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Parasitic Helminths of Eurasian Collared-Doves (*Streptopelia decaocto*) From Florida

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ABSTRACT: Sixty-three Eurasian collared-doves (ECDs) (*Streptopelia decaocto*) from Florida were examined for parasitic helminths from June to December 2001. Nine species of helminths were identified (5 nematodes, 2 cestodes, and 2 trematodes). The most prevalent helminths were *Ascaridia columbae* (73.0%), *Fuhrmannetta crassula* (28.6%), *Ornithostrongylus quadriradiatus* (12.7%), and *Bruscapillaria obsignata* (11.1%). The helminths with the greatest mean intensity were *Tanaisia bragai* (13.5), *A. columbae* (9.3), and *O. quadriradiatus* (7.1). In Florida, the mean intensity of *A. columbae* in ECDs (9.3) was similar to that found in white-winged doves (*Zenaida asiatica*) (9.1) ($P = 0.461$), and both the intensities were significantly higher than that in the native mourning doves (*Zenaida macroura*) (3.7) ($P = 0.001$ and 0.005, respectively). *Fuhrmannetta crassula* is reported for the first time in columbids from Florida.

The North American population of Eurasian collared-doves (ECDs), *Streptopelia decaocto* (Frivaldszky, 1838), is believed to have originated from a group of doves that escaped captivity in the Bahamas in 1974 (Smith, 1987). The exact date of colonization in Florida is unknown because of the misidentification of the ECD as the ringed turtle-dove

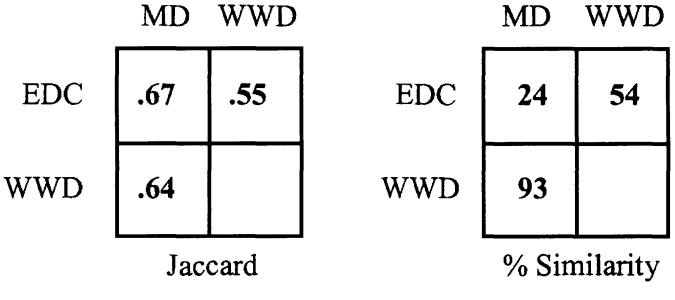

FIGURE 1. Community similarity characteristics of the helminth communities of ECDs, MDs, and WWDs in Florida.

TABLE I. Prevalence and intensity of helminths in Eurasian collared-doves, mourning doves, and white-winged doves in Florida.

Parasite	Eurasian collared-doves, Florida (n = 63)		Mourning doves,* Florida (n = 455)		White-winged doves,† Homestead (n = 119)	
	Prevalence	Intensity‡	Prevalence	Intensity	Prevalence	Intensity
Nematoda						
Ascaridia columbae	73.0	9.3 (1–76)	30.5	3.7 (1–43)	43.7	9.1 (1–47)
Bruscapillaria obsignata	11.1	1.1 (1–2)	0.7	5.7 (1–15)	0.8	2.0
Tetrameres americanus	3.2	1.0	4.2	1.6 (1–28)	—	—
Dispharynx nasuta	4.8	2.7 (1–6)	16.0	10.9 (1–144)	4.2	1.4 (1–3)
Ornithostrongylus quadriradiatus	12.7	7.1 (1–20)	—	—	—	—
Ornithostrongylus spp.§	—	—	67.3	13.1 (1–160)	79.0	10.2 (1–104)
Aproctella stoddardi	—	—	10.3	6.0 (1–34)	—	—
Cestoda						
Fuhrmannetta crassula	28.6	1.8 (1–6)	—	—	—	—
Raillietina sp.‖	9.5	1.5 (1–4)	0.2	2.0 (2)	3.4	2.5 (1–7)
Killigrewia delafondi	—	—	0.7	1.0 (1)	—	—
Hymenolepididae	—	—	1.3	1.0 (1)	—	—
Trematoda						
Tanaisia bragai	3.2	13.5 (3–24)	0.2	12.0 (12)	0.8	3.0
Brachylaima sp.	1.6	4.0	0.2	1.0 (1)	0.8	2.0

* Data from Forrester et al. (1983).
† Data from Conti and Forrester (1981).
‡ Mean values of intensity followed by ranges in parentheses.
§ As reported by the authors: a complex of 2 species, *O. quadriradiatus* and *O. iheringi*, in a ratio of 14:1 based on males only.
‖ Conti and Forrester (1981) and Forrester et al. (1983) report *Raillietina* spp. as a complex of at least 2 species; it is possible 1 of these corresponds to *F. crassula*.

