

Kyoto University Overseas Research  
 Reports of New World Monkeys (1985) 5: 17–24  
 Kyoto University Primate Research Institute

## Helminth Parasites of Bolivian Monkeys

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### ABSTRACT

Parasitologic findings in a survey of 19 Bolivian primates belonging to 9 species of 7 genera, 2 *Callicebus moloch*, 1 *Aotus azarae*, 5 *Saimiri sciureus*, 2 *Cebus albifrons*, 1 *C. apella*, 1 *Alouatta seniculus*, 3 *Saguinus fuscicollis*, 3 *S. labiatus* and 1 *Cebuella pygmaea*, are recorded and discussed. Eighteen of 19 animals harbored one or more species of parasites belonging to more than 20 species. New host records noted in this paper are as follows: *Callicebus mooch*—*Longistriata dubia* (Nematoda: Heligmosomatidae), *Phaneropsolus* sp. (Trematoda: Lecithodendriidae, different from *P. orbicularis*), *Bertiella mucronata* (Cestoda: Anoplocephalidae), *Porocephalus* sp. (Pentastomida); *Aotus azarae*—*Trypanoxyuris interlabiata* (Nematoda: Oxyuridae), *Phaneropsolus* sp.; *Cebus apella*—*Longistriata dubia*; *Saguinus labiatus*—*Molineus vexillarius* (Nematoda: Trichostrongylidae), *Primasubulura jacchi* (Nematoda: Subuluridae), *Dipetalonema gracile* (Nematoda: Dipetalonematidae), *Phaneropsolus orbicularis*, *Prosthenorchis elegans* (Acanthocephala: Gigantorhynchidae); *Cebuella pygmaea*—*Athesmia foxi* (Trematoda: Dicrocoeliidae). The pathogenicity of *Molineus torulosus*, forming tumours in the small intestinal wall of the host animal, is presented.

### INTRODUCTION

Since 1976, research works on South American Primates have been performed by staff members of the Kyoto University Primate Research Institute. In 1984, parasitologic examinations were carried out on some individuals of Bolivian primates which were captured for the purpose of genetic studies.

Records for parasites of New World monkeys were compiled from various literatures by Hershkovitz (1977). He listed 72 nematodes, 13 trematodes, 18 cestodes, 4 acanthocephalids and 2 pentastomid species found in 35 primate species.

This paper reports the incidence and identification of the parasites found at necropsy on 19 Bolivian primates belonging to 9 species of 7 genera.

### MATERIALS AND METHODS

Nineteen primates belonging to 9 species of 7 genera, 2 *Callicebus moloch*, 1 *Aotus azarae*, 5 *Saimiri sciureus*, 2 *Cebus albifrons*, 1 *C. apella*, 1 *Alouatta seniculus*, 3 *Saguinus fuscicollis*,



Fig. 1. Map of Bolivia. Closed circles show locations where this survey was conducted.

Table 1. Species, common names and localities of capture of 19 Bolivian Primates.

Individual No.	Species	Common name	Locality
	CEBIDAE		
1	<i>Callicebus moloch donacophilus</i>	Titi monkey	San Miguel, Santa Cruz
2	<i>Callicebus moloch donacophilus</i>	Titi monkey	San Miguel, Santa Cruz
3	<i>Aotus azarae</i>	Night monkey	Chive, Pando
4	<i>Saimiri sciureus</i>	Squirrel monkey	Chive, Pando
5	<i>Saimiri sciureus</i>	Squirrel monkey	Chive, Pando
6	<i>Saimiri sciureus</i>	Squirrel monkey	Nueva Espana, Pando
7	<i>Saimiri sciureus</i>	Squirrel monkey	Nueva Espana, Pando
8	<i>Saimiri sciureus</i>	Squirrel monkey	Colonia Piray, Santa Cruz
9	<i>Cebus albifrons</i>	White-fronted capuchin monkey	Araonas, La Paz
10	<i>Cebus albifrons</i>	White-fronted capuchin monkey	Chive, Pando
11	<i>Cebus apella</i>	Tufted capuchin monkey	Colonia Piray, Santa Cruz
12	<i>Alouatta seniculus</i>	Howler monkey	Nueva Espana, Pando
	CALLITRICHIDAE		
13	<i>Saguinus fuscicollis weddlii</i>	Saddle-back tamarin	Nazareth, Pando
14	<i>Saguinus fuscicollis weddlii</i>	Saddle-back tamarin	Nazareth, Pando
15	<i>Saguinus fuscicollis weddlii</i>	Saddle-back tamarin	Nazareth, Pando
16	<i>Saguinus labiatus labiatus</i>	Red-chested moustached tamarin	Isla Gargantuan, Pando
17	<i>Saguinus labiatus labiatus</i>	Red-chested moustached tamarin	Nazareth, Pando
18	<i>Saguinus labiatus labiatus</i>	Red-chested moustached tamarin	Nazareth, Pando
19	<i>Cebuella pygmaea</i>	Pygmy marmoset	Conbija, Pando

