Journal of the Arkansas Academy of Science

Volume 38 Article 15

1984

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HELMINTHS OF COMMON GRACKLES (*QUISCALUS QUISCULA-VERSICOLOR*, VIEILLOT) IN CENTRAL ARKANSAS

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INTRODUCTION

Five studies on the helminths of common grackles (*Quiscalus quiscula versicolor*, Vieillot) have been published. Welker (1962) was the first investigator to examine large numbers of the host. His sampling from the northern lake region (110 hosts), central agricultural region (263), and the southern forest-agricultural region (33) of Indiana looked at both fall (195) and spring (211) birds. He catagorized the symbionts by geographical region, season and sex of the host. Stanley and Rabalais (1971) examined 19 adult common grackles in the spring from Erie County and from South Bass Island in Lake Erie in Ohio. Cooper and Crites (1974) analyzed 13 adult and 37 juvenile birds from South Bass Island. This latter summer study (July 1 to August 15) contains the first acknowledgements of the helminths of the juvenile bird. They recovered 15 species of helminths from 48 of 50 common grackles; 10 from adult birds and 15 from juvenile birds. Three trematodes *(Ornithodendrium imanensis, Plagiorchis noblei, Prosthogonimus macrorchis)*, one cestode *(Orthoskrjabinia rostellata)*, and one nematode *(Capillaria exilis)* were reported exclusively from juvenile birds at low infection rates and in small numbers. *Conspicuum icteridorum* (77%:35%), *Choanotaenia musculosa* (23:8), and *Chandlerella quiscali* (38:3) were more prevalent in adult birds. The reverse was true for *Capillaria ovopunctatum* (31:49), *Dispharynx nasuta* (8:35), *Porrocaecum ensicaudatum* (23:54), *Syngamus trachea* (38:64), and *Plagiorhynchus formosus* (31:65). *Anonchotaenia globata* and *Hymenolepis farciminosa* were present in both age groups in small numbers and equal percentages. The authors did not separate the hosts by sex nor did they separate the intensity of the infection in juveniles and adults where the helminth species were shared. This paper also tabulated the species of helminths previously reported from common grackles. Buck et al. (1975) examined 40 adult birds from central Ohio (Columbus) for helminths. Badley and Dronen (1979) posted 21 adult common grackles from Brazos County, Texas. Collections were made during the pre-breeding period in the spring.

Banding of wintering Arkansas common grackles over the past ten years indicates that the Arkansas birds do not migrate to any of the above surveyed areas. Of the 10,000 birds banded in Conway, Arkansas, only rarely are there recoveries east of the Mississippi River. Additionally, no recoveries have been made in Texas of the central Arkansas banded birds. Further, no recoveries of Indiana, Ohio, nor Texas birds have come from the Conway trapping. The central Arkansas common grackle population thus appears to be a separate group from those previously analyzed and constitutes a population not previously examined. This is further borne out by the extensive studies of Meanley. He did not recover Arkansas winter banded birds in any of the three states. A few Indiana and Ohio breeding birds were recovered from Arkansas wintering sites. No Arkansas connection was shown with the Texas birds. Arkansas common grackles migrate north-northwest in the spring (Meanley). The Arkansas breeding population comes largely from Arkansas but also from points south. The preponderance of wintering and pre-breeding birds have northern breeding grounds. Summer birds have Arkansas breeding sites and the juveniles are Arkansas derived. The helminths of juvenile birds are thus local.

It is the purpose of this paper to 1) document the helminth community of a migratory bird throughout three seasons of the year, and in a new locality, 2) investigate the prevalence and intensity of infection as they are affected by the age and sex of the host, 3) locate the origin of the helminths geographically, 4) compare the helminths qualitatively and quantitatively with those obtained from the same host during the same time of the year in Ohio by Cooper and Crites, 5) determine the distribution of the helminths within the host. The paper means to stress the relevance of age and sex of the host, season of the year, and the geographical location when dealing with the symbionts of a migratory species.

MATERIALS AND METHODS

All common grackles were live trapped in Conway, Arkansas, using baited Glenhaven traps. Three seasonal samples of birds were examined. The winter sample from December 15 through January 31 of 1982 and 1983 consisted of 15 adult female (AF-W) and 15 adult male (AM-W) hosts. The pre-breeding group was examined from March 15-22, 1984. This sample consisted of ten adult females (AF-PRB) and ten adult males (AM-PRB). The post-breeding sample contained both adults and juveniles. This sample was taken between July 1 and August 15 of 1982. The sample contained 13 adult females (AF-POB), eight adult males (AM-POB), 15 juvenile females (JF-POB), and 15 juvenile males (JM-POB). The presence of the bursa of Fabricius was used to distinguish the juveniles from the adults.

