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Nutrition, Body Condition, Activity Patterns, and Parasitism of Free-Ranging Troops of Olive Baboons (*Papio anubis*) in Kenya

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Three troops of olive baboons (*Papio anubis*) comprising 134 animals were captured during a translocation program. All three troops (PHG, CRIP, WBY) lived in high-altitude savannah, but two (CRIP and WBY) also frequented human settlements, where they had access to the garbage pits and vegetable gardens. The translocation offered the opportunity to compare body condition, activity patterns, and parasitism among the troops of animals. A variety of body measurements were taken, a physical examination performed, activity patterns for the previous 2 years enumerated, and blood and feces collected for virological and parasitological analyses. Body condition, as judged qualitatively by appearance and quantitatively by subcutaneous fat thickness and body weight, was lowest in PHG, the naturally foraging troop. All animals were negative for all viruses. No blood-borne parasites were found, but the feces of the majority of animals were positive for eggs of strongyles, ascarids, *Trichuris* spp., and *Strongyloides* spp. Quantification of strongyles indicated the heaviest burdens were in the non provisioned troop PHG. These results when combined with the behavioral observations that PHG spent more time foraging and less time resting or socializing than WBY suggest lowered availability and/or a poorer quality of PHG's diet. The data support the hypothesis of a causal relationship between host nutrition and helminth parasite infection but do not permit general conclusions to be drawn on mechanisms of interaction.

Key words: baboon, activities, parasites

INTRODUCTION

The relationship between wild animals and humans has long been a subject of great interest. In recent times, the rapid expansion of human populations, the spread of agriculture, and the resulting destruction of natural habitats have increased both the variety and intensity of interactions. The consequences of close association between humans and wildlife is relevant to conservation and management strategies.

In Kenya, interactions between human and nonhuman primates occur in most

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TABLE I. Composition of Pumphouse (PHG), Wabaya (WBY), and Cripple (CRIP) Troops at the Time of Translocation

	Troop composition			
	PHG	WBY	CRIP	
Males				
Infant	6	9	13	
Juvenile	9	4	4	
Subadult	4	2	2	
Adult	5	4	2	
Females				
Infant	6	5	6	
Juvenile	7	2	1	
Subadult	3 (4)[a]	—	4	
Adult	17 (16)	10	9	
Total	57	36	41	134

[a]Nos. used for behavioral data analysis (see text)

parks, reserves and in many agricultural areas. Often, monkeys become semiprovisioned by tidbits offered by humans or by access to human refuse or crops. The potential zoonotic aspects of disease transmission resulting from close proximity of nonhuman primates to human settlements is also of concern. Equally interesting is the effect of enhanced diet on the wild animals themselves.

In Gilgil, Kenya, three troops of baboons had access to differing food sources for a number of years. In 1984, because of intense conflict between these animals and the local human inhabitants [Strum, 1987], it became necessary to translocate the animals. The translocation exercise offered an opportunity to determine the parasitic load of the animals, compare differences among troops, and to correlate these with the physical condition of the animals. The main objective of the study was therefore to determine if there was a relationship between body condition and parasitic load after access to differing types of food. In addition, as the baboons were part of a long-term study, these data could be correlated with data on activity patterns collected for the same animals.

It is well established that colony born and raised yellow baboons (*P. cynocephalus*) are heavier, have more subcutaneous fat, and exhibit accelerated growth, teeth eruption, and age of menarche than do wild animals [Altmann & Alberts, 1987; Altmann et al., 1981; Phillips-Conroy & Jolly, 1988; Glassman et al., 1984]. The data collected from this study also allowed some comparisons to be made between wild and colony-born and raised olive baboons (*P. anubis*).