\*Transferred from Mukuden, Pando

3 *S. labiatus* and 1 *Cebuella pygmaea*, were captured at 8 localities in Bolivia in September and October, 1984. The details of species names, common names and localities of the capture of each primate are presented in Table 1 and Figure 1. When the primates were necropsied the gastrointestinal organs were removed and preserved in Carnoi's fixative or in 70% alcohol at the place of the capture. The fixed materials were brought back to our laboratory.

Prior to the examination whole fixed materials were immersed in 45% acetic acid solution for one night to make the tissue soft and transparent. Filarial adult worms attaching to the mesentery were collected and then the gastrointestinal tracts were cut open under a dissection microscope for collecting helminths. The collected worms were preserved in acetic alcohol until the morphological observations were performed.

Histopathologic examinations were made on the intestinal tissue at the infected site with *Molinuev torulosus*.

Any organs or tissues other than the stomach, intestine and mesentery were not examined in this work.

Table 2. Distribution of Helminths in 19 Bolivian Primates.

Indivi- dual No.	SP. of Hosts	SP. of parasites																		
1.	<i>Calliebus moloch</i>	NEMATODA																		
2.	<i>Calliebus moloch</i>	NEMATODA																		
3.	<i>Aotus azarai</i>	NEMATODA																		
4.	<i>Saimiri sciureus</i>	NEMATODA																		
5.	<i>Saimiri sciureus</i>	NEMATODA																		
6.	<i>Saimiri sciureus</i>	NEMATODA																		
7.	<i>Saimiri sciureus</i>	NEMATODA																		
8.	<i>Saimiri sciureus</i>	NEMATODA																		
9.	<i>Cebus albifrons</i>	NEMATODA																		
10.	<i>Cebus albifrons</i>	NEMATODA																		
11.	<i>Cebus apella</i>	NEMATODA																		
12.	<i>Alouatta seniculus</i>	NEMATODA																		
13.	<i>Saguinus fuscicollis</i>	NEMATODA																		
14.	<i>Saguinus fuscicollis</i>	NEMATODA																		
15.	<i>Saguinus fuscicollis</i>	NEMATODA																		
16.	<i>Saguinus labiatus</i>	NEMATODA																		
17.	<i>Saguinus labiatus</i>	NEMATODA																		
18.	<i>Saguinus labiatus</i>	NEMATODA																		
19.	<i>Cebuella pygmaea</i>	NEMATODA																		
		CESTODA																		
		TREMATODA																		
		ACANTHOCEPHALA																		
		PENTASTOMIDA																		
		Poroccephalus sp.																		

(.) Negative (●) Positive

## RESULTS AND DISCUSSION

Findings were summarized in Tables 2, 3 and 4. Eighteen out of 19 primates harbored one or more species of parasites belonging to more than 20 species.

*Strongyloides cebus* was found in all of 5 *Saimiri* captured at 3 different localities, but none of 14 primates belonging to other 6 genera was infected with this parasite. The identification of *Strongyloides* was made after the description of Little (1966).

Table 3. Nematode parasites detected in Bolivian Primates.

