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Incidence of *Porocephalus crotali* (Pentastomida) in Florida Mammals

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ABSTRACT

Nymphs of *Porocephalus crotali* were found in 20 (0.9%) of 2,254 mammals examined from localities in 22 counties in Florida. Of 27 species included in the survey, infections were found in the Florida mouse, *Peromyscus floridanus*; cotton mouse, *Peromyscus gossypinus*; and cotton rat, *Sigmodon hispidus*. The last two species represent new intermediate host records for this parasite. Based on total individuals examined, incidence was 0.6, 4.3, and 0.2% in *P. floridanus*, *P. gossypinus*, and *Sigmodon*, respectively. Considering only samples from localities at which infections occurred, prevalence was 1.8% in Florida mice, 13.9% in cotton mice, and 1.0% in cotton rats. There was some evidence of a higher infection rate in males than females of *P. gossypinus* but not in *P. floridanus*. Over half of the infected rodents examined had more than a single nymph, the maximum number recorded being 85. Nymphs occurred at numerous sites in the viscera, mesenteries and walls of the body cavity. Infected animals did not appear to be seriously affected by the parasites, and it is concluded that, except perhaps under conditions of severe environmental stress, *P. crotali* probably does not play an important role as a mortality factor in host populations in Florida. The majority of infections came from a single habitat type; the basis for this restriction is not clear. The data show some suggestion of a higher prevalence rate in the warmer months of the year.

INTRODUCTION

The linguatulid *Porocephalus crotali* Humboldt, 1808 occurs as an adult principally in crotaline snakes, while the nymphal stages are known from a wide variety of mammals in the orders Marsupialia, Primates, Chiroptera, Edentata, Rodentia, and Carnivora¹¹. Although primarily a member of the Neotropical fauna, this parasite has been recorded from several North American mammals. Stiles and Hassall¹³ list *Porocephalus crotali* "subcylindricum" nymphs from the armadillo, *Dasypus novemcinctus* and opossum, *Didelphis marsupialis*, from Washington, D.C., and from the striped skunk, *Mephitis mephitis*, from Florida. The first two records probably represent animals in zoological parks, al-

though this is not stated. These authors also note *Porocephalus* (sp.) from the porcupine, *Erethizon dorsatum*, but give no locality. More recently, *P. crotali* has been reported from the wood mouse, *Peromyscus leucopus*, in Oklahoma¹², the muskrat, *Ondatra zibethicus*, in Louisiana^{9, 8}, and the Florida mouse, *Peromyscus floridanus*, in Florida⁷.

This paper records two new North American mammal intermediate hosts of *P. crotali* and provides further data on its distribution and incidence in Florida mammals.

MATERIALS AND METHODS

A total of 2,254 specimens of the following 27 species of mammals were examined for infections of *Porocephalus crotali*: *Didelphis marsupialis*, 6; *Scalopus aquaticus*,

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5; *Cryptotis parva*, 10; *Blarina brevicauda*, 6; *Sylvilagus floridanus*, 12; *Sylvilagus palustris*, 4; *Sciurus carolinensis*, 11; *Sciurus niger*, 2; *Glaucomys volans*, 2; *Geomys pinetis*, 9; *Oryzomys palustris*, 32; *Peromyscus polionotus*, 43; *Peromyscus gossypinus*, 254; *Peromyscus floridanus*, 1312; *Reithrodontomys humulis*, 2; *Ochrotomys nuttalli*, 12; *Sigmodon hispidus*, 427; *Neotoma floridana*, 2; *Neofiber alleni*, 9; *Rattus norvegicus*, 1; *Rattus rattus*, 18; *Mus musculus*, 328; *Urocyon cinereoargenteus*, 6; *Procyon lotor*, 5; *Mustela frenata*, 1; *Mephitis mephitis*, 1; and *Lynx rufus*, 4.

