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Hepatocystis Parasitemia in Wild Kenya Vervet Monkeys (*Cercopithecus aethiops*)

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Abstract. Blood smears of 159 vervet monkeys from three sites in Kenya were stained with Giemsa and examined for *Hepatocystis* parasites. The populations differ in incidence of parasitemia, ranging from 0-62% affected individuals. These differences are probably due to altitude and local environmental conditions.

Introduction

As part of a genetic and populational study of Kenyan vervet monkeys *(Cercopithecus aethiops)* in the wild [1], blood smears were prepared and examined for parasitic infection. A substantial proportion of animals exhibited protozoan parasites identified as *Hepatocystis* sp., probably *H. kochi*. *Hepatocystis* are hemosporidian parasites of primates, distinguished from the true malarial parasites, *Plasmodium* sp., primarily on the basis of their invertebrate host and site of schizogeny. *Plasmodium* is transmitted by anopheline mosquitoes, and undergoes schizogeny in its vertebrate host's erythrocytes, thereby producing the clinical picture of classic malaria. The dipteran vector of *Hepatocystis* is a biting midge, *Culicoides*, and the parasite undergoes schizogeny in the tissues rather than the blood of its vertebrate host, which does not exhibit malarial symptoms. However, animals infected with *Hepatocystis* exhibit a parasitemia as well as

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characteristic hepatic cysts that contain mature merzoites. Both hemosporidian genera are believed to be derived from a tissue-coccidian ancestry, *Hepatocystis* being the less derived of the two [2,3]. *Hepatocystis* (initially confused with *Plasmodium*) was first observed in 1889 by Koch in wild vervet monkeys and baboons (*Papio* sp.) collected in East Africa. It has since been identified in a variety of African and Asiatic cercopithecids [3]. Several species have been distinguished, mainly on the basis of the structure of the merocysts. *Hepatocystis* of vervets are assigned to *H. kochi,* a species that has also been identified in *Cercocebus* and *Colobus* [2].

Materials and Methods

During 1978 and 1979 vervet monkeys were trapped at three locations in south-central Kenya: Mosiro, Naivasha, and Kimana. A blood sample was taken from the femoral vein of each animal, and smears prepared. These preparations were stained with Giemsa and examined for parasites in the laboratories of The International Center for Insect Physiology and Ecology (ICIPE), Nairobi. In all, 159 animals were tested.

Results

A species of *Hepatocystis,* believed to be *H. kochi,* was the only parasite identified. An overall incidence of 15.7% parasitemia was observed (Table I). No parasites were found in animals from Naivasha, where the sample was drawn from nine local subpopulations (troops), with contiguous ranges. At Kimana, where the animals examined represented four such troops, the overall incidence was 62%. However, parasitemia was very unevenly distributed among troops. Three troops showed almost universal parasitemia, while the fourth was entirely negative. The sample from Mosiro represented five different troops, and the low incidence of parasitemia (26.7%) was evenly spread among them.

In the Kimana and Mosiro samples, animals of both sexes and all ages exhibited the parasite. Contrary to the observation of Garnham [2], there was no significant association between parasitemia and age. However, there was apparently some association with sex: 48% of males, but only 30% of females, were parasitised (Table II).

None of the infected animals showed gross signs of morbidity or debility. Body weights (measured at the time of trapping) of parasitized

Table I. Incidence of *Hepatocystis* parasitemia by region and troop

Site	Troop	Sample size	No. positive
Mosiro	B3	7	1
	B4	14	4
	B5	9	2
	B6	3	2
	B7	12	3
	All	45	12 (26.7%)
Kimana	D1	4	3
	D2	2	2
	D3	8	8
	D7	7	0
	All	21	13 (61.9%)
Naivasha	All	93	0
All		159	25 (15.7%)

Tests for heterogeneity: among regions, $\chi^2 = 26.8$, $P < .001$; among troops at Mosiro, $\chi^2 = 0.84$, $P = .975$; among troops at Kimana (troops D7 vs the rest), $\chi^2 = 5.62$, $P = .025$.

Table II. Incidence of *Hepatocystis* parasitemia at Kimana and Mosiro, by age and sex

	Sample size	No. positive
Adult males	9	5
Adult females	18	6
Young males	20	9
Young females	19	5

Tests for heterogeneity: by age and sex, $\chi^2 = 2.83$, $P = .5$–$.75$; by age, $\chi^2 = 0.15$, $P = .5$–$.75$; by sex $\chi^2 = 2.35$, $P = .1$–$.25$.

animals were not different from those of uninfected animals of the same population when matched for age and sex.

Discussion

According to Garnham [2], *Culicoides* is widespread in trans-Saharan Africa, and most frequent in well-watered woodland and secondary growth. It is much rarer in rain forest and in dry scrublands, and is absent from areas above 2,000 m at the equator. The apparent absence of *Hepatocystis* in vervets living in the *Acacia* woodland surrounding Lake Naivasha can

probably be attributed to altitude; although it receives more rainfall than the other sites sampled, it lies close to an altitude of 2,000 m. Both of the other sites lie in *Acacia-Commiphora* woodland at about 1,000 m altitude, and at each site trapping was carried out close to the course of a perennial river. Mosiro enjoys the higher mean annual rainfall: 400–600 mm compared to 200–400 mm at Kimana. The reason for the difference between the two sites and the distinctiveness of one troop at Kimana in the incidence of *Hepatocystis* is not obvious, but a seasonal factor may be involved. Mosiro populations were trapped in November, during the annual "short" rainy season. Kimana animals were trapped in June, immediately after the end of the "long" rains. Troop 7, the group in which parasitemia was absent, was the last one to be trapped. These data may suggest that the risk of infection by *Culicoides* bite, and consequent parasitemia, rises with the onset of the rains, and falls rapidly again after the rains cease. W.S. Hayes, P.C. Garnham, and G.M. Baqar (personal communication) infer a similar seasonal variation in the incidence of *Hepatocystis* parasitemia among rhesus monkeys *(Macaca mulatta)* in the Muree Hills, Pakistan. On the other hand, the small-scale distribution of *Culicoides* is known to be patchy (T.E. Moore, personal communication), so that the local differences in parasitemia might simply reflect such a distribution.

The occurrence of a high incidence of (apparently) benign *Hepatocystis* parasitemia among some populations of Kenya vervets agrees with previous observations [2], and it is in accord with the view that *Hepatocystis* is an ancient and well-adapted parasite of Cercopithecoidea [3].

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