MATERIALS AND METHODS

Animals

The olive baboons (*Papio anubis*) described in this paper formed part of a longitudinal study which began in 1970 and is described in greater detail elsewhere [eg. Harding, 1976; Strum & Western, 1982; Strum, 1987]. All animals lived at high altitude in the central Rift Valley of Kenya near Gilgil. A description of the area can be found in Blankenship and Qvortrup [1974] and Harding [1976]. The composition of the three troops at the time of capture (September 1984) is indicated in Table I. Exact ages were known for all but the oldest animals in Wabaya (WBY), Pumphouse Gang (PHG), and Cripple (CRIP) troops. For adult individuals of unknown birthdate, classification of age classes for all biological assessments was based on established criteria [Altmann et al., 1981] using eruption of the third molar and not age, size or reproductive status as the criterion for "adulthood" [Bercovitch, 1987]. For behavioral data females were classified as adult at the birth of their first infant (around 6 years of age), while males were classified as adult 6 months after cessation of visible growth (around 10 years of age). These different classifications resulted in only one change in number in the whole data set (1 subadult female more and 1 adult female less in PHG for biological over behavioral data sets).

Members of the same matrilines are present in PHG and WBY, as the latter is a splinter group resulting from troop fission in 1981. From 1972 to 1981, males migrated between PHG and CRIP, and since 1981, males have moved between all three troops.

CRIP's and WBY's principal sources of food were the garbage pits and vegetable gardens around an army camp and school since 1978 and 1982, respectively. WBY was dominant to CRIP at the garbage. Apart from a brief period in 1982 when the troop visited a human settlement and with the exception of 3 "crop raider" males (1981–1983), PHG's source of food during the 1978–1984 period was limited to that found by natural foraging on the ranchland. In 1984, PHG's future was threatened by subdivision of the ranch and the pest status of CRIP and WBY had become unacceptable to the local population. Consequently in September 1984 translocation became a necessary experiment. Details of capture and relocation are published elsewhere [Strum & Southwick, 1986; Strum, 1987; O'Bryan et al., in press].

Trapping

Briefly the procedures were as follows: after a period of baiting with maize, fresh fruit, and vegetables, each troop in succession (CRIP, WBY, PHG) was captured in its entirety in live traps and transported to a central area for processing. They then were immobilized with a 3:7 mixture of xylazine (2%): ketamine hydrochloride (10%) to allow collection of samples and data.

Sample Collection

All animals were weighed, blood taken from a femoral vein, and a physical examination carried out by a veterinarian. The same clinician, (G.M.), examined all animals, paying specific attention to abnormalities in the respiratory and circulatory systems, lymph nodes, spleen, skin, eyes, mouth, and musculature. Presence and type of any ectoparasites were noted as were any injuries or deformities. An overall rating of excellent, good, fair, or poor was given to each animal. The rating was made in comparison to over 150 clinically normal captive animals at the Institute of Primate Research. Skinfold measurements were taken in triplicate at five locations (triceps, biceps, subscapular, abdomen, and thigh) with a pair of calipers and other body measurements (shoulder height, chest circumference and foot, tail, femur, and crown–rump lengths) were all recorded by anthropometer or measuring tape as appropriate. The animals were weighed to the nearest 10 g or 50 g for those less than or more than 2 kg, respectively. All procedures were standardized for all animals and undertaken by the same team of trained technicians. Thick and thin blood smears were prepared, the latter fixed in methyl alcohol, and all were stained with Giemsa. Sera samples were tested by indirect immunofluorescence for the presence of antibodies against Marburg, Ebola, Congo hemorrhagic fever, Rift Valley fever and Lassa fever using the method of Johnson et al. [1982].

Fecal samples were collected over a 24 h period for WBY and PHG and kept at

TABLE II. General Body Condition of the Three Baboon Troops

	General body condition			
	Excellent	Good	Fair	Poor
WBY	2	29	5	0
CRIP	3	25	13	0
PHG	3[a]	25	27	2

[a]"Crop-raiding" males

4°C before being analysed for parasites using the McMaster flotation and the formol-ether concentration techniques [Ritchie, 1948]. Inevitably, fecal samples from adult females were often mixed with feces from their infants.