Although collecting was concentrated in north-central Florida, principally in Alachua and Levy counties, specimens were obtained from localities in 22 counties of the state. The counties included in the survey and samples available from each are as follows: Alachua, 1180; Brevard, 20; Clay, 4; De Soto, 2; Duval, 4; Escambia, 36; Flagler, 1; Franklin, 7; Gilchrist, 19; Highlands, 185; Lake, 1; Lee, 35; Levy, 950; Monroe, 4; Okaloosa, 4; Palm Beach, 6; Pinellas, 42; Putnam, 3; Santa Rosa, 13; St. Johns, 4; Taylor, 2; Walton, 1; county unknown, 1.

An effort was made in collecting to survey as broad a representation of terrestrial habitat types as possible. The habitats sampled and numbers of mammals collected from each included: broad leaved forests represented by mesophytic hammocks, live oak hammocks, upland hammocks, and cabbage palm hammocks, 326; dry pine-oak woodlands, 470; scrub, 947; pine flatwoods, 154; swamps and bayheads, 50; wetlands, including marshes, wet prairies, and borders of roadside ditches and ponds, 83; sparsely vegetated coastal dunes, 47; oldfields, grassy or brushy road shoulders, fence rows, etc., 91; in and around buildings in urban or agricultural areas, 315. Habitat data were not available for 41 specimens included in the sample. More detailed descriptions of most of the above habitat types are given in earlier publications^{1 5 6 7 10}.

Presence of an infection was based on gross examination of the body cavity and viscera at autopsy. Esslinger² found that in experimental infections in laboratory rats the first nymphal stages appeared in the viscera about 8 days after administration of eggs. Thus, the present method of examination probably revealed the majority of infections in the samples handled.

RESULTS

Nymphs of *P. crotali* were found in 20 (0.9%) of the 2,254 mammals examined. Infections occurred in the Florida mouse, *Peromyscus floridanus*; cotton

mouse, *Peromyscus gossypinus*; and cotton rat, *Sigmodon hispidus*. The latter two species constitute new intermediate hosts. All infected specimens came from four collecting stations, all of which were within a distance of about 3 miles of one another, ranging from 6 to 9 miles northeast of the town of Cedar Key in Levy County.

Of the 20 infections recorded, 8 were in *P. floridanus*, 11 in *P. gossypinus*, and 1 in *Sigmodon*. Based on the total number of each species examined, incidence in *P. floridanus*, *P. gossypinus*, and *Sigmodon* was 0.6, 4.3 and 0.2%, respectively. The distribution of infections by locality, species, sex, and age is shown in Table 1. The incidence in adults of each species in the combined samples from the four localities at which infections were recorded was 1.8% in Florida mice, 13.9% in cotton mice, and 1.0% in cotton rats.

The majority (17) of the infected rodents were collected in scrub habitat. Scrub vegetation occurs on well drained, fine, sandy soils and consists primarily of scattered pines, typically sand pine (*Pinus clausa*), and dense, low clumps of various shrubs with patches of exposed sand between. Three oak species (*Quercus myrtifolia*, *Q. virginiana*, and *Q. chapmani*) are characteristic of the scrub layer. All of the infected *P. floridanus* were taken in typical scrub habitats (Levy 10 and 19), as was the single positive *Sigmodon*. Eight infected *P. gossypinus* came from scrub, while 2 were taken in ecotones between scrub and other habitat types (Levy-19): freshwater marsh in one case and a moist bayhead in the other. The remaining specimen was trapped in an oldfield near dry pine flatwoods (Levy-50).

Infected animals were collected in January (1), March (2), April (3), May (2), July (3), August (5), September (2), October (1), and November (1). As approximately equal num-

bers of host species were collected at stations in which infections were found at different seasons, the fact that 15 infections occurred in the April-September interval compared to 5 in the October-March period is suggestive of a seasonal trend.

