PARASITOLOGIC ANALYSES OF THE SIFAKA (*PROPITHECUS VERREAUXI VERREAUXI*) AT BEZA MAHAFALY, MADAGASCAR

Author(s): Michael P. MuehlenbeinMs.P.H., Marion SchwartzM.A., Alison RichardPh.D.
Source: Journal of Zoo and Wildlife Medicine, 34(3):274-277. 2003.
Published By: American Association of Zoo Veterinarians
DOI: http://dx.doi.org/10.1638/1042-7260(2003)034[0274:PAOTSP]2.0.CO;2
URL: http://www.bioone.org/doi/full/10.1638/1042-7260%282003%29034%5B0274%3APAOTSP%5D2.0.CO%3B2

Journal of Zoo and Wildlife Medicine 34(3): 274–277, 2003

PARASITOLOGIC ANALYSES OF THE SIFAKA (*PROPITHECUS VERREAUXI VERREAUXI*) AT BEZA MAHAFALY, MADAGASCAR

Michael P. Muehlenbein, Ms.P.H., Marion Schwartz, M.A., and Alison Richard, Ph.D.

Abstract: A cross-sectional parasitologic survey of a population of wild sifaka (*Propithecus verreauxi verreauxi*) was conducted at the Beza Mahafaly Special Reserve in southwest Madagascar. Ninety fecal samples were collected from thirty 1- to 30-yr-old male and female sifakas, and the formalin-preserved and polyvinyl alcohol–preserved specimens were examined using the zinc sulfate flotation and formalin-ethyl acetate sedimentation techniques. No intestinal parasites were recovered, possibly because the sifakas are arboreal in a dry, riverine habitat and lack human contact. Low rates of parasitic infection may have contributed to the evolution of later age at first reproduction and longer reproductive lifespan, for body mass, in *Propithecus* compared with other placental mammals.

Key words: Sifaka, *Propithecus verreauxi verreauxi*, Madagascar, intestinal parasites.

INTRODUCTION

Primate parasitology seeks to identify ecologic, physiologic, and behavioral determinants and consequences of parasite-induced pathology in natural populations. There are numerous field studies of intestinal parasites in wild primate populations, including muriquis (*Brachyteles arachnoides*) and brown howling monkeys (*Alouatta fusca*) of southeastern Brazil,[22] mantled howling monkeys (*Alouatta palliata*) at La Selva Biological Reserve in northeastern Costa Rica,[21] Costa Rican squirrel monkeys (*Saimiri oerstedi*),[1] free-ranging Cayo Santiago rhesus macaques,[7] olive baboons (*Papio cynocephalus anubis*),[12,13] vervets (*Cercopithecus aethiops*) and sykes (*Cercopithecus mitis*) outside of Nairobi, Kenya,[13] chimpanzees (*Pan troglodytes*) from Gombe, Mahale, and Kibale,[3,4,6,11] and gorillas (*Gorilla gorilla*) of Gabon.[9] Wild Old World and New World primates harbor a wide range of protozoa and helminths.

Verreauxi's sifaka (*Propithecus verreauxi verreauxi*) are diurnal strepsirrhine primates that inhabit the riverine and dry forests of southern Madagascar.[23] The *P. v. verreauxi* at Beza Mahafaly Special Reserve in southwestern Madagascar (Fig. 1) have been studied since 1984. The reserve consists of two small protected areas within a much larger unprotected forest, bounded 15 km to the North by a major river, the Onilahy, and about 20 km to the South by deforested land in the vicinity of Betioky. Only project staff, researchers, and authorized tourists enter the reserve. Animals are not provisioned and no human food is accessible to them in the reserve. Project rules forbid urination or defecation in the reserve. Direct contact by at least some sifaka with human feces is possible, in principle, because use of a latrine is taboo for local staff, who instead have a ''toilet area'' in the unprotected forest adjoining the station. Sifaka spend little time on the ground, however, and the group whose home range encompasses the toilet area has never been seen on the ground there. In sum, anthropogenic contacts in the protected forest are minimal. More opportunities for contact exist in the vicinity of the research station, but the arboreal habits, folivorous diet, and dearth of curiosity characteristic of the sifaka mean that they rarely, if ever, exploit these opportunities.