(*Streptopelia risoria* (Linnaeus, 1758)). The first documented report in southern Florida was in the early 1980s (Romagosa and Labisky, 2000). Within 10 yr of its identification, ECDs had established populations throughout Florida and had been sighted throughout the continental United States by the mid to late 1990s (Romagosa and McEneaney, 1999).

The rapid colonization of North America by ECDs is similar to that seen in Europe in the early to mid 1900s. The ECD has a distinct dispersal pattern, known as "jump" dispersal (Romagosa and McEneaney, 1999), which is characterized by long-distance dispersal of individuals and subsequent population coalescence (Pielou, 1979). The dispersal rate of ECDs across North America is skewed by local releases by breeders throughout the United States and an increased awareness and reporting of the species by bird watchers. The ECDs colonization of the United States is enhanced by its varied diet, ability to breed year round, and tolerance of human populations (Romagosa and Labisky, 2000).

The effects of ECDs on indigenous dove species, such as the mourning dove (MD) (*Zenaida macroura* (Linnaeus, 1758)), and recently established species in Florida, such as the white-winged dove (WWD) (*Zenaida asiatica* (Linnaeus, 1758)) and the ringed turtle-dove, are poorly understood. The only report on helminths in ECDs is based on 5 specimens from Palm Beach, Florida (Forrester and Spalding, 2003). More quantitative data are required to determine the effect that ECDs may have on the spread of parasites to indigenous dove species.

This study was initiated to determine the helminth community of ECDs in Florida from 2 areas and to compare our results with the helminths reported from other doves from Florida.

A total of 63 ECDs was collected from 4 counties in Florida from June to December 2001, i.e., 32 from Pinellas County (27°54′N, 82°41′W), 20 from Okaloosa County (30°25′N, 86°40′W), 7 from Santa Rosa County (30°21′N, 87°10′W), 3 from Bay County (30°11′N, 85°48′W), and 1 from Ramrod Key in Monroe County (24°45′N, 81°20′W). ECDs from Pinellas County were collected in June and July; all other ECDs were collected from October through December. All specimens were part of die-offs that occurred in these areas and were the result of a paramyxovirus and to a lesser extent visceral *Trichomonas gallinae* infections. The dead ECDs selected for this study were in good condition, with most being collected and refrigerated within a few hours of dying. Identification of the ECDs followed the techniques of Romagosa and McEneaney (1999). The specimens were bagged individually and frozen until examined.

Parasite screening techniques used were those described by Kinsella and Forrester (1972). Trematodes and cestodes were preserved in Roudabush's AFA, stained with either Ehrlich's hematoxylin or Semichon's acetocarmine, and mounted in neutral Canada balsam. The nematodes were preserved in 70% ethanol with glycerin, mounted in lactophenol for identification, and then returned to the preservative.