	Parasite	Host	Location
<i>Strongyloides cebus</i>	Rhabdiasoidea	<i>Saimiri sciureus</i>	Small intestine
<i>Molineus elegans</i>	Trichostrongylidea	<i>Saimiri sciureus</i>	Small intestine
<i>Molineus vexillarius</i>	Trichostrongylidea	<i>Saguinus fuscicollis</i> , <i>Saguinus labiatus*</i> , <i>Cebuella pygmaea*</i>	Small intestine
<i>Molineus torulosus</i>	Trichostrongylidea	<i>Cebus apella</i>	Small intestine
<i>Longistriata dubia</i>	Trichostrongylidea	<i>Callicebus moloch*</i> , <i>Cebus apella*</i>	Small intestine
<i>Trypanoxyuris tamarini</i>	Oxyuroidea	<i>Saguinus fuscicollis</i>	Caecum, colon
<i>Trypanoxyuris sceleratus</i>	Oxyuroidea	<i>Saimiri sciureus</i>	Caecum, colon
<i>Trypanoxyuris interlabiata</i>	Oxyuroidea	<i>Aotus azarae*</i>	Caecum, colon
Pin worm (Unidentified)	Oxyuroidea	<i>Callicebus moloch</i> , <i>Saimiri sciureus</i> , <i>Saguinus fuscicollis</i>	Caecum, colon
<i>Primasubulura jacchi</i>	Subuluridea	<i>Saguinus fuscicollis</i> , <i>Saguinus labiatus*</i> , <i>Cebuella pygmaea</i>	Caecum, colon
<i>Physaloptera</i> sp.	Physalopteroidea	<i>Cebus apella</i>	Stomach
<i>Dipetalonema gracile</i>	Filarioidea	<i>Saimiri sciureus</i> , <i>Cebus albifrons</i> , <i>Saguinus fuscicollis</i> , <i>Saguinus labiatus*</i>	Peritoneal cavity
Unidentified (1)	(Larval stage)	<i>Saimiri sciureus</i>	Stomach wall
Unidentified (2)	(Larval stage)	<i>Alouatta seniculus</i>	Colon

\*New host species described.

Table 4. Trematodes, Cestodes, Acanthocephalans and Pentastomid detected in 19 Bolivian Primates.

	Parasite	Host	Location
<i>Phaneropsolus orbicularis</i>	Trematoda; Lecithodendriidae	<i>Saguinus labiatus*</i>	Small intestine
<i>Phaneropsolus</i> sp.	Trematoda; Lecithodendriidae	<i>Callicebus moloch*</i> , <i>Aotus azarae*</i> , <i>Saguinus fuscicollis</i>	Small intestine
<i>Athesmia foxi</i>	Trematoda; Dicrocoeliidae	<i>Cebuella pygmaea*</i>	Bile duct
<i>Bertiella mucronata</i>	Cestoda; Anoplocephalidae	<i>Callicebus moloch*</i>	Small intestine
<i>Atriotaeonia</i> spp.	Cestoda; Anoplocephalidae	<i>Callicebus moloch</i> , <i>Saimiri sciureus</i> , <i>Saguinus fuscicollis</i>	Small intestine
Unidentified	Cestoda;	<i>Saguinus fuscicollis</i>	Small intestine
<i>Prosthenorchis elegans</i>	Acanthocephala; Oligacanthorhynchidae	<i>Saimiri sciureus</i> , <i>Saguinus fuscicollis</i> , <i>Saguinus labiatus*</i>	Ileo-caecal junction
<i>Porocephalus</i> sp.	Pentastomida; Porocephalidae	<i>Callicebus moloch</i>	Tissue cyst (Liver, lung, stomach, mesentery)

\*New host species described.

