Figure 1. Confiscated adult female squirrel monkey (*Saimiri collinsi*) being rehabilitated at the Wild Animal Clinic at Federal Rural University of Amazonia (UFRA)

The area chosen for this action was as close as possible to the area where the animal was found. A group of squirrel monkeys was located and observed nearby, and the individual was released about five meters close to the group. Its interactions with the group members were observed and the primate vocalized towards them, obtaining vocal responses as the individual approached the group. No agonistic interaction was observed and the female then followed the group into the woods, suggesting a positive acceptance.

Even with the impossibility of a post-release monitoring, the protocol adopted for rehabilitation and destination of the individual highlighted the importance and need of a suitable destination protocol for confiscated fauna. This is especially true concerning the northern region of Brazil, where the lack of criteria for the release of confiscated animals is urgent, given the increasing number of confiscated fauna.

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References

Antunes, D. A. 2004. A Importância do comércio legal frente ao comércio Ilegal de animais silvestres. Zootec. 20p.

IBAMA – Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis. 2006. Relatório de atividades das ASM – Áreas de soltura e monitoramento de animais silvestres organizado pelo departamento de comunicação do IBAMA-SP. 56 p.

IUCN. 2000. IUCN Guidelines for the placement of confiscated animals. Approved by the 51st Meeting of the IUCN Council, Gland, Switzerland, February, 2000. Website: http://iucn.org/. Acessada em 12 de março de 2016.

Padrone, J.M.B. 2004. O comércio ilegal de animais silvestres: Avaliação da questão ambiental no estado do Rio de Janeiro. Dissertação (Mestrado em Ciência Ambiental). Universidade Federal Fluminense, Rio de Janeiro.

RENCTAS. 2001. 1º Relatório nacional sobre o tráfico de fauna silvestre. Website: http://www.renctas.org.br/pt/trafico/rel_renctas.asp. Acessada em 12 de março de 2016.

Rocha-Mendes, F., Di Napoli, R.P. and Mikich, S.B. 2006. Manejo, reabilitação e soltura de mamíferos selvagens. Arquivo de Ciências Veterinárias e Zoologia da Unipar. 9 (2): 105–109.

Rodrigues, L.L. 2001. Geoprocessamento como ferramenta na identificação e classificação de fragmentos florestais com potencial para soltura de fauna arborícola resgatada: estudo de caso na hidrelétrica Luis Eduardo Magalhães (Lajeado, TO). Dissertação (Mestrado em Ecologia). Universidade de Brasília, Brasília.

Vidolin, G. P., Mangini, P. R., Britto, M. M., and Muchail, M. C. 2004. Programa estadual de manejo de fauna silvestre apreendida - Estado do Paraná, Brasil. Cadernos da biodiversidade. 4:37–49.

FIRST ASSESSMENT OF HELMINTH PARASITES IN WILD SQUIRREL MONKEYS (*SAIMIRI COLLINSI*) IN NORTHEASTERN PARÁ STATE, BRAZIL

Anita I. Stone
David F. Conga
Jeannie N. dos Santos

Introduction

Pathogens are increasingly recognized as having an important role in the behavioral ecology, health and conservation of primate populations (Gillespie, 2006; Gillespie et al., 2008; Martínez-Mota et al., 2015). Recent studies have focused on parasite surveys in wild populations of neotropical monkeys (Eckert et al., 2006; Kowalewski and Gillespie, 2009; Soto-Calderon et al., 2016). Although some of these studies have sampled squirrel monkeys (Michaud et al., 2003; Phillips et al., 2004), most of the data on helminthic parasites of *Saimiri* come from captive populations. These data indicate a variety of gastrointestinal parasites in these primates, including helminths, bacteria and protozoa. Helminthic parasites include cestodes, acanthocephalans, trematodes and nematodes (Dunn, 1968). Yet, the diversity of gastrointestinal parasites in free-ranging squirrel monkey populations is still less well-known.

Here we present the first assessment of helminthic parasites in wild *Saimiri collinsi*, a species of squirrel monkey endemic to Brazil (Mercês et al. 2015). We collected fecal samples from one group of monkeys in Amazonian Brazil (State of Pará). The habituated social group contained 50 individuals and ranged in 150 ha of predominantly secondary forest. In addition to consuming ripe fruit, squirrel monkeys at this field site are highly faunivorous, spending up to 75% of their foraging time on arthropods, particularly in the dry season (Stone, 2007).

Methods

This study was conducted in the village of Ananim, municipality of Peixe-Boi, 150 km east of Belém, Brazil (01° 11' S, 47° 19' W). Rainfall is highly seasonal in the 800 ha site, with a wet season from January to June and a dry season from July to December. October and November correspond to the period of lowest fruit availability (Stone, 2007).