ECDs collected in Santa Rosa, Okaloosa, and Bay counties, which are located in the northwestern Panhandle of Florida, were combined as a single "Florida Panhandle" sample (n = 30) for statistical comparison with the Pinellas County (n = 32) (west coast of central Florida) collection site. The 2 collecting areas are similar; they are on the Gulf coast of Florida and have large amounts of salt and brackish water surrounding them, a relatively mild climate throughout the year, MDs and rock doves (RD) (*Columba livia* Gmelin, 1789), and a local human population that provides bird feeders and freshwater, which artificially concentrate a variety of avian species into a small area. Host gender was not identified in the Pinellas sample; thus, no statistical analysis between genders was attempted. Because of our relatively small sample sizes, only parasites with prevalences >10% were compared. For comparisons with parasite data reported for MDs and WWDs (Conti and Forrester, 1981, and Forrester et al., 1983, respectively) in Florida, all 63 ECDs (included is the 1 ECD collected from Ramrod Key, Monroe County) were combined for the statistical analyses. A chi-square test was used to compare prevalences, and a Mann–Whitney rank sum test was used to compare intensities using SigmaStat® for Windows (version 2.03, SPSS, Inc., Chicago, Illinois). Significance was set at $P < 0.05$. Parasite community similarities were calculated using Jaccard's similarity index and Sorensen's percent similarity index, where the latter is calculated using parasite abundance (Magurran, 1988). Terminology used is according to Bush et al. (1997). Helminth voucher specimens have been deposited in the U.S. National Parasite Collection (USNPC), Beltsville, Maryland (accession numbers USNPC 94198, 94400, and 94569–94572).

Nine species of helminths were identified in the 63 ECDs that we examined (5 nematodes, 2 cestodes, and 2 trematodes) (Table I). The most prevalent helminths were *Ascaridia columbae* (73.0%), *Fuhrman-*

TABLE II. Prevalence and intensity of helminths in 62* Eurasian collared-doves from Florida.

Parasite	Pinellas County (n = 32)			Florida Panhandle (n = 30)		
		Intensity			Intensity	
	Prevalence	Mean	Range	Prevalence	Mean	Range
Nematoda						
Ascaridia columbae (Gmelin, 1790) (GZ, SI)†	62.5	9.0	1–76	83.3	9.5	1–48
Bruscapillaria obsignata (Madsen, 1945) (SI)	21.9	1.1	1–2	—	—	—
Tetrameres americanus (Cram, 1927) (ES, PV)	6.3	1.0	—	—	—	—
Dispharynx nasuta (Rudolphi, 1819) (ES, PV)	6.3	3.5	1–6	3.3	1.0	—
Ornithostrongylus quadriradiatus (Stevenson, 1904) (SI)	3.1	20.0	—	23.3	5.3	1–15
Ascaridia (larvae) (GZ, SI)	9.4	1.3	1–2	33.3	2.9	1–8
Tetrameres (larvae) (PV)	3.1	1.0	—	—	—	—
Unidentified larvae (SI)	43.8	6.0	1–17	26.6	3.1	1–8
Cestoda						
Fuhrmannetta crassula (Rudolphi, 1819) (SI)	50.0	1.9	1–6	6.6	1.0	—
Raillietina sp. (SI)	15.6	1.6	1–4	3.3	1.0	—
Trematoda						
Tanaisia bragai dos Santos, 1934 (KD)	6.3	13.5	3–24	—	—	—
Brachylaima fuscatum (Rudolphi, 1819) (SI)	—	—	—	3.3	4.0	—

* An additional Eurasian collared-dove was collected on Ramrod Key, Monroe County, in the Florida Keys and was found to have only *A. columbae* with an intensity of 63. This information is not included in this table but is in Table I.
† Location in host: ES = esophagus, GZ = gizzard, KD = Kidney, PV = proventriculus, SI = small intestine.

netta crassula (28.6%), *Ornithostrongylus quadriradiatus* (12.7%), and *Bruscapillaria obsignata* (synonym of *Capillaria obsignata*) (11.1%) (Table I). The helminths with the greatest mean intensity were *Tanaisia bragai* (13.5), *A. columbae* (10.4), and *O. quadriradiatus* (7.1).

