Effects of food provisioning on the behaviour of commensal Hamadryas Baboons, *Papio hamadryas*, at Al Hada Mountain in Western Saudi Arabia

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Abstract: The effects of artificial feeding by humans on the behaviour of Hamadryas Baboons (*Papio hamadryas*) at Al Hada mountain in the western region of Saudi Arabia were examined. Grooming was the dominant behaviour in these baboons, especially in adults throughout all seasons. Play was the dominant activity of juveniles less than 4 years of age. Provisioning the locations changed all categories of behaviour. Less social (in some cases, agonistic) and mounting behaviour were found outside rather than inside provisioning sites. Provisioning periods also changed all kinds of behaviour. Periods of heavy provisioning were characterised by less social behaviour, more play in juveniles and increased agonistic and mounting behaviour in adults.


Key Words: Hamadryas Baboon (*Papio hamadryas*), behaviour, agonistic behaviour, social structure, Saudi Arabia, Arabian Peninsula.

Introduction

Variations in resource availability account for many of the changes in behaviour of primates (Clutton-Brock 1977). Food enhancement offers an opportunity to assess the effects of its availability on different kinds of behaviour. Consumption of food provided by humans strongly affects the activity patterns of baboons in ways consistent with the view that the baboons respond to the available food (Dunbar & Dunbar 1975, Forthman-Quick & Demment 1988). The frequencies of most social interactions in Hamadryas Baboons (*Papio hamadryas*) in Saudi Arabia are related to food availability and distribution (Kamal et al. 1995).

Kummer et al. (1981) indicated that Hamadryas Baboons in Saudi Arabia, like those of Erer-Gota in Ethiopia, have an unusually complex social organization. The smallest units are families, called “one-male units” because each consists of only one adult male and one or several females exclusive to that male. A few one-male units form a “clan”. Several clans are united into a stable “band” of about 40 to 100 animals. Often several bands habitually

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tolerate one another on the same cliff face where they pass the nights. These sleeping aggregations or “troops” vary in size from day to day, in contrast to the three smaller units which are stable social groups.

Among the baboons and macaque species, only *P. hamadryas* has an exclusively polygynous relationship between sexes. KUMMER et al. (1981) suggested, however, that the social behaviour of baboons in Saudi Arabia differed from that of Erer-Gota, Ethiopia, in many respects:

- There are more subadult and adult females per adult male.
- Females fight more and more independently of male intervention.
- Males chase and fight rarely, tolerate smaller distances among each other and interact closely but less frequently.

Polygyny among animals can come about in two ways. Males may aggressively compete for females so that the most powerful fighters and herders assemble more females than others, or females may chose the best male available as a genetic father, protector and provider (ALTMANN et al. 1977). Baboons in Saudi Arabia seem closer to the female choice model, whereas the Erer-Gota counterparts provide more evidence of the aggressive male competition model.

Grooming is the major element of social activity seen between adult baboons. Adult females usually groom the leader males of their unit and the young. Little grooming generally occurs between females (KUMMER 1968). Grooming has a role in improving relationships between individuals (STAMMBACH & KUMMER 1982) and such activity is elevated in the initial units before relations between male and female are settled. The activity decreases with the number of females in the unit (KUMMER & KURT 1965). Grooming rates for females toward the leader male increase after intermale aggression or fights between females (KUMMER & KURT 1965).

Grooming has been reported in a wide range of primate species (DUNBAR 1991). In addition to the recognized hygienic functions (BARTON 1985, SAUNDERS 1987), this activity may serve important social functions, as an appeasement behaviour (MARLER 1965, WILSON 1975, O'BRIEN 1993a, b), as an assertion of social dominance (GASTON 1978, EISENBERG 1981, KAUFMAN 1983), to reduce tension (BOCIA 1987, KEVERNE et al. 1989), and as a currency in reciprocal relationships (SEYFARTH & CHENEY 1984, WALTERS & SEYFARTH 1986). Adult females benefit from grooming relationships with juveniles that offer allomaternial care for infants (O'BRIEN & ROBINSON 1991). Females tend to form relatively small, stable grooming clusters, which are generally composed of closely-related individuals (DUNBAR 1979, 1980, 1983a). Young males groom their females more routinely than do older males, and there is a general decline in the male’s interest in his females with age. A similar loss of control over females by the male with advancing age has been reported by KUMMER (1968) for this species.