Activity patterns for PHG and WBY presented in this paper were taken from scan samples of activities for six months during 1983 and 1984 (the 2 years before the translocation) and formed part of a larger data set from a 7 year period of study [Oyaro & Strum, 1984] (Strum, in prep). Scan samples were taken twice an hour. All animals were listed as individuals in appropriate age-sex classes and their activity recorded. These activities were reduced from 28 types into the broad categories of foraging, travelling, resting, and grooming and "other social" for presentation herein. Scans during which less than half the troop was contacted are omitted. Activity patterns were compared between the two troops according to age sex classes (adult, subadult, juvenile and infant). A total of 1,361 scans containing 40,215 data points were utilized for the analysis.

Statistical Analysis

All data were analysed by ANOVA using a SPSS package on a IBM PS/2 computer.

RESULTS

Results of body condition are given in Table II. Only eight animals were considered to be in excellent condition with 80%, 61%, and 44% in the good category for WBY, CRIP, and PHG, respectively. Only PHG had animals in the poor category (2/57) and 47% (27/57) of that troop were considered to be fair as opposed to only 14% and 32% for WBY and CRIP, respectively. The only animals in the excellent condition for PHG were the three male baboons which crop raided during the 1981–1983 period.

Chest circumference and femur length were shorter in PHG females than in WBY (Table III) and crown–rump length and femur length shorter in PHG than CRIP.

There were fewer observations in the physically immature ("still growing") animals of the younger age classes, and therefore comparison of body measurements and skinfold thicknesses was made only in mature animals where numbers were greater and growth and development were complete. Values and statistical analysis of weights and skinfold thicknesses for these adult animals are given in Table IV. There was no significant difference between CRIP and WBY males or females for weight and skinfold except for a larger abdominal skinfold thickness in CRIP males. However, PHG females were significantly lower than both WBY and CRIP for all parameters except biceps and triceps skinfolds. For PHG males, three of the skin folds differed from those of CRIP but only one (abdomen) with WBY.

The activity patterns for WBY and PHG are given in Table V. With few exceptions highly significant differences between the troops occurred for each age

TABLE III. Body Measurements (Mean ± S.D., cm) for Adults

	CRIP	PHG	WBY
Females	(9)[a]	(17)	(10)
Chest	54.1 ± 1.8	52.8 ± 1.6*	56.6 ± 3.3
Crown–rump	61.0 ± 2.4	58.73 ± 2.0**	60.06 ± 1.7
Femur	21.0 ± 1.3	19.6 ± 0.6***	20.3 ± 0.8
Foot	18.4 ± 0.7	17.7 ± 0.9	17.9 ± 1.1
Shoulder	42.0 ± 2.1	41.3 ± 1.3	41.7 ± 1.3
Tail	41.6 ± 2.6	41.7 ± 1.6	41.7 ± 1.8
Males	(4)	(9)	(5)
Chest	63.1 ± 2.7	66.5 ± 4.9	61.2 ± 3.8
Crown–rump	66.5 ± 1.6	67.7 ± 2.1*	70.3 ± 3.7
Femur	26.0 ± 2.4	23.3 ± 1.4	23.6 ± 2.0
Foot	21.0 ± 1.1	20.2 ± 0.8	20.7 ± 1.4
Shoulder	48.7 ± 2.0	47.9 ± 1.1	48.4 ± 2.7
Tail	46.0±2.4	48.7 ± 3.3	50.2 ± 2.8

[a]( ) = n.
ANOVA: *PHG vs. WBY; $P<.001$. **PHG vs. CRIP; $P<.05$. ***PHG vs. WBY; $P<.05$, PHG vs. CRIP $P<.001$.

sex comparison for feeding, resting, and socializing, but not for travelling or grooming. On average, 50% of PHG animals were feeding when sampled and less than 10% resting or socializing as compared to 30% feeding and around 20% resting and socializing among WBY animals. The divergence in activity patterns between PHG and WBY applied to each age-sex class, in each month, and in each season included in this analysis.