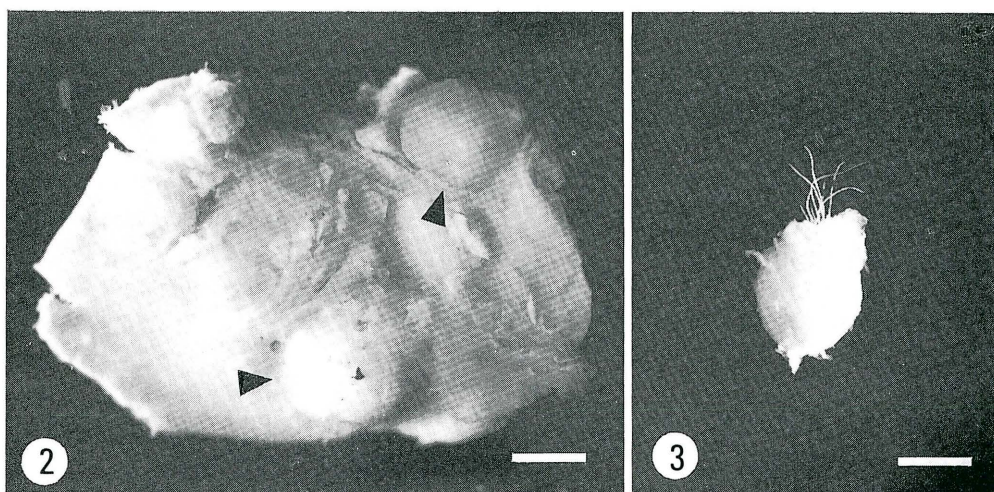


Fig. 2. A tumour removed from the small-intestinal wall. Several adult *Molineus torulosus* exposed their anterior or posterior portion of bodies out of the tumour to the lumen (topside). Scale shows 5 mm.

Fig. 3. Serosal surface of the small intestine infected with *Molineus torulosus*. Arrows show the sites protruded with tumours or nodules formed around worms. Scale shows 5 mm.

Three *Molineus* species were found: *M. elegans* in 4 of 5 *Saimiri*; *M. vexillarius* in all of 3 *Saguinus fuscicollis*, 3 *S. labiatus*, and 1 *C. pygmaea*; *M. torulosus* in 1 *C. apella*. The identification of *Molineus* species was made after the description of Dunn (1961). Adult *M. elegans* and *M. vexillarius* were found in the lumen of the duodenum and jejunum, and they showed no pathologic effects. On the other hand, most adult *M. torulosus* were found burrowing into the lining of the small intestine where the tumours or nodules were found around them. The tumours were 7–8 mm in diameter and contained about 10 adult worms in each of them. They protruded on the serosal surface of the small intestine, and the mucosal surface was almost flat (Fig. 2). Several worms exposed their anterior or posterior portion of bodies out of the tumour to the lumen (Fig. 3). The details of histopathologic findings on the tumour will be reported in the near future. On the pathogenicity of *M. torulosus* a hemorrhagic, ulcerative enteritis in primates was described (Lapin and Yakovleva, 1960), but the tumour-forming instances like the present case were not reported in the past. Hershkovitz (1977) listed *Saguinus nigricollis*, *S. fuscicollis*, *S. leucopus* and *S. oedipus* as hosts of *M. vexillarius*. To this list *S. labiatus* and *C. pygmaea* may be added as new hosts from the present survey.

*Longistriata dubia* was found in 2 *C. moloch* and 1 *C. apella*. This parasite was recorded from *Saimiri*, *Saguinus* and *Alouatta* (Dunn, 1968; Cosgrove et al., 1968; Porter, 1972). To the host list of Hershkovitz (1977) for *L. dubia*, *C. moloch* and *C. apella* may be added from the present survey as new hosts for this parasite.

Pin worms were found in 1 *C. moloch*, 1 *A. azarae*, 3 *Saimiri*, and 2 *S. fuscicollis*. *Trypanoxyuris (H.) tamarini* from *S. fuscicollis*, *T. (T.) sceleratus* from *Saimiri* and *T. (T.) interlabiata* from *A. azarae* were identified after Inglis (1961), Inglis and Dunn (1964) and Inglis and Cosgrove (1965). But other pin worms from 1 *C. moloch*, 1 *Saimiri*, and 1 *S. fuscicollis* were detected single or a few female specimens only, so that their species could not be determined. *A. azarae* may be added as a new host of *T. (T.) interlabiata* to the host list of Hershkovitz (1977).

