Integrated non-invasive investigations of captive Abyssinian colobus monkeys (*Colobus guereza*): behaviour, stress and parasitism

Submitted by Johanna Rabineau, to the University of Exeter as a thesis for the degree of Doctor of Philosophy in Biological Sciences, September 2009.

I certify that all material in this thesis which is not my own work has been identified and that no material has previously been submitted and approved for the award of a degree by this or any other University.

…….. Johanna Rabineau

Abstract

The prime aim of the present study was to investigate the welfare of Abyssinian colobus monkeys (*Colobus guereza kikuyuensis)* held in captivity, by behavioural, endocrinological and parasitological approaches. Five groups of colobus monkeys were studied, in the UK at Port Lympne Zoo, Banham Zoo and Paignton Zoo (separate male and female groups) and in France at La Boissière du Doré Zoo.

Overall, the patterns of behavioural activity for captive colobus monkeys agree with observations of wild colobus monkeys, suggesting that there was generally good welfare at all zoos. However, local differences in group composition (i.e. age and gender) or management practices were shown to affect activity budgets. At Banham Zoo, where colobus monkeys had access to a large paddock and food was offered only twice a day, animals spent significantly more time foraging/feeding than other groups which received three meals a day. At Paignton Zoo (adult male only group) animals spent more time resting alone and less time resting socially or being social than other zoos. Generally, across zoos, older, higher ranking animals spent less time moving and more time feeding than younger, more subordinate ones.

Social dominance rank and linearity of the hierarchy in the five groups of colobus was determined. Large mixed groups of colobus monkeys including both males and females displayed strong linear dominance hierarchies, but in single sex groups, the strength of the hierarchy was found to depend on local events and group composition. Generally, male colobus monkeys displayed most of the dominance behaviour, however, females were an integral part of the dominance hierarchy with unidirectional dominant behaviour between both genders in large mixed groups.

Factors such as life history, which may influence social dominance ranking, were investigated. Index of success (another measurement of dominance rank) was mainly explained by age and gender. Social behaviours such as play behaviour and grooming were also associated with ranking. Older, more dominant animals were more often the recipient of grooming behaviour whereas younger more subordinate animals spent more time playing..

Faecal egg counts of the intestinal nematode parasite, *Trichuris trichiura*, were investigated in relation to individual index of success, age, gender, and husbandry practices at each zoo. No significant differences in egg count were observed between genders. Egg count was explained by the index of success and anti-helmintic practices at zoos. The highest count of eggs were observed at La Boissière du Doré Zoo, probably due to the fact animals were locked in for several months in

the winter, therefore favouring re-infection of infective larvae. The lowest count of *Trichuris* egg was at Paignton Zoo female group, who had the largest enclosure, with very low animal density. Counts of eggs were at their lowest in the winter compared to other season of the year. Differences between zoos seem to result from anti-helmintic practices coupled with the influence of enclosure size and husbandry regimes.

Faecal glucocorticoids and their metabolites, in colobus monkeys held in the five groups, were measured by radioimmunoassay and investigated in relation to index of success, levels of aggression, gender, age and reproductive status of females. The overall dominant animals in various groups had higher levels of faecal glucocorticoids. Males had significantly lower faecal glucocorticoid than females, and pregnant females had higher levels than others. The older, higher ranking colobus monkeys initiated significantly more acts of aggression than younger, lower ranking animals. Seasonal variation in faecal cortisol equivalents were observed in the autumn where higher levels were recorded compared to other seasons. Comparison of faecal content of cortisol equivalents of the different groups showed the lowest levels at Port Lympne Zoo and Banham Zoo while the highest levels were at Paignton Zoo (female groups). This suggests that the large multi-male, multi-female groups had the lowest levels of stress and associated high levels of welfare.

These studies lead to the recommendation that single sex groups of captive Abyssinian colobus monkeys should be avoided, particularly when this involves breaking down the social structure of established groups.

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