The winter and pre-breeding birds differ basically in that there has been little opportunity to pick up additional infections since the birds are granivorous at this season of the year. Symbionts of these birds are very likely derived from some northern latitudes.

Analysis was made of the following organs and structures: gall bladder, brain, eye, trachea, digestive tube, kidney, liver, heart, body cavity and reproductive ducts. The organs in the digestive tube were isolated (esophagus, proventriculus, ventriculus, intestine) and examined separately. The intestine was divided into six equal parts and each section independently examined. Standard methods were used to extract, clean, fix, stain, clear and mount the specimens. Voucher specimens were prepared for a deposit in the United States National Museum Helminthological Collection.

It is assumed for this study that all the hosts are inhabitants of the Mississippi flyway and would have common symbionts, although the north south origins could differ.

DISCUSSION

Previous studies on the symbionts of the common grackle have opted for a tabulation of the prevalence and intensity of the infection without regard to the developmental and migration aspects of the host. Most of the studies, from northern states, are of breeding or post-breeding adults. Cooper and Crites in the Ohio sample showed the greater susceptibility of the juvenile common grackles through the greater number of incidental species found in those hosts. The differentiation and maturation of the structure and physiology of the juvenile bird apparently provides a suitable habitat for opportunistic symbionts.

All 101 common grackles examined in this study were parasitized by helminths. Table 1 lists the symbionts recovered from central Arkansas grackles and their host location. Table 2 shows the distribution of the number of species of helminths per host category. The mean is not substantially different in the eight categories. The total cases reflect the clustering of species number from three to five. The distribution ap-

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Table 1. Helminths in Arkansas Common Grackles

Trematoda	
Conspicuum icteridorum Denton and Byrd, 1951	Gall bladder
Echinostoma revolutum (Froelich, 1802)	Posterior intestine
Leucocloridium macrostoma (Rudolphi, 1802) Poche, 1907	Posterior intestine
Cestoda	
Hymenolepis farciminosa Goeze, 1782	Intestine
Choanotaenia musculosa (Fuhrmann, 1896)	Intestine
Acanthocephala	
Plagiorhynchus cylindraceus (Van Cleave, 1918)	Posterior intestine
Mediorhynchus grandis (Van Cleave, 1916)	Posterior intestine
Nematoda	
Chandlerella quiscali (von Linstow, 1904)	Cerebral ventricles Under occipital meninges
Syngamus trachea (Montagu, 1811)	Anterior trachea
Acuaria quiscali Williams, 1929	Under gizzard tunic
Capillaria ovopunctatum (von Linstow, 1873)	Anterior intestine
Diplotraena sp.	Air sacs
Oxyspirura petrowi Pence, 1972	Eye
Dispharynx nasuta (Rudolphi, 1819)	Proventriculus
Eufilaria hibleri Granath, 1981	Subcutaneous tissue
Microtetrameres sp.	Proventriculus

pears to show a normal curve.

Table 3 illustrates the number of symbionts per host with numbers above 60 being unusual. The means for the host categories suggest for the adult female that there is a marked drop in the intensity of infection manifest after the breeding period and perhaps concurrent with that period. This is unexpected because the opportunities for infection are increased with the greater demand for food during the reproductive period. There is thus a suggestion of another agent at work in protecting the breeding female.

Table 2. Species of Helminths per Host

	1	2	3	4	5	6	7	$\bar{X}$
AF-W	0	2	5	5	2	0	1	3.7
AM-W	0	0	5	6	3	1	0	4.0
AF-PRB	0	2	2	4	2	0	0	3.6
AM-PRB	0	2	5	2	0	1	0	3.3
AF-POB	0	1	4	1	4	3	0	4.3
AM-POB	0	2	1	2	1	1	1	4.1
JF-POB	1	3	1	2	7	1	0	3.7
JM-POB	1	1	3	4	3	3	0	4.1
	2	13	26	26	22	10	2	