Kato techniques for schistosome ova detection and examination of blood for parasites were uniformly negative. Ectoparasites were recovered from both PHG and WBY troops but predominantly from those animals in PHG which were in poorer body condition where the majority had lice nits matting the hair. However, only two adult lice were collected and these were from only one animal (a juvenile male in CRP). These were identified as *Pedicinus hamadryas*, previously observed on numerous *Papio* spp. [Myers and Kuntz, 1965].

Parasitological examination of fecal samples from PHG and WBY using the formol-ether concentration technique revealed the presence of a variety of helminth ova as shown in Table VI. There were no differences either between troops nor within troops in the incidence of these parasites. Quantitative assessment of nematode ova using the McMaster technique was only considered relevant for strongyle-like nematodes (*Necator* spp., *Oesophagostomum* spp., *Trichostrongylus* spp., etc). Egg counts were performed on 45 animals from PHG troop comprising 18 males (9 juveniles, 4 subadults, 5 adults) and 27 females (7 juveniles, 3 subadults, 17 adults) and 22 animals from WBY troop comprising 10 males (4 juveniles, 2 subadults, 4 adults) and 12 females (2 juveniles, 10 adults). PHG had a mean (± S.D.) of 1,748 ± 1,554 strongyle eggs per g of feces (range 200–8,400) while WBY had a mean of 344 ± 453 (range 0–1,900). A statistically significant difference ($P<.001$) was demonstrated between the troop means but not among age or sex classes ($P>.05$).

DISCUSSION

On the basis of body weight, body measurements, subcutaneous fat thickness, and rating of appearance, the provisioned animals with continual access to human

TABLE IV. Body Weight (kg) and Skinfold Thickness (mm) for Adults

Troop variable	CRIP				PHG				WBY			
	Mean	S.D.	Minimum	Maximum	Mean	S.D.	Minimum	Maximum	Mean	S.D.	Minimum	Maximm
Females			(n = 9)				(n = 17)				(n = 10)	
Weight	16.07	1.57	14.00	18.20	13.01*,***	8.4	11.70	14.10	15.16	1.53	13.00	18.00
Subscapular	4.8	1.0	3.50	6.40	3.3*,***	0.6	2.00	4.00	4.6	0.7	3.30	6.00
Thigh	1.9	0.2	1.40	2.30	1.6**	0.3	1.00	2.20	2.0	0.4	1.50	2.70
Biceps	1.6	0.4	1.00	2.00	1.6	0.3	1.00	2.00	1.8	0.5	1.20	2.50
Triceps	2.4	0.2	2.00	2.60	2.1	0.3	1.80	3.00	2.4	0.7	2.00	4.00
Abdomen	2.6	0.6	2.00	4.20	1.8*	0.3	1.30	2.50	2.1	0.4	1.50	2.90
Males			(n = 4)				(n = 9)				(n = 5)	
Weight	24.80	2.63	21.80	27.20	23.88	3.03	17.90	27.80	22.72	3.83	16.50	26.10
Subscapular	6.1	1.1	4.80	7.40	4.3**	1.1	3.00	6.00	4.6	1.3	3.50	6.50
Thigh	2.0	0.3	1.60	2.40	1.7	0.3	1.00	2.00	1.8	0.2	1.60	2.00
Biceps	2.7	0.9	1.90	3.80	1.8**	0.3	1.40	2.00	1.7	0.2	1.50	2.00
Triceps	2.7	0.5	2.00	3.00	2.3	0.5	1.50	3.00	2.4	0.3	2.00	2.70
Abdomen	3.4‡	0.7	2.70	4.00	2.0*,'	0.2	1.80	2.30	2.4	0.2	2.00	2.50

ANOVA *$P<.001$ and **$P<.05$ for PHG with CRIP.
***$P<.001$ and '$P<.05$ for PHG with WBY.
‡$P<.05$ for CRIP with WBY.