There have been two parasitologic surveys of *Propithecus* sp. Using a single-sampling regime and the zinc sulfate flotation technique, no intestinal parasites were observed in a population of 34 free-ranging golden crowned sifaka (*Propithecus tattersalli*) in northeastern Madagascar,[5] although circulating microfilariae (*Mansonella* sp.) were present in 59% of the individuals. These sifakas may have been prevented from coming into contact with the majority of contaminating fecal matter because they are arboreal.[5] Fecal samples were collected from 18 sifaka (*P. v. verreauxi*) in gallery and transitional forest at the Beza Mahafaly Special Reserve in southwest Madagascar during a study of food preferences.[16] One-hundred forty samples were collected from November to December 1994 and 251 samples from November to December 1995. Only one animal was positive by direct fecal smear for *Ogmocotyle* sp. and another animal was positive for *Enterobius* sp.[16]

We conducted a parasitologic survey of the *P. v. verreauxi* living in the same area at the Beza Mahafaly Special Reserve to confirm extremely low prevalence, if not complete absence, of intestinal parasites in the sifaka of Madagascar.

From the Anthropological Parasitology Laboratory, Department of Anthropology, Yale University, 51 Hillhouse Avenue, New Haven, Connecticut 06520, USA. Correspondence should be directed to Dr. Muehlenbein.