Table 3. Number of Helminths per Host

Host Category	0-20	21-40	41-60	61-80	81-101	$\bar{X}$
AF-W	5	2	4	2	2	45.9
AM-W	4	5	3	2	1	40.9
AF-PRB	3	2	1	2	2	48.6
AM-PRB	2	5	2	1	0	33.8
AF-POB	6	2	5	0	0	28.7
AM-POB	3	2	2	1	0	34.4
JF-POB	9	4	1	1	0	23.3
JM-POB	6	5	3	0	0	31.0
TOTAL	38	27	21	9	5	

Table 4 shows the percentage of infection in the eight host categories. In agreement with Cooper and Crites (1974), it is obvious that certain symbionts are incidental, present due to physiological or behavioral idiosyncrasies of the host. The following fall into that category: *Leucocloridium macrostoma, Diplotriaena sp., Oxyspirura petrowi, Eufilaria hibleri, Microtetrameres sp. Eufilaria hibleri* is a subcutaneous symbiont (Granath, 1981) and could have been missed in this study which concentrated on the viscera. Four symbionts are consistently found in high percentages and are thus the basic helminth fauna of the host in this flyway: *Conspicuum icteridorum, Chandlerella quiscali, Acuaria quiscali, Capillaria ovopunctatum.* There appears to be no age or sex difference in the infection considering that the juveniles have only had a maximum of three months to pick up the infections. Five species show a seasonal relationship to infection. *H. farciminosa* is exclusively a post breeding symbiont. The same is largely true of *C. musculosa* since the pre-breeding specimens were very small in number and size. Both acanthocephalan species are present in POB and W samples. The winter sample could be a retention of the POB infection. They are both absent in the PRB sample. This suggests that the symbionts are lost during the winter or that they are lethal to the host. *S. trachea* is distinctly a POB symbiont with some retention throughout the year.

Table 5 documents the mean intensity of infection for each symbiont for each host category. Only symbionts regarded as major symbionts are included. Juveniles appear to get a high dosage of *C. icteridorum* and the intensity decreases during the remainder of the year. *C. quiscali* has the greatest number of specimens per infected host. All adults are heavily infected. *C. ovopunctatum* is unusual in that the POB adults are so lightly infected compared to the other adults. This suggests a resistance to the infection during the breeding season with a second possible explanation being the food selection. Since the juveniles are more heavily infected, the opportunity for infection obviously exists. All of

Table 4. Prevalence (%) of Helminths in Arkansas Common Grackles

Helminth	AF-W	AM-W	AF-PRB	AM-PRB	AF-POB	AM-POB	JF-POB	JM-POB
C. icteriderum	93	100	100	100	100	100	73	87
E. revolutum	0	13	10	0	8	13	20	40
L. macrostoma	7	0	0	0	0	0	0	0
H. farciminosa	0	0	0	0	31	13	7	27
C. musculosa	0	0	20	10	8	13	7	0
P. cylindraceus	7	33	0	0	0	25	7	13
M. grandis	7	13	0	0	15	25	47	20
C. quiscali	93	80	100	90	92	100	93	47
D. tracheа	0	13	10	0	46	13	33	20
A. quiscali	67	53	40	40	39	38	40	20
C. ovopunctatum	73	93	80	60	77	75	67	53
Diplotraena sp.	20	7	0	20	0	0	0	0
O. petrowi	7	0	0	0	7	0	0	0
D. nasuta	0	7	0	0	0	0	33	47
E. hibleri	7	0	0	0	0	0	20	7
Microtetrameres sp.	0	0	0	10	0	0	0	0

Table 5. Intensity of Infection of Arkansas Common Grackles with Helminths

Helminth	AF-W	AM-W	AF-POB	AM-POB	AF-POB	AM-POB	JF-POB	JM-POB
C. icteridorum	7.6	8.9	4.8	6.6	4.9	5.3	5.8	6.0
E. revolutum	0.0	1.0	4.0	0.0	1.0	1.0	2.3	2.2
H. farciminosa	0.0	0.0	0.0	0.0	1.0	8.0	35.0	6.7
C. musculosa	0.0	0.0	1.0	1.0	2.7	1.0	2.0	8.0
P. cylindraceus	1.0	1.0	0.0	0.0	0.0	2.0	4.5	1.0
M. grandis	2.0	1.5	0.0	0.0	1.0	1.0	2.6	1.0
C. quiscali	26.6	27.7	32.7	15.5	20.3	21.5	4.5	6.5
C. trachea	0.0	2.0	2.0	0.0	2.3	6.0	3.6	2.8
A. quiscali	6.2	3.1	2.8	7.0	2.2	3.0	3.3	3.7
C. ovopunctatum	12.3	9.2	11.5	16.0	2.7	4.5	4.6	11.3
TOTAL	55.7	55.2	58.8	46.1	38.1	55.3	72.2	50.3

the other symbionts are present in small numbers, suggesting a limited carrying capacity of the host for these forms. If the adult POB males and females are compared, the females are consistently lower in intensity of infection with every symbiont.