Two of 8 *P. floridanus* had single nymphs, while the remainder had anywhere from about 5 to as many as 85 nymphs. *P. gossypinus* had fewer multiple infections than the preceding species, only 5 of the 11 animals having more than a single nymph. Approximately 15 nymphs were recorded in one specimen, while the remaining individuals with multiple infections contained from 2 to 6 nymphs. Between 20 and 25 nymphs were present in the single infected cotton rat examined.

The nymphs occurred throughout the viscera, mesenteries, and wall of the thoracic and abdominal cavities. Infected males of all three species almost invariably had nymphs located beneath the peritoneum of the testes or epididymides and occasionally along the course of the deferent ducts. Nymphs frequently oc-

curred also on the surface of, or partially embedded in, the liver, kidneys, spleen, lungs, urinary bladder, intestine, stomach, and in associated mesenteries and walls of the abdominal or pleural cavities (Fig. 1). None of the infected mammals showed any obvious signs of weakness or emaciation or other evidence of poor condition that might be attributed to the parasite, although it is quite likely that examination of such physiological parameters as blood cell counts, hematocrit, serum proteins, or hemoglobin concentration would have revealed evidence of physiological influences of the infection on the host.

DISCUSSION

The present data indicate that *P. crotali* is a relatively rare parasite of Florida mammals and is localized in its distribution in the state. It appears that *P. gossypinus* is more frequently infected than either *P. floridanus* or *Sigmodon*. Based on total numbers of each species examined, mean prevalence in the Florida species is considerably lower than the values (9.3 and 11.5%) found in musk-

TABLE 1. Occurrence of *Porocephalus crotali* in relation to population, species, and sex of host.

| Station and Host | TOTAL | | MALES | | FEMALES | |
|----------------------|-----------------|------------------|-----------------|------------------|-----------------|------------------|
| | Number Examined | Percent Infected | Number Examined | Percent Infected | Number Examined | Percent Infected |
| LEVY-10 | | | | | | |
| <i>P. floridanus</i> | 177 | 3.9 | 79 | 2.5 | 98 | 5.1 |
| <i>P. gossypinus</i> | 8 | 25.0 | 4 | 50.0 | 4 | 0 |
| <i>S. hispidus</i> | 29 | 0 | 20 | 0 | 9 | 0 |
| All species | 214 | 4.2 | 103 | 3.9 | 111 | 4.5 |
| LEVY-19 | | | | | | |
| <i>P. floridanus</i> | 178 | 0.6 | 91 | 1.1 | 87 | 0 |
| <i>P. gossypinus</i> | 55 | 10.9 | 33 | 15.1 | 22 | 4.5 |
| <i>S. hispidus</i> | 50 | 2.0 | 25 | 4.0 | 25 | 0 |
| All species | 283 | 2.8 | 149 | 4.7 | 134 | 0.7 |
| LEVY-28 | | | | | | |
| <i>P. floridanus</i> | 76 | 0 | 36 | 0 | 40 | 0 |
| <i>P. gossypinus</i> | 15 | 13.3 | 6 | 33.3 | 9 | 0 |
| <i>S. hispidus</i> | 6 | 0 | 4 | 0 | 2 | 0 |
| All species | 104 | 1.9 | 46 | 4.3 | 51 | 0 |
| LEVY-50 | | | | | | |
| <i>P. gossypinus</i> | 1 | 100.0 | 1 | 100.0 | — | — |
| <i>S. hispidus</i> | 7 | 0 | 3 | 0 | 4 | 0 |
| Both species | 8 | 12.5 | 4 | 25.0 | 4 | 0 |

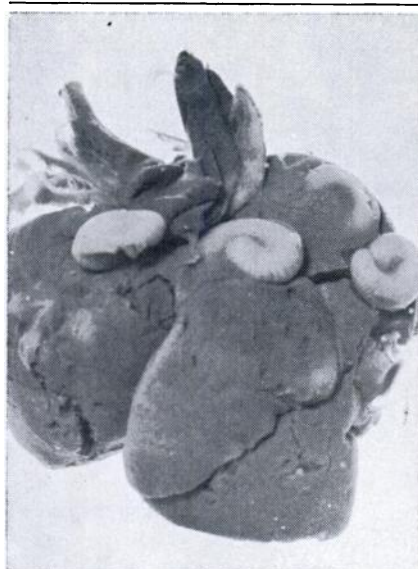


FIGURE 1. *Porocephalus crotali* nymphs in liver of *Peromyscus floridanus* from Levy Co., Florida.