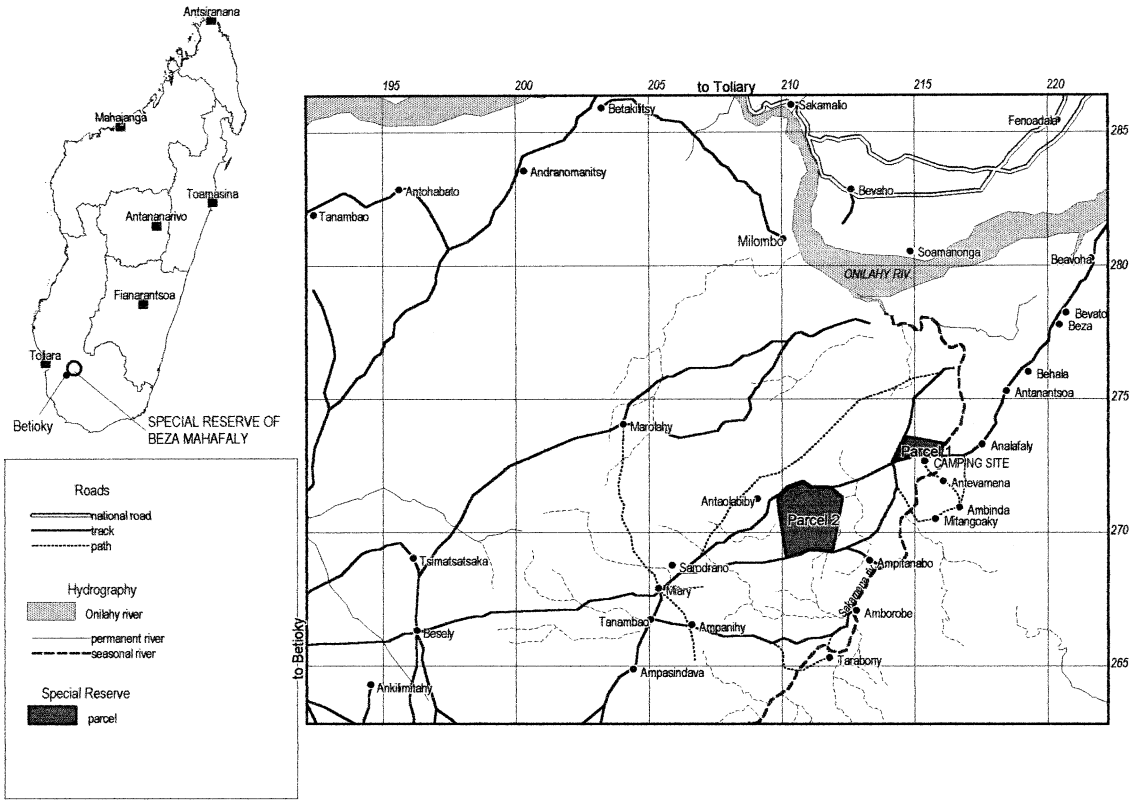

Figure 1. Location of the Beza Mahafaly Special Reserve.

MATERIALS AND METHODS

Field site and study population

This study was conducted in 100 ha of the Beza Mahafaly Special Reserve, Parcel 1, which encompasses a gradient from xerophytic vegetation to a narrow strip of riverine forest dominated by *Tamarindus indica* on the west bank of the Sakamena River. Parcel 1 has been completely fenced since 1979.

There are approximately 54 *P. verreauxi* social groups with home ranges partly or completely within the boundaries of Parcel 1. Groups contain 2–14 animals, vary markedly in sexual composition,[19] and have home ranges of 4–6 ha, with considerable overlap between neighboring ranges. Sifakas at Beza primarily eat young leaves, shoots, and seasonally available fruit.[8,15]

Sample collection

Ninety fecal samples were collected from thirty 1- to 30-yr-old male and female sifaka during July–August 2001. Individual animals were identified and followed. Their fecal samples were obtained off dry leaf litter immediately after defecation and preserved in duplicate using Para-Pak plastic transport vials (Meridian Diagnostics, Cincinnati, Ohio 45244, USA) prealiquoted with 10% neutral-buffered formalin and low-viscosity polyvinyl alcohol. Tubes were marked with the date, name, and number of the individual animal. Care was taken during collection to avoid contamination of samples with soil.

Three samples were collected from each animal on nonconsecutive days to increase the likelihood of positive diagnoses in cases of low or recent infection. Whereas most helminth eggs are passed continually, protozoan cyst output is highly variable, even within the same day and from hour to hour.[2]

Parasitologic analyses

Samples were transported to the Anthropological Parasitology Laboratory at Yale University. Each specimen was examined using the zinc sulfate flotation and formalin-ethyl acetate sedimentation techniques.[2,10,24]

RESULTS

No intestinal parasites were recovered.

DISCUSSION

Our results confirm previous suggestions of an absent or low intestinal parasite burden in the *Propithecus* of Madagascar.[5,16] No enteric parasites were found in 34 free-ranging golden crowned sifaka (*P. tattersalli*) in northeastern Madagascar using a single-sampling regime and zinc sulfate flotation technique.[5] Using the direct smear technique on fecal samples from 18 *P. verreauxi* from Beza Mahafaly, Raveloarisoa (2000) diagnosed that one of 18 *P. verreauxi* from Beza Mahafaly was positive for *Ogmocotyle* by direct smear and another was positive for *Enterobius*.[16] Differences in parasitologic techniques (e.g., direct smears vs. concentration techniques) and in sampling (e.g., single vs. multiple samples) most likely explain the minor differences in results between this study and past studies.

There are several possible explanations as to why *Propithecus* may have lower enteric parasite burdens compared with other primates. Tropical, moist climates may favor parasitic life cycle perpetuation better than the dry habitat of the riverine forest of southwest Madagascar. In Costa Rica, intestinal parasites are more prevalent in howling monkeys within the tropical rainforest La Selva Reserve than in howlers inhabiting dry deciduous forest at La Pacifica.[21]