Fighting between males is only evident when the attacker is largely dominant over the victim (KUMMER 1973). Aggression between females occurs mostly between members of the same unit. Females often use the “protected threat” by threatening from beside the male leader. However, fights between females are usually curtailed by male intervention (KUMMER et al. 1981, 1985). Between-group antagonism or territoriality in primates may serve two different but compatible functions: resource defence or mate defence. Females would be expected to be involved more strongly in the first and males in the second (VAN SCHAIK et al. 1992).
Fig. 1. Average number of grooming behaviour events per hundred animals by categories of primate (specified on the abscissa), during non-provisioned and provisioned periods, outside and inside parking areas. F = females, FO = females in oestrus, M = males, 4Y = 4 years, 2Y = 2 years. White columns: outside parking areas; striped columns: inside parking areas.

Fig. 2. Average number of grooming behaviour events per hundred females directed towards conspecifics of different kinds (specified on the abscissa), during non-provisioned and provisioned periods, outside and inside parking areas. The arrangement enables one to show which categories of animals the behaviour were directed towards. For abbreviations, see Fig. 1.
Play behaviour is mostly restricted to the young individuals and rarely seen after three years of age in Hamadryas Baboons according to Kummer (1968). Infants and young spend one third of their social activities out of their mother's unit, compared to one tenth in adults (Kummer 1968).

The present study was undertaken to examine the effects of human-provided naturally-available food on the range of baboon behaviour in a population in western Saudi Arabia. During the course of this study, baboons were faced with variations in food quality and quantity as consequences of the level of provisioning inside and outside parking sites. The studies reviewed above had strongly suggested that supplementary feeding, especially when located within a particular area, would have a profound effect on the social behaviours of these animals. It was expected that this would be expressed via agonistic behaviour and other activities and that these would influence different age and sex categories in varied ways.

Materials and methods

Baboons are present in Saudi Arabia only in the mountains of the western region. For the present study, a particular location at Al Hada mountain was selected. The escarpment road of Al Hada mountain is located 30 km northwest of Ta'if city. This site was chosen because it is the only location where a commensal baboon troop is fed by people for most of the year (high provisioning period). The escarpment road is closed for maintenance during winter months (January and February are thus low provisioning months), and, at this time, baboons forage for natural vegetation in the mountain. Human food included in handouts mainly consisted of bread, apple, orange, cabbage, cooked rice, tomato, potato, watermelon and cooked meat. It was impossible to determine the weight or quantity of human foods, eaten by free-living baboons, because people just throw food inside the ten different parking areas and baboons always run immediately to take food from people. The main food plants in the mountain were Juniper spp., Acacia spp., Gramins, Ficus spp., Osteospermum and Withania (Boug et al. 1994).

The ecology and climate of this study area are described elsewhere (Kamal et al. 1994) as are the trapping and marking methods for baboons (Boug et al. 1994). Data were collected during 720 observation hours, covering four seasons. The baboons were observed for five full days per month inside and outside parking areas (where human provisioning was and was not provided, respectively). For this study, two males and three females from two units belonging to the same clan were marked and individually identified by ear tags (one male was also equipped with a radio collar). Data were collected by instantaneous scan sampling every 15 minutes centered on the radio-collared male and including all individuals visible in his vicinity (see Boug et al. 1994). Behaviours were grouped into two major categories namely:

Social behaviour: (grooming, presentation, notification, sexual, playing, maternal and suckling behaviour), which are associated with decreased tension and lower aggression between males (Kummer et al. 1974). Grooming and play are discussed in more detail because they are respectively the most common behaviours in adults and juveniles under 4 years of age.

Agonistic behaviour: (fighting, submission, herding females, tension behaviour, mounting), these behaviours occur between males over female possession and between females for access to males (Kummer 1973). Mounting is discussed in more detail because this behaviour (Kummer et al. 1981) may be seen in male-male and male-female encounters for different purposes (i.e. it is not purely a reproductive activity).
Fig. 3. Average number of grooming behaviour events per hundred males directed towards conspecifics of different kinds (specified on the abscissa), during non-provisioned and provisioned periods, outside and inside parking areas. For abbreviations, see Fig. 1.

Fig. 4. Average number of agonistic behaviour events per hundred females directed towards conspecifics of different kinds (specified on the abscissa), during non-provisioned and provisioned periods, outside and inside parking areas. For abbreviations, see Fig. 1.
Fig. 5. Average number of agonistic behaviour events per hundred males directed towards conspecifics of different kinds (specified on the abscissa), during non-provisioned and provisioned periods, outside and inside parking areas. For abbreviations, see Fig. 1.