Intestinal helminths appeared to be distributed in the organ according to species (Table 6). *Capillaria ovopunctatum* was found almost entirely in the anterior half of the intestine. The tapeworms, *H. farciminosa* and *C. musculosa*, appear to avoid the extreme segments. This latter case is somewhat biased due to the presence of 35 young tapeworms in the 4th segment of one host. *Choanotaenia* nevertheless appears to opt for a more anterior location. The two species of acanthocephala *(Plagiorhynchus cylindraceus* and *Mediorhynchus grandis)* together with the fluke, *Echinostoma revolutum*, are basically posterior half symbionts. There is a correlation between degree of invasiveness of the symbiont and posterior location. *C. ovopunctatum* are very thin nematodes which are threaded into the mucosa or are luminal. Each *H. farciminosa*

Table 6. Intestinal Helminth Distribution

Symbiont	Intestinal Section					
	1	2	3	4	5	6
C. ovopunctatum	265	256	119	13	6	1
H. farciminosa	0	0	5	45	5	1
C. musculosa	0	22	1	0	1	0
P. cylindraceus	0	0	1	5	10	2
M. grandis	0	0	0	3	26	4
E. revolutum	0	0	7	4	4	11

has 20 small hooks with which to attach to the intestinal wall. *Choanotaenia* likewise has minute but more numerous hooks. The other three species have hooks attached to a proboscis or the anterior end. Both the proboscis and the anterior end are large and are involved in the invasion.

Four of the incidental symbionts are found exclusively in the adults. *E. revolutum* has a greater incidence in the juvenile than the adult. *E. hibleri* was only found in the juveniles. *D. nasuta* appears to be an exclusive juvenile symbiont.

None of the incidentals reported by Cooper and Crites was found in the POB Arkansas birds. The comparison POB data by species concerning adult versus juvenile infection shows *C. iteridorum* (100:80), *C. musculosa* (10:4) *C. quiscali* (95:44), *C. ovopunctatum* (76:60), *D. nasuta* (0:40), *S. trachea* (33:27), *P. cylindraceus* (10:10). *P. ensicaudatum* and *A. globata* were both absent from Arkansas hosts. Ohio birds were heavily infected with the former. *E. revolutum, M. grandis, A. quiscali,* as well as the incidentals, were only found in the Arkansas birds. However, Buck, Cooper, and Crites documented *E. revolutum* in central Ohio birds. *C. icteridorum, C. quiscali, C. ovopunctatum,* and *H. farciminosa* are much more abundant in Arkansas birds than Ohio hosts. The reverse is true for *C. musculosa, S. trachea,* and *P. cylindraceus.* The observation of the heavy incidence of *D. nasuta* by Cooper and Crites in juvenile birds is borne out by the present study.

CONCLUSIONS

Sixteen species of helminths are designated as being present in Arkansas common grackles. These all constitute new locality records (Table 1). Twelve species are documented as having an Arkansas origin - present in juvenile birds.

Porrocaecum ensicaudatum, a common symbiont in Ohio birds, is absent in Arkansas grackles. *Mediorhynchus grandis* and *Acuaria quiscali* are present in Arkansas birds and not recorded in the Ohio birds. *E. revolutum, C. icteridorum, C. quiscali, C. ovopunctatum,* and *H. farciminosa* were more prevalent in Arkansas birds. The reverse is true for *C. musculosa, S. trachea,* and *P. cylindraceus. D. nasuta* is virtually an exclusive juvenile symbiont in grackles in both areas.

The major species with regard to the intensity of infection in the Arkansas birds appear to be *C. quiscali, C. ovopunctatum, A. quiscali,* and *C. icteridorum.* Other species are present in small numbers in the hosts.

The five species of intestinal helminths are partitioned along the entire intestine. Though the entire organ is used the helminths opt for certain sections by species of worm.

Juvenile birds have a higher propensity for infection with *E. revolutum.* Sex of the host is a factor when POB females and males are compared. The mean weight of all the adult females birds was 81.7 g. and of the adult male birds 106.7. Therefore, the females contain only 76% of the mass of the males. The same intensity of infection could have substantially greater consequences in the female.

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