The low level of contact between humans and *P. v. verreauxi* in Beza may partly explain the low parasite prevalence rates. Risk of infection is lower for primates in undisturbed habitats where human population density is low.[13] Conversely, higher prevalence in some primate species may be due to contamination from humans and their livestock.[13] Arboreality may also limit the potential for fecal–oral transmission, although studies on arboreal Costa Rican squirrel monkeys and howlers suggest very high parasite prevalence rates.[1,21]

Regardless of which mechanism(s) limits parasite prevalence within the Beza sifaka population, it is reasonable to assume that low parasite prevalence reduces the risk of mortality in all age cohorts. The rates and age-specific patterning of mortality in wild populations have direct, but incompletely understood, consequences for the evolution of life history patterns.[20]

Primate mortality rates are lower than those of most similarly sized mammals, and this may have contributed to the evolution of longer lifespan, slower postnatal growth, and later age at first reproduction that characterizes most primates.[14] The sifaka population at Beza Mahafaly has low risk of parasite-induced mortality and a suite of particularly ''slow'' life history traits. Controlling for body mass, females in this population give birth for the first time later and have a longer reproductive life than other primates, including chimpanzees and humans, or mammals belonging to other orders.[17,18] More detailed parasitologic research on similar wild primate populations may help us understand the determinants of variations in life history patterns between taxa.

Acknowledgments: We thank the Government of Madagascar for permission to undertake this research and the following persons for collecting the fecal samples: Diane Brockman, Laurie Godfrey, Richard Lawler, Patricia Whitten, Cynthia Balyeat, Stephanie Combs, Julie Parks, Milena Viljoen, Rigobert Emady, Enafa Efitroaramy, Edidy Ellis, Jeannicq Randrianarisoa, Joelisoa Ratsirarson, and Sylvia Ravelonjatovo. Frank Cogswell and Shelle Schwamberger provided valuable logistical support, and the manuscript was improved by the comments of Richard Bribiescas and Seamus Decker. This research was supported by the Schwartz Family Foundation, the Department of Anthropology at Yale University; the Graduate School Summer Study Fund at Yale University; and a Howard Foundation Fellowship.

LITERATURE CITED

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

2. Ash, L. R., and T. C. Orihel. 1991. Parasites: A Guide to Laboratory Procedures and Identification. American Society of Clinical Pathologists, Chicago, Illinois.

3. Ashford, R. W., G. D. F. Reid, and R. W. Wrangham. 2000. Intestinal parasites of the chimpanzee *Pan troglodytes* in Kibale Forest, Uganda. Ann. Trop. Med. Parasitol. 94: 173–179.

4. File, S. K., W. C. McGrew, and C. E. G. Tutin. 1976. The intestinal parasites of a community of feral chimpanzees, *Pan troglodytes schweinfurthii*. J. Parasitol. 62: 259–261.

5. Garell, D. M., and D. M. Meyers. 1993. Hematology and serum chemistry values for free-ranging golden crowned sifaka (*Propithecus tattersalli*). J. Zoo Wildl. Med. 26: 382–386.

6. Kawabata, M., and T. Nishida. 1991. A preliminary note on the intestinal parasites of wild chimpanzees in the Mahale mountains, Tanzania. Primates 32: 275–278.

7. Kessler, M. L., B. Yarbrough, R. G. Rawlins, and J. Berard. 1984. Intestinal parasites of the free-ranging Cayo Santiago rhesus monkeys (*Macaca mulatta*). J. Med. Primatol. 13: 57–66.

8. Kubzdela, K. S. 1997. Sociodemography in Diurnal Primates: The Effect of Group Size and Female Dominance Rank on Intra-Group Spatial Distribution, Feeding

Competition, Female Reproductive Success, and Female Dispersal Patterns in White Sifaka, *Propithecus verreauxi verreauxi*. Ph.D. Dissertation, Univ. Chicago, Chicago, Illinois.

9. Landsoud-Soukate, J., C. E. G. Tutin, and M. Fernandez. 1995. Intestinal parasites of sympatric gorillas and chimpanzees in the Lope Reserve, Gabon. Ann. Trop. Med. Parasitol. 89: 73–79.