Fig. 6. Average number of mounting behaviour events per hundred males directed towards conspecifics of different kinds (specified on the abscissa), during non-provisioned and provisioned periods, outside and inside parking areas. For abbreviations, see Fig. 1.
The following age-sex classes were considered (after ABEGGLENE 1984): **adult males** (fully developed with a grey mantle); **subadult males** (from first signs of mantle on shoulders to a well-developed brown mantle); **adult and subadult females** (seated height 0.5 m, with obvious stretched nipples); **juveniles 2** (up to 4 years of age, males with no mantle, and a seated height of 0.4 to 0.5 m; females with nipples not longer than wide); **juveniles 1** (up to 2 years of age brown hair; seated height less than 0.4 m), and **black infants** (hair partially or completely black).

Grooming, agonistic, mounting and play behaviours, were compared in and outside provisioning sites, during high and low provisioning periods, using the differences exceeding a significance level of 0.05, on the chi square test.

**Results**

Grooming was the dominant social activity recorded in females (Fig.1), but the different age and sex classes account for varied amounts of this activity. Females spend significantly more time grooming outside provisioning sites than inside these locations (R = 3.45, p<0.05), but no significant difference was found between high and low provisioning periods in these locations. Oestrus females spent less time grooming outside parking areas than inside these zones (R = 2.53, p<0.05), but no significant difference was found between high and low provisioning periods. Grooming activity of males outside provisioning sites was less than inside (R = 2.45, p<0.05) and was significantly higher during provisioning periods (R = -2.51, p<0.05). Baboons aged 4 years spent less time grooming outside than inside provisioning sites (R = 2.53, p<0.05) and less when not provisioned (R = 2.45, p<0.05). Baboons aged 2 years spent more time grooming outside than inside provisioning sites (R = 3.53, p<0.05), and more when not provisioned (R = 2.51, p<0.05).

Grooming between or by adult females (Fig. 2) was higher outside provisioning sites (R = 2.45, p<0.05), and not different between low and high provisioning periods. However, more grooming was directed by females to males during high provisioning period and males (Fig. 3) also groom females more during high provisioning periods (R = 2.51, p<0.05), and to a greater extent outside than inside the parking areas (R = 2.45, p<0.05). There were no significant differences in the other age categories in terms of this activity.

The total agonistic behaviour in the Al Hada group (Figs. 4 and 5) was greater on provisioning sites both in low and high provisioning periods. Most of the competition for food involved male aggression which was significantly higher in low provisioning periods on feeding sites (R = -4.09, p<0.05). In females, low provisioning also increased aggression on provisioning sites (R = -2.15, p<0.05).

The age-sex classes concerned with mounting behaviour were adult males and subadult males. The mounts performed by the subadults were, however, very few. Mounting (Fig. 6) occurred significantly more on provisioning sites in high provisioning periods (R = -3.50, p<0.05).

Play behaviour (Fig. 7) was only observed in three age classes: black infants and the 1–2 and 3–4 year old categories. In black infants, no significant differences were observed in or out of provisioning sites. There was, however, significantly more play during non-provisioning periods (R = 3.90, p<0.05).

In the 1–2 year old categories, more time was spent playing outside provisioning sites than on them (R = 7.57, p<0.05) and there was also an increase of play during non-
provisioning periods (R = 7.45, p<0.05). In the 3–4 year old age group, less play behaviour occurred outside provisioning sites (R = -3.74, p<0.05) and there was a reduction during non-provisioning periods (R = -8.71, p<0.05).