Prevalences and intensities of parasites for the Pinellas County and the Florida Panhandle collecting sites are given in Table II. Only 5 parasite species had prevalences >10%. There was no significant difference in prevalences or intensities for *A. columbae* between the Panhandle site and the Pinellas County site (P = 0.120 and 0.689, respectively). The Panhandle site had a significantly higher prevalence of *O. quadriradiatus* (23.3%) than the Pinellas site (3.1%) (P = 0.024) but a lower prevalence of *B. obsignata* (0.0%) than the Pinellas site (21.9%) (P = 0.010). The prevalence of *F. crassula* was significantly higher at the Pinellas site (50%) than the Panhandle site (6.6%) (P = 0.001); however, the prevalence of *Raillietina* sp. was statistically similar at both sites (P = 0.197). Jaccard's index (0.55) and Sorensen's percent similarity index (44.7%) indicate some similarity between the Pinellas and Panhandle ECD helminth community compositions, but these were not identical. All the species of parasites found in ECDs have been identified previously in MD and WWD populations in Florida (Table I), except for *F. crassula*, which is reported for the first time in columbids from Florida.

A comparison of prevalences and intensities for parasites of the 63 ECDs and those reported in WWDs and MDs are given in Table I, and helminth community similarities are given in Figure 1. Prevalence of *A. columbae* was significantly higher in ECDs (73.0%) than those reported for WWDs (43.7%) and MDs (30.5%) in Florida ($P < 0.001$ for both). The prevalence of *A. columbae* reported for WWDs was significantly higher than that reported for MDs in Florida (P = 0.009). The mean intensity of *A. columbae* in ECDs (9.3) was similar to that found in WWDs (9.0) (P = 0.461) in Florida; however, both were significantly higher than the intensity reported for MDs (3.6) in Florida (P = 0.001 and 0.005, respectively).

The parasite community similarities among ECDs, MDs, and WWDs in Florida are presented in Figure 1. Jaccard's index indicates some similarity in the helminth species present in all 3 dove species. However, Sorensen's percent similarity index, which uses parasite abundance, indicates a low similarity between the parasite communities of ECDs and MDs but a high similarity between MD and WWD parasite communities.

The significant differences in the prevalences between the 2 collection sites for several of the ECD parasites may be due, in part, to the jump dispersal of the host as described by Romagosa and McEneaney (1999). The ECDs for these 2 areas of Florida may have different origins and, therefore, had slightly different parasite faunas to start with, especially if many of them were released by breeders, pet owners, or both. The 2 collection areas are ecologically similar. The differences may also be attributed to seasonal variations in some of the helminths, as reviewed by Bush (1990).

Ascaridia columbae seems to be 1 of the core parasite species in the ECDs throughout Florida. It was found in ECDs from the Florida Keys (Ramrod Key, Monroe County) in the south to Santa Rosa County in the northern Panhandle. Although Ramrod Key was the only location on the east coast of Florida where ECDs were collected, it is likely that *A. columbae* can be found in any ECD population in Florida. It is interesting to note that the prevalence and intensity of *A. columbae* were highest in the introduced columbids, ECDs, and WWDs and lowest in the native MDs.

We did not compare prevalences and intensities for *Ornithostrongylus* sp. or *Raillietina* sp. in the ECDs with those reported in WWDs or MDs. Both Conti and Forrester (1981) and Forrester et al. (1983) reported *Ornithostrongylus* spp. as "a complex of 2 species, *O. quadriradiatus* and *O. iheringi* in a ratio of 14:1 based on males only." Confounding this further is the fact that there has been some ambiguity among the data due to taxonomic changes over the years. *Ornithostrongylus crami* was once thought to be synonymous with *O. quadriradiatus* until Durette-Desset et al. (2000) gave evidence for it being a separate species. Therefore, some of the *Ornithostrongylus* spp. reported previously in the MDs and WWDs in Florida may have been *O. crami*. Similarly we did not compare the cestodes in the ECDs with those reported in MDs and WWDs in Florida by Conti and Forrester (1981) and Forrester et al. (1983). The *Raillietina* spp. reported in MDs and WWDs by these authors were "a complex of at least 2 species." Because at the time of these reports *Fuhrmannetta* was considered a subgenus in the genus *Raillietina*, it is possible that *F. crassula* may have been present in the MDs, WWDs, or both and grouped and reported as *Raillietina* spp. with the others. However, 1 of us (J.M.K.) examined the voucher specimens deposited in the USNPC by both Conti and Forrester, and none was *F. crassula* (=*R.* (*F.*) *crassula*). The *Raillietina* sp. we report in the ECDs appears to be a single species.