10. Long, E. G., A. T. Tsin, and B. A. Robinson. 1985. Comparison of the FeKal CON-Trate system with the formalin-ethyl acetate technique for detection of intestinal parasites. J. Clin. Microbiol. 22: 210–211.

11. McGrew, W. C., C. E. G. Tutin, D. A. Collins, and S. K. File. 1989. Intestinal parasites of sympatric *Pan troglodytes* and *Papio* Spp. at two sites: Gombe (Tanzania) and Mt. Assirik (Senegal). Am. J. Primatol. 17: 147–155.

12. Muller-Graf, C. D. M., D. A. Collins, and M. E. J. Woolhouse. 1996. Intestinal parasite burden in five troops of olive baboons (*Papio cynocephalus anubis*) in Gombe Stream National Park, Tanzania. Parasitology 112: 489–497.

13. Munene, E., A. Otsyula, D. A. N. Mbaabu, W. T. Mutahi, S. M. K. Muriuki, and G. M. Muchemi. 1998. Helminth and protozoan gastrointestinal tract parasites in captive and wild-trapped African non-human primates. Vet. Parasitol. 78: 195–201.

14. Promislow, D. E. L., and P. H. Harvey. 1990. Living fast and dying young: a comparative analysis of life history variation among mammals. J. Zool. 220: 417–437.

15. Ranarivelo, N. A. 1993. Etude de la variation locale et saisonnière du régime et du comportement alimentaire de *Propithecus verreauxi verreauxi* dans la première parcelle de la Réserve Spéciale de Beza Mahafaly. Mémoire de fin d'études. ESSA Eaux et Forêts. Univ. d'Antananarivo, Antananarivo, Madagascar.

16. Raveloarisoa, A. 2000. Contribution à l'étude de la préférence alimentaire du *Propithecus verreauxi verreauxi* de la Réserve Spéciale de Bezà Mahafaly (Parcelle I). Mémoire DEA. Département de Biologie Animale (Option Ecologie Animale-Environnement), Faculté des Sciences. Univ. d'Antananarivo, Antananarivo, Madagascar.

17. Richard, A. 1992. Aggressive competition between males, female-controlled polygyny and sexual monomorphism in a Malagasy primate, *Propithecus verreauxi*. J. Hum. Evol. 22: 395–406.

18. Richard, A., R. E. Dewar, M. Schwartz, and J. Ratsorarsom. 2002. Life in the slow lane? Demography and life histories of male and female sifaka (*Propithecus verreauxi verreauxi*). J. Zool. 256: 421–436.

19. Richard, A., P. Rakotomanga, and M. Schwartz. 1993. Demography of *Propithecus verreauxi* at Beza Mahafaly, Madagascar: sex ratio, survival, and fertility, 1984–1988. Am. J. Phys. Anthropol. 84: 307–322.

20. Stearns, S. C. 1992. The Evolution of Life Histories. Oxford Univ. Press, New York, New York.

21. Stoner, K. E. 1996. Prevalence and intensity of intestinal parasites in mantled howling monkeys (*Alouatta palliata*) in Northeastern Costa Rica: implication for conservation biology. Conserv. Biol. 10: 539–546.

22. Stuart, M. D., K. B. Strier, and S. M. Pierberg. 1993. A coprological survey of parasites of wild muriquis, *Brachyteles arachoides*, and brown howling monkeys, *Alouatta fusca*. J. Helminthol. Soc. Washington 60: 111–115.

23. Tattersall, I. 1982. The Primates of Madagascar. Columbia Univ. Press, New York, New York.

24. Truant, A. L., S. H. Elliot, M. T. Kelly, and J. H. Smith. 1981. Comparison of formalin-ethyl ether sedimentation, formalin-ethyl acetate sedimentation, and zinc sulfate flotation techniques for detection of intestinal parasites. J. Clin. Microbiol. 13: 882–884.

Received for publication 14 October 2002