rats in Louisiana^{9,8}. Even considering only samples from localities in which infected animals were recorded, only *P. gossypinus* approaches the levels of infection reported for Louisiana muskrats. Additional data on incidence of this parasite in other North American mammals is given by Self and McMurry¹², who observed nymphs in one of 10 wood mice, *Peromyscus leucopus*, collected in Oklahoma.

Penn and Martin⁹ found considerable geographic variation in prevalence of *P. crotali* in Louisiana muskrat populations, infection rates at five localities ranging from 1.2 to 14.5%. A similar tendency is suggested by the Florida data, incidence at the four stations where infections were recorded ranging from 1.6 to 12.5%.

All infected Florida rodents were adults. Penn⁸ also recorded infections only from adult muskrats, but he reported a slightly higher incidence of *Porocephalus* in females. In contrast, *P.*

gossypinus in this study showed a preponderance of infections in males, but there was no sex difference in infection rates of *P. floridanus*. These apparent variations in incidence of the parasite in males and females of different species may reflect interspecific sex differences in home range behavior, dispersal tendencies, or other habits related to exposure to infections.

Penn and Martin⁹ noted that most infections in muskrats in Louisiana involved only single nymphs, although one animal contained 1600. In contrast, over half of the infected Florida rodents contained more than a single nymph. It appears that *P. floridanus*, and perhaps *Sigmodon* also, tend to acquire heavier infections than *P. gossypinus*. The single *P. leucopus* examined by Self and McMurry¹² had 10 nymphs. The present limited data suggest the existence of interspecific differences in intensity of infections of *P. crotali* among mammalian intermediate hosts. Such differences possibly reflect variation in degree of immunity to the parasite or variability in habits contributing to exposure to infections. The distribution of nymphs in the viscera and body cavities does not appear to vary in different species of hosts, although Penn and Martin⁹ did not note the tendency of nymphs to be located around the testes and epididymides of males as was found in this study.

One of the more interesting results of the present survey is the indication of narrow habitat restriction in the occurrence of *P. crotali* in Florida mammals. The majority of infections occurred in scrub habitats, despite the fact that the same rodent species were collected from other habitat types. Unlike the environment in which *P. crotali* is known in Louisiana, scrub is a relatively xeric habitat with very well drained soils. The reasons for the apparent habitat restriction of *P. crotali* to scrub are not known.

Some of the scrub stations from which infected animals were trapped appeared to have relatively high snake populations, and this may have been one factor explaining the presence of *Porocephalus*. However, as similar conditions existed at other stations in different habitat types from which no infections were recorded, this is unlikely to be the sole explanation. The ability of *Porocephalus* ova to resist dessication³ undoubtedly plays an important role in allowing it to exist in dry areas.

Esslinger⁴ observed histopathological effects of immature stages of *P. crotali* in the liver of experimentally infected laboratory rats, but mentions no mortality or overt symptoms from infection. None of the infected wild rodents examined in the present study showed any gross indication of deleterious effects of the parasite. Thus, although infections of *P. crotali* undoubtedly have some in-

jurious effects on the host, particularly in cases where numerous nymphs are present, otherwise healthy animals are probably not seriously handicapped by infections under normal conditions. However, the effects of the parasite on the host may become more serious under conditions of environmental stress such as severe weather or food shortage. Under such circumstances, the parasite may contribute to higher mortality. In general, however, *Porocephalus crotali* probably plays a relatively minor role in the dynamics of mammalian host populations in Florida.

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