Table 3. (Intensity data were not available for *T. tenuis* in August and September 1983.)

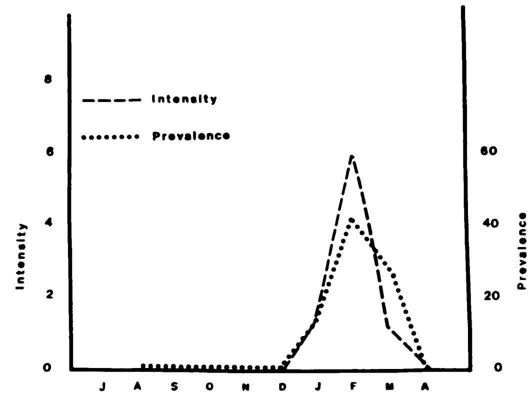

FIGURE 2. Prevalence and intensity of larvae of *Trichostrongylus tenuis* in juvenile northern bobwhite quail at Tall Timbers Research Station, 1983–1984.

Table 2 (juvenile birds) and Table 3 (adult birds). The Southeastern Cooperative Wildlife Disease Study (SCWDS) shared their 1968 data with us, and we were thus able to compare intensity and prevalence between 1968 and 1983 birds when sample size permitted (October + November and December + January for juveniles, October + November and February for adults; Table 4). Where differences were observed, 1968 values (both prevalence and intensity) usually were lower; the sole exception was the prevalence of *R. cesticillus* in December + January juvenile quail. This agrees with the trends for the entire sample (Table 1). In their 5-yr southern Florida study, Forrester and co-workers (1984) found statistically significant year-to-year differences in prevalence for four helminths (*C. colini*, *Ascaridia galli*, *T. tenuis* and *H. isolonche*), and significant intensity differences for *C. colini*.

Bobwhite populations have declined generally at Tall Timbers (Davidson, pers. comm.). This may have contributed to the local extinction of *Strongyloides* and decreases in *C. spinosa* and *T. pattersoni*. However, four of the five common helminths have increased in prevalence and/or intensity since 1968. This suggests that factors other than definitive host density may be influencing populations of helminths in bobwhites. Changes in the availability and susceptibility of intermediate hosts may be important in this regard. The joint decline of *C. spinosa* and *T. pattersoni*, the only two species with grasshoppers as intermediate hosts (Cram et al., 1931), is consistent with this suggestion, as is the fact that heteroxenous species exhibited more changes in intensity and prevalence than did monoxenous ones (Table 4).

TABLE 3. Helminth parasitism in adult northern bobwhites from Tall Timbers Research Station, Leon County, Florida.

Helminth	October (n = 4)	November (n = 6)	February (n = 14)
Dispharynx nasuta	25 (2.0) 2[a]	17 (2.0) 2	7 (1.0) 1
Raillietina cesticillus	0	50 (32.7) 2–86	21 (2.7) 1–6
	20 (2)	30 (2)	50 (7)
Raillietina colinia	0	50 (9.3) 1–26	93 (13.5) 2–36
	0 (0)	20 (1)	50 (3)
Cheilospirura spinosa	25 (1.0) 1	—	—
	80 (5)	90 (3)	70 (3)
Cyrnea colini	100 (3.0) 1–7	100 (4.2) 1–9	100 (3.3) 1–7 (n = 13)
	30 (4)	60 (2)	60 (4)
Heterakis isolonche	100 (78.6) 11–186	100 (25.1) 1–123	100 (51.7) 1–137
	100 (73)	100 (45)	100 (17)
H. isolonche (immature)	33 (1.0) 1 (n = 3)	83 (1.8) 1–3	64 (3.4) 1–9
	30 (5)	40 (2)	0 (0)
Tetrameres pattersoni	—	16.7 (2.0) 2	7 (1.0) 1
	80 (9)	80 (7)	80 (12)
Trichostrongylus tenuis	75 (19.7) 9–38	83 (20.3) 1–49	100 (92.8) 14–290
	90 (22)	100 (33)	100 (32)
T. tenuis (immature)	0	17 (1.0) 1	36 (8.2) 1–20

[a] Percent prevalence (average/infected bird) range—1983–1984. When two lines of data are displayed, the lower line is from the 1968 study and represents percent prevalence (average/infected bird), n = 10. 1983–1984 sample sizes are indicated under the month unless otherwise noted.

Abiotic conditions may be important also. These may contribute to the puzzling seasonal pattern exhibited by larvae of *T. tenuis* (Fig. 2). Under optimal conditions, this monoxenous nematode can develop from fresh egg to larva in 1–2 days, and once ingested, to adulthood in 4 days (Cram et al., 1931). Increases in prevalence and intensity of adult *T. tenuis* (Fig. 1, Table 2) accompanying similar increases in larvae (Fig. 2) confirmed the fact that, despite its potentially brief,

TABLE 4. Within-season comparisons of intensity and prevalence of common bobwhite quail helminths, 1968–1969 and 1983–1984.

Helminth	Intensity		Prevalence	
	Juvenile quail	Adult quail	Juvenile quail	Adult quail
Cyrnea colini	1968 lower ($P < 0.05$, Dec + Jan)	NS[a]	1968 lower ($P < 0.05$, Oct + Nov)	1968 lower ($P < 0.005$ Oct + Nov and Feb)
Raillietina cesticillus	1968 lower? ($P < 0.10$, Oct + Nov)	NS	1968 higher? ($P < 0.10$, Dec + Jan)	NS
Raillietina colinia	1968 lower? ($P < 0.10$, Dec + Jan)	NS	1968 lower? ($P < 0.10$, Dec + Jan)	1968 lower ($P < 0.025$, Feb)
Heterakis isolonche	NS	1968 lower ($P < 0.05$, Feb)	—	—
Trichostrongylus tenuis	NS	NS	NS	NS

[a] NS = not significant.

monoxenous life cycle, this is a seasonally occurring worm. Hon and co-workers (1978) observed similar *T. tenuis* seasonality in wild turkeys in southern Florida. Temperature and moisture have been shown to influence greatly the development of *T. tenuis* in the laboratory (Leiper, 1911) and of a congener (*T. vitrinus*) in the field (Callinan, 1979; Rose and Small, 1984). The other monoxenous helminth in this study, *H. isolonche,* exhibits a seasonal pattern similar to that of *T. tenuis* (Fig. 1), and may likewise be responsive to abiotic conditions. Although definitive host density clearly influences the population biology of bobwhite helminths (Davidson, pers. comm.), not all populations have behaved similarly over time, and other influences, such as intermediate host and abiotic factors, are implicated.

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