Mollhagen (1976) described *Tetrameres columbicola* as a separate species from the previously recognized *Tetrameres americanus* (Cram, 1927). According to his description, several articles written in the early 1980s identified the *Tetrameres* sp. found in MDs and RDs as *T. col-*

umbicola (Conti and Forrester, 1981; Forrester et al., 1983; Simpson et. al., 1984). The *Tetrameres* sp. from the ECDs also fit Mollhagen's description of *T. columbicola* more closely than the previously described *T. americanus*. However, Mollhagen's description has no taxonomic validity under the International Code because his data were reported only in a Ph.D. dissertation and never published in a refereed journal. Therefore, the *Tetrameres* species found in the ECDs, WWDs, and MDs is *T. americanus*.

In Florida, the ECDs have a helminth fauna similar to those found in the WWD and native MD populations. The higher prevalences and intensities for some of the helminths in the ECDs may be because of their being the most recent of the introduced exotic dove species in Florida.

The effect of the paramyxovirus and visceral *T. gallinae* infections on the helminth fauna of the ECDs we sampled is unknown. Because of the small sample sizes for our ECDs, the statistical analyses presented in this study may be rather weak. A larger sampling of the ECD population in Florida, including samples from the interior regions of the peninsula, which are lacking in this study, and the inclusion of immature as well as adult birds as found in the MD and WWD surveys, is needed to substantiate our conclusions.

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Clinical Muscular Sarcocystosis in a Dog

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ABSTRACT: Muscular sarcocystosis is a rare infection in dogs. Clinical myositis associated with an unidentified species of *Sarcocystis* was diagnosed in an adult dog from Canada. There was granulomatous myositis associated with numerous immature sarcocysts in a muscle biopsy obtained from the dog. The sarcocysts were up to 550 μm long and up to 45 μm wide. The sarcocyst wall was approximately 1 μm thick and contained short, stubby, villar protrusions that lacked microtubules. This is the first report on clinical muscular sarcocystosis in a dog.

Species of *Sarcocystis* have a 2-host, prey–predator, life cycle, with herbivores as intermediate hosts and carnivores as definitive hosts (Dubey et al., 1989). The intermediate host becomes infected with *Sarcocystis* spp. by ingesting sporocysts or oocysts, or both, excreted in the feces of the definitive host. After a brief period of schizogony, the parasite encysts in muscles and forms sarcocysts. The definitive host becomes infected by ingesting sarcocysts in infected muscles of intermediate hosts. Some animals act both as intermediate and definitive hosts but usually not for the same species of *Sarcocystis* (Dubey et al., 1989). The domestic dog (*Canis familiaris*) is a definitive host for numerous species of *Sarcocystis* (Dubey et al., 1989), but only sexual stages are known to occur, and they are restricted to the intestine. In addition, there are reports on sarcocysts of unknown species in the muscles of 4 dogs (Sahasrabudhe and Shah, 1966; Hill et al., 1988; Blagburn et al., 1989; Bwangamoi et al., 1993). Findings of sarcocysts in a dog from India (Sahasrabudhe and Shah, 1966), from Georgia, U.S.A. (Hill et al., 1988), from Alabama, U.S.A. (Blagburn et al., 1989), and from Kenya (Bwangamoi et al., 1993) were incidental, apparently without any clinical signs. The dogs from Georgia and Kenya also had carcinoma. We report clinical myositis associated with numerous sarcocysts in a dog from Canada.

A 5-yr-old, neutered, male Labrador cross dog with a history of lethargy, anorexia, and vomiting of 1 day's duration was admitted in May 2003 to a veterinary hospital in British Columbia, Canada. The owners reported that the dog was hiking with them in high-range country 5 days earlier and had disappeared for a short time during the hike. Clinical evaluation indicated a fever (rectal temperature 41.5 C), dehydration, abdominal pain, and ataxia, with occasional petit mal seizure activity. Initial therapy included intravenous fluids and a broad-spectrum