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# Differences in Daily Life Between Semiprovisioned and Wild-Feeding Baboons

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Activity budgets and social aspects of feeding, among the adult females in a group of semiprovisioned baboons that fed from a garbage dump were compared with those of adjacent wild-feeding groups in Amboseli National Park, Kenya, during the dry seasons of 1984 and 1985. Statistically significant differences were found in time spent feeding, distance travelled, and the relationship between dominance rank and time spent feeding. The garbage-feeding animals fed for 20% of the time and rested for almost 50%, in contrast to approximately 60% and 10%, respectively, for the wild-feeding animals. Speed of travel, length of day-route, and home range size were greatly reduced for the garbage-feeding animals. Use of sleeping trees and day route were highly regular in contrast to the unprovisioned group. At the garbage dump, time spent feeding was correlated with dominance rank among the adult females of this study. This was not the case for feeding on wild foods. Human enriched food sources offer the opportunity to study limiting factors and relationships between ecology and behavior. However, these conditions lead to human–animal conflicts that may be to the animals' long-term detriment. Conservation and management implications are discussed.

**Key words: *Papio cynocephalus*, limiting factors, food provisioning, dominance, activity budgets**

## INTRODUCTION

Among nonhuman primates, differences in social structure, behavior, and size and use of home range have been attributed to characteristics of food resources [e.g., Clutton-Brock & Harvey, 1977; Altmann, 1974; Chivers et al., 1984; Rodman & Cant, 1984]. With few exceptions, however, [e.g., Southwick, 1967; Southwick et al., 1976; Wrangham, 1974], direct quantitative comparisons and documentation of such relationships within or between species have been lacking from the literature until recently [e.g., Forthman-Quick, 1984, 1986; Musau & Strum, 1984; Brennan et al., 1984, 1985; Lee et al., 1986; Belzung & Anderson, 1986]. The presence of a small human settlement within the range of a single group of savannah baboons,

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*Papio cynocephalus,* provided us with the opportunity to make the first statistical comparisons within a single population, that of the Amboseli Basin in southern Kenya [Altmann & Altmann, 1970; Altmann et al., 1985; Samuels & Altmann, 1986]. The present study was undertaken to initiate a series of investigations into the effects on the baboons of the human settlement and, in particular, of a garbage dump there that provides a concentrated food source that is highly accessible to the animals. In this report, differences are examined in patterns of daily activity and in the use and size of the day range between this food-enriched group and adjacent wild-foraging groups that are otherwise similar in access to resources, exposure to predation, and other environmental conditions.

The study reported here focused on the adult female members of three baboon groups that range in the semiarid savannah and waterhole areas of the Amboseli Basin, including Amboseli National Park proper. The two wild-foraging groups have been the subject of various investigations [e.g., Hausfater, 1975; Altmann et al., 1977, 1981, 1985; Altmann, 1980; Post, 1982; Walters, 1981; Pereira, 1983; Stacey, 1986; Altmann & Alberts, 1987; Silk, 1987] (Alto's Group since 1971 and Hook's Group primarily since late 1980). Systematic observations on animals in the garbage-eating Lodge Group began in mid-1984 with the present study, although limited information and censuses were available prior to that time.

Lodge Group's home range included savannah, woodland, and waterhole areas. In addition, however, their range encompassed part of the Park's tourist lodge settlement of Ol Tukai. Although 50% of Ol Tukai land is savannah [Brennan et al., 1985], the rest is a landscaped environment consisting of native and exotic plants. Lawns are watered, and the plants receive horticultural attention. An electric fence around the grounds of the New Amboseli Lodge and the Kiliminjaro Safari Lodge excludes most large mammals but does not restrict the movements of the baboons, who readily crawl under the fence or vault over or through it at the fenceposts.

No natural water sources are found in Ol Tukai. However, Lodge Group baboons readily obtain water from a number of artificial sources, including leaky pipes, water storage towers, and waterholes. Although groups of vervet monkeys range entirely within the area of the several lodges and are fed directly by humans there [Brennan et al., 1985], the baboons are only rarely close to or fed directly by humans. Provision of food by humans is indirect, through concentrated supplies of food at the garbage pits and trash cans of the human settlement, primarily at the large garbage pit that serves the two lodges and their service personnel. Garbage is brought to this pit on an almost daily basis.

The present study was conducted during the latter half of the dry seasons of 1984 and 1985, from the end of August to the end of September of each of these years. Alto's Group, Hook's Group, and Lodge Group consisted of approximately 65, 50, and 30 animals, respectively, during these periods.