TABLE V. Activity Patterns of Wabaya (WBY) and Pumphouse Gang (PHG)

	Activities (%)									
	Feed		Travel		Rest		Social		Groom	
	WBY	PHG	WBY	PHG	WBY	PHG	WBY	PHG	WBY	PHG
Males										
A	21.2***	45.7	26.2	32.0	38.5***	12.5	6.7**	3.2	7.2**	5.5
SA	21.2***	43.5	30.3	35.0	33.5***	12.3	10.8***	5.5	5.3	4.5
J	27.5***	53.8	26.2	26.2	26.5***	8.8	19.3***	7.8	3.8	3.3
I	30.5***	46.2	23.3	29.7	10.7**	3.8	35.5***	17.3	3.5	2.8
Females										
A	29.0***	55.7	31.0	28.7	25.7***	6.6	3.5**	2.2	9.3	7.7
SA	—	58.5	—	27.7	—	4.8		3.7	—	4.8
J	38.7***	58.7	21.7	24.2	18.7***	5.7	16.0***	6.2	5.3	5.5
I	32.7**	43.3	21.7**	31.3	11.5**	3.8	29.8*	18.8	4.8**	2.7
Mean	28.6	50.6	27.2	29.3	23.5	7.3	17.3	8.1	5.6	4.6

*$P<.10$; **$P<.05$; ***$<.01$ between troops.

TABLE VI. Comparison of Rates of Infection of Helminth Parasites in Fecal Samples From Wabaya (WBY) and Pumphouse (PHG) Baboon Troops

		No. of animals positive			
Baboon troop	No. of animals examined	Strongyles	*Trichuris* spp.	*Strongyloides* spp.	Ascarids
WBY	22	19	6	4	0
PHG	45	45	9	7	1

food waste and the vegetable gardens were in overall better body condition than their unprovisioned counterparts.

Many of the growth and size parameters measured in this study were of a lower magnitude or occurred at a later age than those reported for colony born and raised *P. anubis* [Coelho, 1985]. This concurs with the data for wild and captive yellow baboons [Altmann & Alberts, 1987; Altmann et al., 1981].

Preliminary analysis of growth rates up to 3 years of age where growth is linear [Altmann & Alberts, 1987; Glassman et al., 1984] suggests that PHG and WBY grew at 5.1 and 5.8 g/day, respectively, as compared to 8.6 g/day for our own colony animals. This latter figure is in agreement with that of Coelho [1985], while the lower figures in the wild agree with Altmann and Alberts's [1987] figure of 5.1 g/day from 500 observations on 56 yellow baboons. This prompted their statement that "wild foraging baboons [have growth rates] consistently one-half to two-thirds those of captive animals."

Both weights and skinfold thicknesses were uniformly less than those given by Coelho [1985]. In that study, 8-year-old females and males weighed 16.85 ± 2.59 and 29.24 ± 4.17 kg, respectively, as compared to 15.59 ± 1.58 and 23.64 ± 3.34 for the food-enhanced adult animals in this study (CRIP and WBY combined). None of the PHG females and only one in each of the other troops exceeded the mean weight of Coelho's animals. No male achieved the mean weight.

Phillips-Conroy and Jolly [1988] noted that baboons under differing "natural" food diets were similar in size. This is consistent with the data of Mori [1979], who showed that weight and not trunk length was affected by nutrition in wild Japanese macaques. In our study, however, in addition to weight and subcutaneous fat measurements being different among the troops, chest circumference, C-R length, and femur length of females were also slightly less in the unprovisioned adult females in PHG than in the other troops. The difference in chest circumference could be attributed to increased skinfold thickness. The cause of the differences in C–R and femur lengths is unclear. As some of the adults were still growing when the food resource first became available, the improved nutrition could account for the bone length difference. The fact that males moved between troops and that crop raiders were not different further supports this view. Bone length in infants and juveniles who were born and raised on the different food sources would confirm the finding. However, number and distribution of ages do not allow an accurate determination to be made.

