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Survey of Raccoons on Key Largo, Florida, USA, for *Baylisascaris procyonis*

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ABSTRACT: Numbers of the endangered Key Largo woodrat (KLWR; *Neotoma floridana smalli*) have been declining for at least 25 yr. The raccoon (*Procyon lotor*) roundworm, *Baylisascaris procyonis,* has been found to have an adverse effect on the survival of Alleghany woodrats (*N. magister*). High densities of raccoons can exacerbate this problem by increasing the amount of feces containing viable eggs of *B. procyonis* available to woodrats. In 2002, 64 fecal samples were collected and examined for eggs of *B. procyonis* from >32 raccoons within the KLWR's known range on Key Largo, Florida, USA. All samples were negative for eggs of *B. procyonis.* Raccoon density in this area was approximately 0.62 raccoons/ha. Despite this high density of raccoons, *B. procyonis* does not appear to be a threat to the KLWR population.

Key words: *Baylisascaris procyonis,* density, endangered species, Key Largo woodrat, *Neotoma floridana smalli, Procyon lotor,* raccoon, Florida.

The endangered Key Largo woodrat (KLWR; *Neotoma floridana smalli*) is a federally listed endangered subspecies endemic to Key Largo, Florida, USA. The population of KLWRs has undergone a precipitous decline, with current numbers estimated between 26 and 106 individuals (McCleery, 2003). A population viability analysis predicted >95% probability of KLWR extinction within the next 10 yr if significant management actions are not taken (McCleery, 2003). Numerous untested hypotheses including feral cat predation (Humphrey, 1992), predation by fire ants (*Solenopsis* spp.; Frank et al., 1997), habitat fragmentation (U.S. Fish and Wildlife Service [USFWS], 1999), competition with black rats (*Rattus rattus*; Humphrey, 1992), various infectious agents (USFWS, 1999), and a combination of these factors (Frank et al., 1997) have been suggested as causes of the KLWR's decline.

McGowan (1993) and LoGiudice (2001, 2003) suggested that *Baylisascaris procyonis,* a common parasitic nematode of raccoons (*Procyon lotor*; Kazacos, 2001), adversely affected the survival of the Alleghany woodrat (*N. magister*). Infected raccoons pass large numbers of eggs of *B. procyonis* in their feces. Under suitable environmental conditions, these eggs become infectious second-stage larvae in about 10–14 days and can remain infectious for years (Kazacos, 2001). Woodrats and many other rodents commonly feed on undigested seeds in raccoon feces (LoGiudice, 2001). *Baylisascaris procyonis* is highly pathogenic and infection with this organism is often fatal in these intermediate hosts (Kazacos, 2001). Woodrats are particularly susceptible to ingesting larval *B. procyonis* because of their feeding behavior. For example, woodrats collect raccoon feces and store them in food caches, where infectious larval *B. procyonis* can contaminate other foods (LoGiudice, 2001). Moreover, woodrats often wait several weeks for fecal matter to harden before harvesting it, allowing the eggs of *B. procyonis* time to embryonate (LoGiudice, 2001). High raccoon density appears to increase the threat of transmission of *B. procyonis* to woodrats by increasing the amount of feces containing viable eggs of *B. procyonis* available to woodrats (Kazacos, 2001; LoGiudice, 2003).

Our objectives were to determine whether *B. procyonis* was present in the raccoon population on Key Largo, Florida, USA, and to estimate raccoon density on north Key Largo so we could accurately

assess the degree of risk that *B. procyonis* poses to the endangered KLWR population. Key Largo (25°15′N, 80°15′W) is the first and largest in a chain of islands (keys) that extend from the southern tip of peninsular Florida. We limited our study to KLWR habitat (845 ha) along an 11-km stretch of protected hardwood hammock forest on the northern third of Key Largo. The hardwood hammock contains a high abundance of West Indian plants and trees (Strong and Bancroft, 1994). Common trees include gumbo-limbo (*Buresa simaruba*), poisonwood (*Metopium toxiferum*), wild tamarind (*Lysiloma bahamensis*), pigeon plum (*Cocoloba diversifolia*), willow bustic (*Bumelia salicifolia*), and Jamaican dogwood (*Piscidia fostidissimum*).