Fecal samples were collected from 13 individuals in November 2013, during the annual capture procedure of squirrel monkeys at our field site (Stone et al., 2015). After capture, the monkeys remained in a rectangular trap which was divided into individual compartments; the trap contained a tray on the bottom. After releasing the monkeys (within six hours of capture), we collected any fecal material that remained in the tray; these were preserved in 10% formaldehyde solution for later laboratory analysis. Fecal samples did not have contact with the soil. We collected four samples on four different trapping days (Table 1). Two of the samples were from individual monkeys (one adult female and one adult male), and two of the samples collectively contained fecal material from all the individuals trapped on that particular day (five to six individuals including adult females, adult males and juveniles). Individuals were only sampled once. All adult females were in the last third of gestation (gestation is five months in *Saimiri*; Garber and Leigh, 1997; Stone, 2006). Coprological analyses of the samples were carried out using the spontaneous sedimentation in tube technique (Smith et al, 2007). The resultant one drops of samples were placed on a slide, stained using iodine stain, and examined under a light microscope. Helminth larvae and eggs were identified based on size and morphology. Samples were scored as either positive or negative for each fecal sample.

Results and discussion

We sampled 13 wild squirrel monkeys, including adult females, adult males and juveniles. As shown in Table 1 and Figures 1 and 2, several types of helminthic parasites were found Nemadoda, Cestoda and Acanthocephala). In particular, we found that the intestinal nematode *Strongyloides*

Figure 1. (A–E) Light microscope pictures of parasite eggs recovered from fecal samples of Squirrel monkeys (*Saimiri collinsi*) in Pará, Brazil. (A) *Strongyloides* sp., (B) Trichostrongylidae, (C) *Trypanoxyuris* sp., (D) *Prostenorchis* sp., (E) Taeniidae, scale bar = 20 µm.

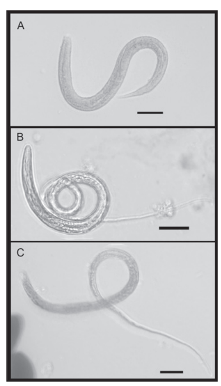

Figure 2. (A–C) Light microscope pictures of nematode larvae recovered from fecal samples of Squirrel monkeys (*Saimiri collinsi*) in Pará, Brazil. (A) *Strongyloides* sp., (B-C) *Filariopsis* sp, scale bar = 20 µm.

sp. was present in 100% of sampled material. According to Dunn (1968), this soil-transmitted parasite can be pathogenic when the infection is heavy.

Previous reports on gastrointestinal parasites in squirrel monkeys focused primarily on captive populations or newly captured monkeys (e.g. Dunn, 1968; but see Appleton and Boinski, 1991), and helminthic burdens are often substantial in newly captured and captive animals. In fact, all types of helminths present in our samples were reported previously by Dunn (1968) in newly imported South American squirrel monkeys, but particularly the helminth *Prosthernorchis elegans*. This helminth also was present in nearly all samples obtained from free-ranging *Saimiri boliviensis* and *S. macrodon* captured in Peru (Michaud et al., 2003). It is noteworthy that in their examination of fecal

Table 1. Helminthic parasites present in fecal samples of one social group of *Saimiri collinsi* in Pará, Brazil. Identifications were made using eggs and larvae, except when noted. All adult females were gravid.

Samples	Age-sex class	Parasites
Sample 1	2 adult females 1 adult male 3 juveniles	Nematoda: Trichostrongylidae *Trypanoxyuris* sp. *Strongyloides* sp. *Filarioides* sp. Acanthocephala: *Prosthernorchis* sp.
Sample 2	5 adult females	Nematoda: *Strongyloides* sp.
Sample 3	1 adult male	Nematoda: Trichostrongylidae *Strongyloides* sp. Acanthocephala: *Prosthernorchis* sp. Cestoda: Taeniidae
Sample 4	1 adult female	Nematoda: Tricostrongylidae *Strongyloides* sp. Cestoda: Taeniidae

parasites in Costa Rican squirrel monkeys (*S. oerstedii*), Appleton and Boinski (1991) did not find several of the helminths we recorded in *S. collinsi*, including *Trypanoxyuris* sp. and Taeniidae. However, *Filaroides* sp, which were also highly prevalent in the Costa Rican population, were recorded in our samples. Interestingly, no *Strongyloides* sp. (the most common parasite in our study) were recorded in wild *S. sciureus* sampled in Peru, although multiple social groups were sampled (Phillips et al., 2004).