Discussion

The time devoted to grooming depends partly on the time spent in gathering food. In Rhesus Monkeys (Macaca mulatta) and baboons, provisioned groups spend less time feeding and more time grooming than under feral conditions (FORTHMAN-QUICK & DEMMENT 1988, MALIK & SOUTHWICK 1988, MARRIOT 1988). In the Al Hada group, however, baboons move from site to site in order to get food from people. When provisioning was low, grooming increased. In terms of baboon social activities, grooming was the major activity between adults. At the sleeping sites in Africa, the adult males spent 12% of the time grooming, while sexual and aggressive behaviour occupy 1.5% of the time (KUMMER & KURT 1965). Pigtailed Macaques (Macaca nemestrina) spend an average of 16% of observed time on grooming behaviour (BERNSTEIN 1972). High ranking females receive most of the grooming directed at this sex in captivity (STAMMBACH & KUMMER 1982). Females spend an average of 56.6% of their potential social activity interacting with other members of their unit. Of this, an average of 11.0% is spent interacting with the unit's male, 4.3% with other or subadult male members of the unit, 27.4 % with other reproductive
females, and 13.9% with immatures animals (usually the female’s own offspring) (DUNBAR 1983b). Male unit leaders spend an average of 56.6% of their available social time interacting. Of this, 2.4% is spent interacting with juveniles and other adults or subadult males of the unit, and the rest (54.2%) is devoted to interacting with the reproductive females (DUNBAR 1983b). It is possible that provisioning of Hanuman Langurs (Presbytis entellus) at Jodhpur (BORRIES 1993) provided the females of the species with spare time that is, to some extent, invested in grooming. The same may be true of the present study of P. hamadryas in Saudi Arabia.

These present results agree with observations on other semi-provisioned baboons. For example, agonistic behaviour between females and between males and females is increased, and social behaviour decreased, by provisioning in Yellow Baboons, Papio cyncephalus (MURUTHI et al. 1991). This is because of the increase of competition for food (more time is spent feeding and less time is left for social behaviour). Aggression in provisioned groups could be artificially decreased by lowering competition, either by increasing food availability or increasing distance between food sources (WASSERMAN & CRUIKSHANK 1983). In nature, the increased interadult spacing of mountain baboons during the dry season, is also linked with decreased aggression (BYRNE et al. 1989). So, leaving baboons to feed from nature may be the best way of reducing their aggression.

Agonistic behaviour occurred following provisioning in P. entellus, and adult females played an essential part. Indeed, most aggression was exchanged between females (BORRIES 1993), and occasionally intergroup fighting started during the provisioning. Specific parts of a nearby road were defended where langurs were regularly fed by people. Despite the van Schaik model's predictions, the Jodhpur females contested for food, even for leaves (BORRIES 1993).

KUMMER et al. (1981) also reported that baboons in Saudi Arabia showed unrestrained fights among adult females. At Erer-Gota, no more than 6 full teeth-to-teeth fights were seen in 40 months of observation, whereas a total of 8 in only 68 hours were observed in Saudi Arabian sites. Female quarrels seen in Saudi Arabia escalated to full fights even in the presence of males. Males either did not intervene or did so only after a full scale fight had already developed. Female baboons in Saudi Arabia tend to rely less on the male's assistance and to fight more by themselves than the Ethiopian females. They may be more likely to fight on their own, or have more to fight for. Concentrated food was a possible object (as in this study) for fights between females. The aggressive tendencies among females in Saudi Arabia suggest that they might be quite effective in excluding other females from their one-male units.

Three reasons could explain the fact that mounting is more common during the provisioning periods and on the parking areas. Firstly, the longer the baboons stay close to provisioning sites in the afternoon, the greater the waiting periods described by KUMMER (1968) during which mating occurs. Secondly, increased tension at provisioning sites, due to food competition, may be linked with increased "tension mount" from males to females of their units. Moreover, crowding is likely to decrease cohesiveness between members of the unit, thus increasing such tension between males and females (KUMMER 1968). Finally, the provisioning areas become the pivot of daily travel. Departure from these locations is likely to be linked with the occurrence of notifying behaviour, mostly mounting (SIGG & STOLBA 1981). Mounting was mainly used, and was successful in halting aggression in the present study. Peaceful interventions appear to protect the attacked animal, while preserving the
social relationship between intervener and target (PETIT & THIERRY 1994). The females tend to initiate sexual interactions and do not pay any more attention to the male during oestrus than they do during anoestrus. The male interest in the female is likewise little affected by her sexual state (DUNBAR 1978).

The greater importance of play during provisioning periods can be understood because most of the baboon troop is then assembled around the provisioning sites, morning and afternoon. Juveniles have easy access to peers from other groups. They play more with peers of the same age-class, in all young age classes.

Thus, the provisioning of wild baboons with food produces measurable social conflict in these animals. Although such human feeding, probably at least partially, accounts for the spread of these animals within Saudi Arabia, efforts should be made to try to do so in a manner (probably by scattering the material to a greater extent or making provision less predictable) that reduces the conflict it clearly generates. The data strongly confirm that this kind of provisioning dramatically alters the social behaviours of Hamadryas Baboons in this defined area and that the effects are most potent in terms of fighting in adult females, but are also seen in social grooming and play activities.

References


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