Although significant, the differences in skeletal size of the free-ranging animals were small and overall measurements were similar to those of captive animals with mean (± S.D.) C–R lengths of 59.67 ± 2.04 and 68.16 ± 2.81 cm in the wild similar to those published by Coelho (1985) of 60.0 ± 2.5 and 70.4 ± 2.2 for males and females, respectively.

Similar to Coelho [1985], we found little dimorphism in skinfold thickness. Abdominal skinfold in captive animals is in excess of 5 mm ranging from 1.8 to 16.0 mm with mean thickness for subscapular and triceps being approximately 4.3 and 2.2 mm, respectively [Coelho, 1985]. Our reported values for the food-enhanced troops are in a similar range but with far less variation than for captive animals. PHG which feed naturally had far less subcutaneous fat overall. CRIP animals who benefitted from the human food longest were larger and had more subcutaneous fat (although not significantly) than WBY. Our results are in agreement with those found in yellow baboons at Kibwezi in Kenya (Muchemi, pers. comm.). There, the adult females who associated with a garbage dump (n = 8) were heavier than their non-provisioned contemporaries (n = 7; mean ± S.D. 12.8 ± 0.2 kg vs. 11.9 ± 1.5 kg) and had significantly more subcutaneous fat in the subscapular and thigh regions (mean ± S.D. 4.37 ± 0.29 mm vs. 3.25 ± 0.43 mm and 2.11 ± 0.21 mm vs. 1.81 ± 0.16 mm, respectively).

The activity patterns for the troops for the 1983–84 period are similar to data on activity budgets collected during 1981–82 using focal samples [Forthman Quick, 1986; Forthman-Quick & Demment, 1988]. This suggests that because of the frequent sampling and the large sample size, activity patterns extracted from our scan samples are an accurate reflection of the actual time spent in activities by individuals of the different troops and age-sex classes.

Distribution of feeding among animals in the semi-provisioned WBY was almost half of that in PHG (28.6% vs. 50.65%). In the focal data used in Forthman-Quick's study [1986], activity budget figures for feeding were 28% and 48% for the same troops, respectively. These results are similar to those reported for rhesus monkeys [Southwick et al., 1982; Seth & Seth, 1986] and are also comparable to 20% versus 40% for provisioned/non-provisioned vervets in Amboseli Park [Brennan et al., 1985; Lee et al., 1986] and 20% vs. 60% for yellow baboons also in Amboseli [Altmann & Muruthi, 1988]. These latter semi-provisioned animals were reported to have a more leisurely life, leaving their sleeping sites later and spending twice as much time resting as the wild feeding troop. Travel time was similar but reported to be at a slower pace. Our results are similar in that a greater proportion of animals were resting and socializing in WBY vs. PHG (23.5 vs. 7.3% and 17.3 vs. 8.1%), while similar proportions of time were spent traveling (27.2% vs. 29.3%), although the purpose and patterning of travel was different in PHG and WBY (Strum, unpublished observation).

The uniformity of grooming times across seasons and across troops is surprising, particularly because WBY had "extra" time that could have been devoted to grooming and in view of the fact that there were individuals in both troops with evidence of lice nits. The distribution of nits was not random. In both troops, these were found in juveniles and adult females from lower-ranking families, and on an orphan juvenile of high rank. In addition, all immatures in one high-ranking extended family had evidence of infestation. This family has a distinctive history: they wean their infants early and are relatively inattentive. Thus, the presence of nits suggests a lack of attention, for whatever reasons, and challenges the statement that primates groom more than is necessary for cleanliness. The uniformity of grooming under different conditions also calls into question hypotheses about the social function of grooming.