The fecal samples were collected in the driest month of the year, when fruit availability in the forest is low and the monkeys spend more time eating arthropods (Stone, 2007). This may explain the presence of cestodes and acanthocephalans in our samples, as insects serve as intermediate hosts of these parasites (Michaud et al., 2003; Wenz et al., 2010). We note that, upon clinical examination, all individuals appeared healthy (e.g. four females in our sample subsequently gave birth to healthy infants). Thus, it did not appear that the parasites had become pathogenic in the monkeys. The same lack of harmful health effects was reported for wild *Saguinus leucopus* individuals sampled in Colombia by Soto-Calderon et al. (2016). These authors further argue that factors associated with captivity, such high densities and weakened immune responses, can facilitate pathogenicity when wild-caught individuals are placed into captive facilities.

The data listed in Table 1 likely represent a minimum level of infection, due to our small sample size and lack of replicate samples for each subject (hence, we do not report prevalence rates), although we highlight the diversity of helminths present in the small sample. In fact, compared to other neotropical primates such as howler monkeys, the squirrel monkeys showed more parasite number and taxa per sample (R. Martinez-Mota, pers. communication). Possibly, strictly arboreal primates such as howlers are less exposed to parasitic infections. In contrast, squirrel monkeys use different forest strata such as the under canopy and even the ground (Stone, 2007), where parasites may be more prevalent. An additional factor that may contribute to high parasite loads in squirrel monkeys is their large group sizes (40-50 animals; Stone, 2007), as sociality can predict an increase in parasite exposure (Rifkin et al., 2012; Webber et al., 2016).

Overall, then, our results provide initial information on the types of helminthic parasites of *Saimiri collinsi* in this region of Eastern Amazonia, yielding important baseline data for future studies of these primates.

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References

Appleton, C. C. and Boinski, S. 1991. A preliminary parasitological analysis of fecal samples from a wild population of Costa Rican squirrel monkeys (*Saimiri oerstedii*). *J. Med. Primatol.* 20:402–403.

Dunn, F. L. 1968. The parasites of *Saimiri* in the context of Platyrrhine parasitism. In: *The Squirrel Monkey*. L. A. Rosenblum, and R. W. Cooper. (eds.), pp.31–68. Academic Press, New York.

Eckert, K. A., Hahn, N. E., Genz, A., Kitchen, D. M., Stuart, M. D., Averbeck, G. A., Stromberg, B. E. and Markowitz, H. 2006. Coprological surveys of *Allouattapigra* at two sites in Belize. *Int. J. Primatol.* 27: 227–238.

Garber, P. A. and Leigh, S.R. 1997. Ontogenetic variation in small-bodied new world primates: implications for patterns of reproduction and infant care. *Folia Primatol.* 68: 1–22.

Gillespie, T. R. 2006. Noninvasive assessment of gastrointestinal parasite infections in free-ranging primates. *Int. J. Primatol.* 27:1129–1143.

Gillespie, T. R. and Chapman, C. A. 2008.Forest fragmentation, the decline of an endangered primate and changes in host-parasite interactions relative to an unfragmented forest. *Am. J. Primatol.* 70: 222–230.

Kowalewski, M. M. and Gillespie, T. R. 2009. Ecological and anthropogenic influences on patterns of parasitism in free-ranging primates: a meta-analysis of the genus *Alouatta.* In: *South American Primates*. P. A. Garber, Estrada, A., Bicca-Marques, J. C., Heymann, E. W. and Strier, K. B (eds.), pp. 433–461. Springer Press, New York.

Martínez-Mota, R., Kowalewski, M. M. and Gillespie, T.R. 2015. Ecological determinants of parasitism in howler monkeys. In: *Howler Monkeys*. M.M. Kowalewski, P. A. Garber, Cortés-Ortiz, L., B. Urbani and D. Youlatos (eds.), pp. 259–285. Springer Press, New York.

Mercês, M. P., Lynch-Alfaro, J. W., Ferreira, W. A. S., Harada, M. L. and Silva-Júnior, J. S. 2015. Morphology and mitochondrial phylogenetics reveal that the Amazon River separates two eastern squirrel monkey species: *Saimiri sciureus* and *S. collinsi*. *Mol. Phylogenet. Evol.* 82:426–435.

Michaud, C., Tantalean, M., Ique, C., Montoya, E. and Gonzalo, A. 2003. A survey for helminth parasites in feral New World non-human primate populations and its comparison with parasitological data from man in the region. *J. Med. Primatol.* 32: 341–345.