## METHODS

At the initiation of detailed behavioral studies, each Amboseli baboon group was habituated to the noninteractive presence of an observer, who moved among the animals on foot at a distance of several meters. On each day of observation that the animals were located while they were still at the trees, the identity of the sleeping grove used by the baboons the night before was recorded as well as the time of descent from the sleeping trees of the median group member. During the day, the location of the group was recorded on an hourly basis by an observer using a gridded map. Throughout the day, ad libitum records of winner and loser in decided agonistic encounters [sensu Hausfater, 1975] were recorded to identify

dominance relationships. These monitoring procedures have been described in more detail by Altmann and Altmann [1970] and by Hausfater [1975]. Occasionally, logistical problems resulted in partial observation days, particularly for Lodge Group during 1984 data collection period.

In addition to collecting data on daily ranging patterns for the group, we gathered data on activity time budgets of all females in each group who had reached menarche [Altmann et al., 1977, 1981]. In Lodge Group, there were nine adult females in each year; in Alto's Group, there were 17 adult females in 1984 and 20 in 1985; and, in Hook's Group, there were 12 adult females in 1984 and 14 in 1985. On each day for which the activity data were collected, 27 10-min samples were scheduled at predetermined times, three for each hour of the day from 0800 through the 1700 hour, with the exception of the 1200 hour. Approximately 500 10-min activity samples were obtained for Lodge Group and about the same number for the two wild-foraging groups combined.

Each female served as the focal subject for 10 min at a time (the order of subjects determined by a table of random numbers), during which both point (instantaneous) sampling and continuous focal sampling were done [Altmann, 1974]. At the beginning of each sample, and at the sound of a timer at 1-min intervals thereafter, we recorded the female's activity (categorized mutually exclusively as feeding, walking, resting, grooming, being groomed, or other social activities [definitions basically as in Altmann, 1980; Post, 1982; Post et al., 1980]). In Lodge Group, we also recorded the type of food when feeding was scored.

To estimate the distance travelled by females more precisely than would be possible from mapping group movements or from activity budgets [Altmann, 1987; Altmann & Samuels, unpublished manuscript], a separate data set was collected on the pace length during walking. Throughout the day for Lodge Group during 1985, additional 10-min samples were conducted, during which the number of paces that the subject animal took were counted. These data were combined with measurements of mean pace length for the females to obtain estimates of distance travelled. Comparable data were available for Hook's and Alto's Groups [Altmann & Samuels, unpublished manuscript].

## RESULTS

The differences among the groups were clear from the start of the day when the animals were located in their sleeping groves. Daily activities started later for members of Lodge Group than for the others. Time of descent from the trees of the median group member occurred before 0800 on only four of 19 days for Lodge Group, in contrast to 21 of 29 days for Alto's Group and 21 of 24 days for Hook's Group. In addition, grove use was more predictable for Lodge Group than for the other groups. The members of Lodge Group used the same grove of sleeping trees on each of the 24 days of systematic observation and on all other days for which we have records. In contrast, Alto's Group used at least 16 different widely dispersed groves over the 30 days of observation during this period, and Hook's Group used six groves over 24 days.

The later descent time of Lodge Group baboons was the forerunner of a day that continued largely unpressured by foraging demands. Although females in Lodge Group spent somewhat more time socializing than did those in the other groups, the major differences in activity budgets were in time spent resting and feeding (Fig. 1). Females in Lodge Group spent about twice as much time resting and only one-third as much time feeding as did the females in Hook's and Alto's Groups. Overall, members of Lodge Group fed for 22% of the daytime, in contrast to 65% for Hook's Group and 60% for Alto's Group. During no hour of the day did

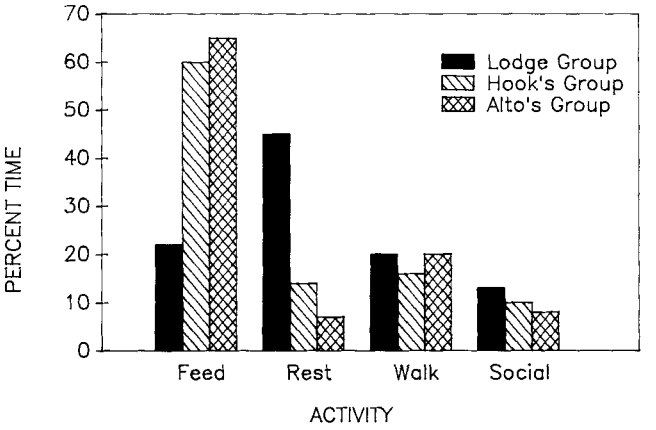


Fig. 1. Time spent in various activities by female baboons in a semiprovisioned group (Lodge Group) and by those in unprovisioned groups (Hook's Group and Alto's Group) during the dry season in Amboseli National Park.

the Lodge Group females feed for as much time as did those in the other groups (binomial test, $p < 0.005$). Even at the garbage pit, where feeding time was greatest, time spent feeding was only 30% for Lodge Group females; this was predominantly during the 1600 and 1700 hours.

