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A Coprological Survey of Parasites of Wild Mantled Howling Monkeys, *Alouatta palliata palliata*

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ABSTRACT: Fecal samples from 155 mantled howling monkeys (*Alouatta palliata palliata*) examined at Centro Ecologico La Pacifica, Guanacaste Province, Costa Rica, revealed 75 (48%) had parasitic infections. A sampling of nine howling monkeys from Santa Rosa National Park, Costa Rica indicated only one infected animal (11%). Only three of 19 (16%) spider monkeys (*Ateles geoffroyi*) also from Santa Rosa were infected. *Controrchis biliophilus, Trypanoxyuris minutus,* unidentified strongylid eggs and *Isospora* sp. oocysts were found. Three monkeys from La Pacifica died and were examined for adult helminths. They were infected with *Ascaris lumbricoides, C. biliophilus* and *T. minutus.*

Key words: Mantled howling monkey, *Alouatta palliata, Controrchis biliophilus, Trypanoxyuris minutus, Ascaris lumbricoides,* spider monkey, *Ateles geoffroyi,* survey.

Although neotropical monkeys in general and howling monkeys in particular have not been surveyed systematically, a variety of parasites have been listed from the alimentary tract of howling monkeys (*Alouatta palliata*) in Central America. Parasites reported from *A. palliata* (=*A. villosa* from Panama) include *Trichomonas* sp., *Giardia* sp., *Entamoeba* (=*Endamoeba*) sp., *Chilomastix* sp., *Retortamonas* sp., *Isospora arctopitheci* (experimental infection), *Toxoplasma* sp., *Controrchis biliophilus, Raillietina demerariensis, Trypanoxyuris minutus, Parabronema bonnei* and *Prosthenorchis elegans* (Hegner, 1935; Jiménez-Quirós and Brenes, 1957; Thatcher and Porter, 1968; Hendricks, 1977; Frenkel and Sousa, 1983; González et al., 1983).

In conjunction with an ecological study of mantled howling monkeys at the Centro Ecologico La Pacifica near Cañas, Guanacaste Province, Costa Rica, fecal samples were examined for parasite eggs, larvae and oocysts. Since *Alouatta palliata* is protected by the Costa Rican government and animals may not be deliberately killed, fecal analysis was the only viable option for a survey of parasites. La Pacifica is a privately owned cattle ranch covering 1,330 ha. It is located at the base of the Cordillera de Tiliran, five km northwest of Cañas, Guanacaste Province, Costa Rica (10°28′N and 85°07′W). The ranch is 45 m above sea level and lies within the lowland tropical dry forest life zone. Some 450 ha of semi-deciduous forest remain on the ranch in two large tracts, as well as wind-break strips and riparian forests. *Alouatta palliata* is the only nonhuman primate occurring on the ranch and is not molested by the local inhabitants. Since December 1985 the ranch has been designated as an agricultural and ecological research station. As part of a long-term study by two of the authors (KEG and MRC), the howlers are captured once a year for measuring, marking and sexing of newborns. There are presently 273 marked individuals in 28 different social groups.

During July–August of 1986 and July–August 1987, 200 fecal samples were collected from 155 monkeys captured at La Pacifica. The samples consisted of 108 individuals from 13 groups living in tropical dry forest and 47 individuals from seven groups living in riverine forests along the Rio Corobici, the Rio Tenorio, or the Rio Tenorito. Feces were preserved immediately after defecation in 10% buffered for-

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malin FeKal transport vials (Trend Scientific, Inc., St. Paul, Minnesota 55112, USA). The presence of ova and larvae was determined using Trend Scientific's CON-Trate system®, a formalin/ethyl acetate centrifugation technique (Long et al., 1985). After centrifugation, two drops of the concentrate were placed on a microscope slide and all ova and larvae under an 18 × 18 mm coverslip were counted. Pinworms were collected from the feces and perianal region of captured monkeys. Three animals died during the capture process and the body cavities and digestive systems were examined for adult worms. Colin Chapman, working at the Santa Rosa National Park on the Costa Rica/Nicaragua border in the northwest corner of Guanacaste Province (10°54'N and 85°39'W), collected an additional nine fecal samples from howling monkeys and 19 samples from sympatric spider monkeys (*Ateles geoffroyi*). The Santa Rosa samples were preserved and examined in the same fashion as the La Pacifica samples.

The total numbers of parasitized animals did not differ significantly between dry forest and riverine groups ($\chi^2 = 0.12$, $P = 0.73$) although there was a difference in the species composition. No difference existed between sexes in number of parasitized individuals ($\chi^2 = 0.24$, $P = 0.63$). Ectoparasites were not found although botfly larvae, presumably *Alouattamyia baeri*, had been previously noted in the region by Zeledón et al. (1957).

Controrchis biliophilus (Digenea: Dicrocoelidae) eggs were found in the feces of 50 howlers (32% of monkeys captured). Dry forest monkeys had a prevalence of 37% (40 of 108) while riverine forest groups had a prevalence of 21% (10 of 47). This difference was nearly significant ($\chi^2 = 3.3$, $P = 0.07$) and probably biologically important. The intermediate hosts for this digenean are unknown but presumably follow a typical dicrocoelid pattern from a snail to an ant. Howling monkeys are primarily folivorous and are not known to deliberately consume insects. However, 25 of the 209 howling monkey fecal samples (12%) contained insect remains, probably accidentally eaten with flowers and fruits.

Twenty-two of 155 (14%) individuals had thin-shelled and often fully embryonated eggs with a mean size of 50 μm × 32 μm. Larvae were present in some samples. Since the buccal tube of a typical larva was longer than the width of the head, these eggs were tentatively identified as belonging to the nematode order Strongylida. *Ancylostoma* sp. and *Vianella* (=*Longistriata*) *dubia* have both been reported from howling monkeys (Dunn, 1968; Durette-Desset, 1968). However, until further surveys can be completed, the identification of this parasite must remain tentative. Strongylid infections were almost four times as high in animals from riverine forest as in individuals from dry forests (30% to 7%). This difference was highly significant ($\chi^2 = 18.1$, $P = 0.001$). Differences in microenvironment and troop behavior may contribute to the higher prevalence of infection in riverine forests. A higher humidity which would prolong larval survival and a greater tendency among the riverine troops to repeatedly use specific pathways, as reported by one of the investigators (MRC), may lead to a greater fecal contamination of pathways.

The monkeys do live in close proximity to the families of ranch workers on La Pacifica and often raid cultivated mango plantations adjacent to housing. One monkey contained a single specimen of *Ascaris lumbricoides*, suggesting contact with human feces.

Direct observation of helminths in the feces and perianal region of 103 monkeys captured during the 1987 season indicate that prevalence of *T. minutus* is 100% in monkeys >4-wk-old. However, eggs or larvae were found in the fecal samples of only 22% (34 of 155).

The number of species of parasites and their prevalence may be related to the high density of howling monkeys on the ranch: 74.3 per km² (Clarke et al., 1986) as opposed to 4.7 per km² in Santa Rosa National

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Park (Fedigan et al., 1985). The 27 samples (howling and spider monkeys) from Santa Rosa showed a substantially lower prevalence than those from La Pacifica. Only three of 19 spider monkeys (two with strongylid larvae and one with *Trypanoxyuris* sp.) and one of nine howling monkeys (infected with *Isospora* sp.) were parasitized. More extensive comparative surveys from the national park and from rain forest populations are needed to determine the effects of cattle husbandry and ranching on the ecological relationships of dry deciduous forest monkeys and their parasites.

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