At capture, WBY animals had fewer wounds than those in PHG. However, the long-term records show that the rate of injury per individual did not differ significantly between the troops either on a yearly or monthly basis from 1981 through 1984 (monthly data, sign test, $n = 34$, $x = 16$, $P > 0.4$), nor did the type of injuries differ between the troops. Wrangham [1980] and Goodall [1986] both suggested that owing to social tension in the confines of garbage pits, greater numbers of wounds would be evident. In vervet monkeys with access to human refuse, Brennan et al. [1985] noted higher rates of aggressive and competitive interaction than in a wild feeding troop. Our observations are not in agreement with either of these studies.

Lee et al. [1986] suggested that mortality rates of garbage eaters should be monitored carefully because the eating of contaminated foods could result in zoonoses. However in our study there were no disease related deaths during 1981–1984 in the garbage eating troop and the parasites recovered were consistent in both groups. There was, however, a cost of the proximity to humans in terms of mortality. Only 5 of the 15 deaths (33%) in WBY were of "natural" causes as compared to 28 of the 40 deaths (70%) which were "natural" in PHG. The remaining 10 deaths in WBY were due to gunshot, electrocution on power cables, and road kills. Furthermore, infant survivorship in the first 2 years was higher among the garbage eaters than in the troop which foraged naturally.

Human food refuse and crops allow baboons (and other primates) to eat faster and more. The food comes in larger "packages" than natural forage with the result that an individual can save both time and energy in meeting daily requirements. These "enhanced" foods are also not limited by seasonal fluctuation in food availability or quality that characterize a natural diet. Thus primates living on the edge of human settlement, whether it be agriculture or tourist lodges, are presented with new and better feeding opportunities which are quickly reflected in their activity patterns and their physical condition.

Although it is well recognised that nutrition and infection are interrelated, the nature of this relationship remains unclear. Infection may enhance host malnutrition or host malnutrition may potentiate parasite transmission or there may be some other interaction between the two. Furthermore, the effect of host malnutrition on parasite malnutrition and hence parasite fecundity deserves further investigation [Bundy & Golden, 1987]. Meade [1983] demonstrated that infection rates in yellow baboons were seasonal with rainfall in particular affecting parasite egg survival. All samples in the study reported herein were collected within a 3 week period during which climatic conditions were unchanged. Consequently direct comparisons between troops is valid.

In the Amboseli yellow baboon study [Meade, 1983] infection rates of strongyle-like nematodes (*Oesophagostomum* spp., *Trichostrongylus* spp., *Necator* spp.) were over 80% and infection rates for *Trichuris* spp. *Strongyloides*, and ascarids were 98%, 19%, and 0%, respectively. Our rates for olive baboons in WBY and PHG troops for the same parasites were 86% and 100%, 27% and 20%, 18.0% and 15%, and 0% and 2%, respectively. Although different methodologies make direct comparison difficult, the figures from both studies are similar to each other and to six other studies [see Meade, 1983, p 69] with one exception: only Amboseli animals had infection rates for *Trichuris* spp. above 50%.

The two troops we studied were therefore similar to each other in terms of the composition of the helminth fauna. In terms of intensity, however, strongyle egg counts did reveal a major difference with the non-provisioned troop having significantly higher fecal egg count. It is known that level of nutrition can affect immunocompetence [Harland, 1965; Suskind, 1977], and Bundy and Golden [1987], postulated that in mild to moderate malnourished individuals, immunosuppression is the predominant determinant of helminth infection. Such individuals could therefore be expected to have fecund worm burdens of higher intensity as compared to well-nourished animals.

This study endorses the concept of a causal relationship between parasite load and nutritional status. It does not further elucidate the mechanisms of this relationship but may offer a more meaningful model than do laboratory studies of small animals for additional work in this area, which is of major importance for human populations in developing countries.

CONCLUSIONS

1. Food enhanced free-ranging baboons were in better body condition than their non-provisioned counterparts.

2. Activity patterns reflect a greater quality and abundance of human refuse over the naturally available food on savana ranchland.

3. Nutritional resources, body condition, and parasitism are all interrelated, but the mechanisms of that relationship remain unknown.

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