We livetrapped raccoons within remaining KLWR habitat to determine the presence of *B. procyonis* in summer and fall when the parasites and eggs are most prevalent (Kidder et al., 1989). The study area was sampled by utilizing existing 28-ha blocks used in monitoring KLWRs by the USFWS. In using the grid design, we systematically sampled the entire KLWR range and could validate the presence of *B. procyonis* in areas known to have KLWRs. We placed four box traps (Tomahawk 106 and 108 live-traps, Tomahawk, Wisconsin, USA) within each block and baited them with dry cat food for a period of 2–3 days. Traps were checked and closed in the mornings and opened in the evenings. Trapping ceased once a raccoon was captured and a fecal sample was collected within each block. Fecal samples were placed individually into plastic bags and refrigerated at approximately 5 C until analyzed. Thirty samples were collected between June and September 2002. In November 2002, raccoon density was estimated and additional fecal samples were taken from a portion of the study site sampled between June and September. A 132-ha tract of hardwood hammock bordered by water and a major highway was chosen for intensive sampling because it had a large portion (40%) of the entire KLWR population occurring there and raccoon dispersal was limited. We placed 40 traps 150 m apart along transects and baited them with dry cat food every day for 12 days. Again, traps were checked daily, and closed in the mornings and opened in the evenings. Captured raccoons were marked with colored polyvinyl chloride cement and released. They were marked on the right side if a fecal sample was collected; otherwise the left side was marked. Raccoon density was estimated by using the Schnabel method, a population estimator that extends the Peterson method for marked and released animals in a closed population over multiple trapping sessions (Krebs, 1999). Additionally we calculated the prevalence of *B. procyonis* with 95% binomial confidence intervals (CIs) for the entire study site and for the 132-ha tract of hammock used for the mark–recapture estimate of raccoon density (Krebs, 1999).

Fecal samples (~3 g) were examined with a modified centrifugal flotation technique by using a sodium nitrate solution (Sloss et al., 1994). Flotations were examined with a compound microscope at 100× and 400× for the presence of eggs of *B. procyonis*.

Fecal samples were collected from 32 raccoons during the second round of trapping in November. No eggs of *B. procyonis* were found in any of 64 samples. Approximately 25% of these samples came from juvenile raccoons, which are known to have higher rates of infection with *B. procyonis* and to shed more eggs in their fecal matter than adults (Kazacos, 2001). Raccoon density for north Key Largo was approximately 0.62 raccoons/ha (95% CI=0.38–1.21 raccoons/ha). Prevalence on the 132-ha tract of hammock used for the mark–recapture study was 0.0% (0.0–8.5%) for the estimated raccoon population of 82 individuals. For the lower and upper CI of this estimate (50, 160), prevalence of *B. procyonis* was estimated at 0.0% (0.0–6.5%) and 0.0% (0.0–9.7%), respectively.

The apparent absence of the nematode

B. procyonis from sympatric raccoons leads us to conclude that there is little subsequent risk to the KLWR population. However, raccoon density on Key Largo was much higher than reported for most other rural areas (typically <0.2 raccoons/ha; Walker, 1993), including regions where *B. procyonis* occurs.

Kazacos (2001) reported low prevalences of *B. procyonis* in the southeastern United States. *Baylisascaris procyonis* has been reported from raccoons in Georgia (Kazacos, 2001) and coastal Texas (Kerr et al., 1997), but no records exist of this parasite in Florida (Forrester, 1992). Kazacos (2001) maintained that the absence of *B. procyonis* in many southeastern states was not related to environmental factors; rather, this parasite probably was not present in the raccoons that originally colonized these areas. Although *B. procyonis* does not currently appear to be a problem for KLWRs, the high raccoon densities on Key Largo may mean that KLWRs could easily be exposed should this parasite be inadvertently introduced onto Key Largo by raccoons or domestic dogs with patent infectious transported from areas having high prevalences of *B. procyonis* (Kazacos, 2001).

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