Members of Lodge Group spent 38% of their feeding time consuming human-provided food, primarily at the garbage pits. Because of easy accessibility, the human refuse probably accounts for considerably more than 38% of the nutritional intake of Lodge Group. Most of the foods eaten at the garbage dump were common Kenya fruits and vegetables. However, prepared foods, such as jam, baked goods, and milk products, were also eaten, as was meat when available. The latter is particularly surprising, because wild-feeding baboons usually only eat meat that they or another group member has just caught and killed; they ordinarily pass up even fairly fresh carrion [Hausfater, 1976; Strum, 1981].

The human-provided food resources that Lodge Group members obtained were also spatially concentrated. Animals that fed at the garbage pit were brought into close proximity there; they often competed directly for choice food items as well as generally supplanting each other from locations in the pit area. Whereas there was no significant correlation between agonistic dominance rank [sensu Hausfater, 1975] and time spent feeding on wild foods in this study for female members of Lodge Group ($p > 0.05$) or on wild foods in previous studies for wild-feeding groups (Post et al. 1980), the amount of time that Lodge Group females spent feeding at the garbage dump was strongly related to their dominance rank (Spearman rank test, $p < 0.03$ for the average values over the two years; see Fig. 2).

Animals in the three groups spent similar amounts of time walking (Fig. 1). However, this similarity in time budget belies some major differences in travelling. Based on data for pacing rates of individual females in each group, the females of Lodge Group travel at a much more leisurely pace than do those of the other groups. Only 18 of 53 samples of rate of movement for females in Lodge Group were above the median values for the respective hour for females of Hook's Group and Alto's Group (binomial test, $p < 0.01$), and the hourly median distance travelled (based on pace length and pace rate) was less for members of Lodge Group during each hour of the day (binomial test, $p < 0.005$). Overall, the day route of

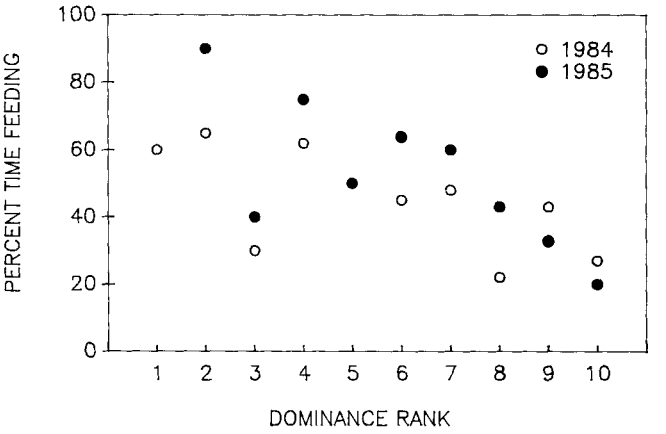


Fig. 2. Time spent feeding, as a function of agonostic dominance rank, when females of Lodge Group were in the garbage dump area, during the dry seasons of 1984 and 1985. For two of the females, data were available for only one of these years.

Lodge Group baboons was not only shorter, but was also more predictable than that of the other two groups. On most days, animals moved from the sleeping grove directly to a water trough, where they remained until mid- or late afternoon, at which time workers added new refuse to the dump. The group spent about 2 hr at the garbage pit and then moved rapidly back to the grove just before dark. On an annual basis, members of Lodge Group use a range of less than 4 $km^2$, whereas those of Alto's and Hook's Groups use over 40 $km^2$, a tenfold difference.

## DISCUSSION

For Lodge Group, predictability of home base, route, and routine replaced the varied sleeping and foraging patterns exhibited by the unprovisioned groups. A day that began slowly and was occupied by feeding only about 20% of the time and resting almost 50% of the time replaced one that started earlier and proceeded in the opposite proportions. In addition, members of Lodge Group spent more time socializing and they travelled at a more leisurely rate, with individuals covering much shorter distances in the same amount of time spent walking, than did animals in Hook's and Alto's Groups.