Phillips, K. A., Hass, M. E., Grafton, B. W. and Yrivarren, M. 2004. A survey of the gastrointestinal parasites of the primate community at Tambopata National Reserve, Peru. *J. Zool. London* 264: 149–151.

Rifkin, J. L., Nunn, C. L. and Garamszegi, L. Z. 2012. Do animals living in larger groups experience greater parasitism? A meta-analysis. *Am. Nat.* 180: 170–182.

Smith, P. H., Wiles S. E., Malone, J. B. Jr. and Monahan, C. M. 2007. Collection, preservation, and diagnostic methods. In: *Flynn's Parasites of Laboratory Animals*, Baker, D. G. (ed.), 2nd ed. Blackwell, Oxford.

Soto-Calderon, I. D., Acevedo-Garces, Y. A., Alvarez-Cardona, J., Hernandez-Castro, C. and Garcia-Montoya, G. M. 2016. Physiological and parasitological implications of living in a city: the case of the white-footed tamarin (*Saguinus leucopus*). *Am. J. Primatol.* 78: 1272–1281.

Stone, A. I. 2006. Foraging ontogeny is not linked to delayed maturation in squirrel monkeys. *Ethology* 112: 105–115.

Stone, A. I. 2007. Responses of squirrel monkeys to seasonal changes in food availability in an Eastern Amazonian rainforest. *Am. J. Primatol.* 69:142–157.

Stone, A. I., Castro, P. H. G., Monteiro, F. O. B., Ruivo, L. P. and Silva-Junior, J. S. 2015. A novel method for capturing and monitoring a small Neotropical primate, the squirrel monkey (*Saimiri collinsi*). *Am. J. Primatol.* 77: 239–245.

Webber, Q. M. R., Brigham, R. M., Park, A. D., Gillam, E. H., O'Shea, T. J. and Willis, C. K. R. 2016. Social network characteristics and predicted pathogen transmission in summer colonies of female big brown bats (*Eptesicus fuscus*). *Behav. Ecol. Sociobiol.* 10: 701–712.

Wenz, A., Heymann, E.W., Petney, T. N. and Taraschewski, H. F. 2010. The influence of human settlements on the parasite community in two species of Peruvian tamarin. *Parasitology* 137: 675-684.

PREDATION OF A LIZARD (*PLICA UMBRA*) BY PYGMY MARMOSETS (*CEBUELLA PYGMAEA*) IN A FOREST FRAGMENT IN SOUTHWESTERN BRAZILIAN AMAZON

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Rodrigo Canizo
Jailini da Silva Araújo

The pygmy marmoset (*Cebuella pygmaea*) is the smallest species of New World primate, and is found exclusively in the western Amazon basin (Townsend, 2001; Ankel-Simons, 2007; Messias *et al*. 2011). Given their small size and cryptic behavior, these monkeys are difficult to observe in the wild. They are found mainly in Amazonian alluvial and *terra firme* forests. Like other marmosets, *C. pygmaea* is highly specialized for the dietary exploitation of plant exudates (Moynihan, 1976; Soini, 1982; 1988; Yépez *et al*., 2005; Youlatos, 2009), but also feeds on insects and small vertebrates (Townsend and Wallace, 1999). This study describes the predation of a vertebrate by *Cebuella pygmaea* in an urban forest fragment (Parque Zoobotânico – PZ; 09°57'S, 67°57'W) of approximately 150 ha, which belongs to the Federal University of Acre (UFAC) in Rio Branco, capital of the Brazilian state of Acre (Fig. 1). This site is occupied by at least three groups of *C. pygmaea*, one of which was the subject of a previous ecological study

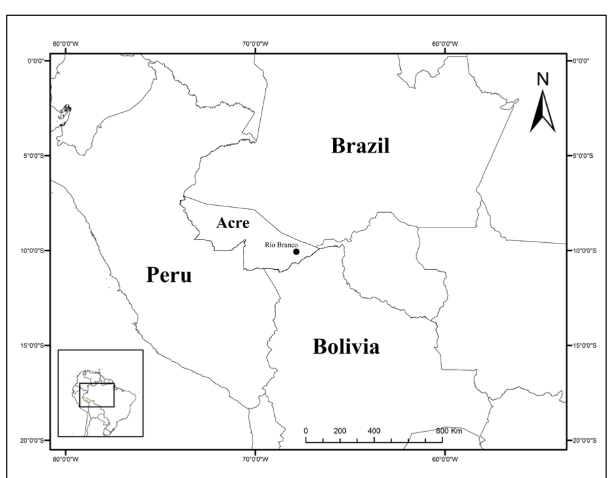

Figure 1. Geographical location of the Rio Branco city, State of Acre, Brazil.