*Primasubulura jacchi* was found in 1 *S. fuscicollis*, 3 *S. labiatus*, and 1 *C. pygmaea*. Hershkovitz (1977) listed 15 primate species belonging to Callitrichidae and *C. moloch* as hosts of this parasite. *S. labiatus* may be added as a new host to this parasite.

*Physaloptera* sp. was found in 1 *C. apella*. Specific identification could not be made because of lack of references.

*Dipetalonema gracile* was found in 3 *Saimiri*, 1 *C. albifrons*, 1 *S. fuscicollis*, and in 2 *S. labiatus*. All worms were removed from the mesentery. For this parasite *S. labiatus* may be added as a new host.

One *Saimiri* and 1 *A. seniculus* were infected with one of two kinds of nematode larva, the one was in the subserosa of the stomach and the other was in the lumen of the large intestine respectively. Their species identification could not be made.

Five individuals were infected with trematodes. *Phaneropsolus orbicularis* was found in 1 *C. albifrons*. *Phaneropsolus* sp., the body and egg of which were quite different in size from those of *P. orbicularis*, was found in 1 *C. moloch*, 1 *A. azarae*, and in 1 *S. fuscicollis*. *C. moloch*, *A. azarae* and *S. labiatus* may be added as new hosts of *Phaneropsolus* spp. to the host list of Hershkovitz (1977).

Two adult *Athesmia foxi* were found in the bottom of the bottle which preserved gastrointestinal organs of 1 *C. pygmaea*. The worms should have flown down through the bile duct at the necropsy. *C. pygmaea* may be added as a new host of this parasite.

Six of 19 primates were infected with cestodes. *Bertiella mucronata* was found in 1 *C. moloch*. Species identification of other cestodes found in 1 *C. moloch*, 2 *Saimiri*, and 2 *fuscicollis* are still undermined because of lack of references. *C. moloch* may be added as a new host of *Bertiella mucronata*.

*Prosthenorchis elegans*, Acanthocephalid, was the most commonly encountered parasite. This worm was found in 4 *Saimiri* and all of 6 tamarins. *S. labiatus* may be added as a new host of this parasite.

Nymphs of *Porocephalus* sp., pentastomid, were found in 1 *C. moloch*. Some of the worms were found beneath the serosa of the stomach or of the mesentery, and others were embedded firmly in the liver and lung. *C. moloch* may be added as a new host of this parasite.

Yamashita (1963) and Dunn (1963) reported the ecological relationships between parasites and primates. One of present authors, Minezawa, has studied on the evolution and phylogeny of the New World primates from the cytogenetic aspect (Minezawa and Borda, 1984 a, b). Some parasites, especially the Oxyuridae parasitic in primates, have a restricted host range with one species of parasite characteristic of one genus of host (Inglis, 1961). And there is a broad correlation between the trends that can be established in the morphology of the parasites and the phylogeny of the hosts (Inglis and Cosgrove, 1965). One of the main purposes of present work was to establish in detail the ecological and phylogenetic relationships between parasites and the New World primates. However, available specimens of each primate genus were so few that the conclusions were left over until the following survey.

## ACKNOWLEDGEMENTS

This research was supported by the Overseas Scientific Research Funds of the Ministry Education, Science and Culture, Japan, and constituted a part of the research project of the Primate Research Institute, Kyoto University headed by Dr. N. Nogami. We would like to express our sincere thanks to Prof. N. Kempff Mercado, el director del Zoo de Fauna Suda-

merica Santa Cruz y el miembro de la Academia Nacional Ciencias de Bolivia, and Coronel Mendez Jordan, Cobija, Pando, Bolivia. We also wish to thank to Dr. C. Jaime Valdivia B., and the other members of the Instituto Bioclinico Central, Santa Cruz, Bolivia, for their kind collaboration in this work. We are grateful for Mr. Jiro Ohnishi and D.V.M. Otto Carlos Jordan C., Zoological Garden Supplier, for their helpful collaboration in obtaining samples.

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