The activity budget differences demonstrated in the present study are in close agreement with those reported for several other cercopithecine primates. Provision of human-supplied food, whether through presence of crops, garbage, or direct feeding, reduced by half the time that the animals in these various studies spent feeding and obtaining food. Increases in socializing time and even greater increases in resting time resulted, consistent with Dunbar's argument that resting time represents "slack" time more than does socializing time [Dunbar & Sharman, 1984]. Vervet monkeys (*Cercopithecus aethiops*) in Amboseli under conditions of food enrichment, spent just under 20% of the time feeding, while wild-foraging vervets spent almost 40% of the time feeding [Brennan et al., 1985; Lee et al., 1986]. The semiprovisioned vervets spent more time resting and socializing and moved less than did the unprovisioned animals. Olive baboons (*Papio anubis*) in Gilgil, Kenya, fed or foraged approximately 25% of the time if they had access to garbage and planted crops and almost 50% of the time without such access [Musau

& Strum, 1984; Forthman-Quick, 1984, 1986]. The food-enriched Gilgil baboons spent almost twice as much time being "passive" [Forthman-Quick, 1986], slightly more time socializing, and slightly less time moving than did the unprovisioned animals. Malik [1986] and Seth and Seth [1986] summarize data on activity budgets of rhesus monkeys (*Macaca mulatta*) in a variety of habitats in India. At one extreme were the heavily provisioned monkeys, usually at temple sites, that spent 10–17% of the time feeding. Forest monkeys, in contrast, spent 40% of the time feeding. Groups that were partially provisioned spent 16–27% of the time feeding.

The difference between the food-enriched and wild-foraging baboons in Amboseli is probably less in the rainy season, as is the case with vervets in the same habitat [Lee et al., 1986]; wild-foraging baboons spend less time feeding in the rainy season [Altmann, 1980; Post, 1982]. However, there was no month of the year when members of Alto's or Hook's Group spend as little time feeding as the members of Lodge Group during the present study [Altmann, 1980, and unpublished data].

Although time itself can be a limiting resource, other important subtle and complex effects of quantity and distribution of food may underlie the fairly uniform changes in activity budgets that have been reported. If a food source is also highly accessible, rich, and spatially concentrated, greater levels of aggression and competition may result [see, e.g., Southwick, 1967; Wrangham, 1974; Brennan et al., 1985] and can lead to greater variance, across individuals in reproductive and survival parameters [Mori, 1979; Sugiyama & Ohsawa, 1982]. Whether major reductions in food availability result in more or less social interaction and competition seem to depend on the amount, distribution, and stability of the food supply [Southwick, 1967; Dittus, 1979; Rosenblum & Sunderland, 1982; Belzung & Anderson, 1986]. Some of these relationships may not be monotonic [see, e.g., Southwick, 1967]. More complete characterization of the resource base, including processing time for various foods [Shopland, 1987], estimates of the animals' energy balance, and measures of social spacing and interactions, will be critical to an understanding of the behavioral, developmental, and reproductive consequences of food [Altmann, 1986] within and between groups.

Finally, although food provisioning may have survival costs, such as more frequent wounding resulting from an increase in social tension [see, e.g., Wrangham, 1974; Goodall, 1986] or increases in disease resulting from the greater number of individuals in close proximity or from the presence of antibiotic-resistant bacteria [Rolland et al., 1985; but see Routman et al., 1985], provisioning usually leads to more rapid maturation, to higher rates of survival and reproduction, and ultimately to population growth and greater population densities. This growth, combined with the fact that the provisioning comes either directly or indirectly from humans, means that competition and conflict with humans is almost inevitable [Else & Eley, 1985].

Because nonhuman primate species ultimately lose in competition with humans, the apparent benefit to those species that adapt their diets to human-modified food sources will usually be misleading and emphemeral. The resultant conflicts rapidly lead to calls for eradication of the animals that are perceived as dangerous or pests. Removing the offending animals without eliminating the conflict situation often results in movement by adjacent animals into the vacated prime habitats, and the cycle begins again [Brennan et al., 1985; Else & Eley, 1985; Lee et al., 1986]. Thus a solution that may appear to be quick and low-cost can lead to the loss of many animals from their home area, sometimes the loss of an entire population, and can involve considerable financial outlay. It is often

implicity or explicitly assumed that adaptable omnivorous species do not have conservation problems. The problems and solutions for the conservation of those species will be different but no less real than those for species for whom human encroachment is more immediately and obviously detrimental.

Provisioning situations provide an excellent opportunity to study social and ecological factors that operate in a continuum of environments ranging from various undisturbed habitats through provisioned, semicaptive, and completely captive ones, and these situations can contribute to documentation of limiting factors for populations. However, another important potential of such studies is their possible contribution to management policies that modify or eliminate many of these sites of conflict.

## CONCLUSIONS

1. Availability of a human-provided food supply resulted in less time spent feeding and more time spent resting among adult females in a group of free-ranging baboons in Kenya in comparison to wild-feeding animals in the same population. Socializing time was only slightly increased, and time spent in locomotion was not changed.

2. Speed of locomotion and home range size were greatly reduced in comparison to those of wild-feeding animals in the area.

3. Time spent feeding at the concentrated, human-provided food source was correlated with dominance rank among the females of the semiprovisioned group.

4. The problems and solutions for conservation of adaptable omnivores such as baboons are different but no less real than those for species for which human encroachment is more immediately and obviously detrimental.

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