

food. The female thick-tailed bushbaby, though staying with other galagos for less of her time, allogroomed for longer in winter. This was due mainly to the change in her relationship with her offspring; though she was with them for shorter periods as they grew older she was meeting them more often and grooming with them more frequently. Grooming, rather than continual contact, was maintaining their bonds by this time. Young offspring of other females were also old enough to wander alone, meet and be groomed by the focal female.

Though G. crassicaudatus was more sociable during its active period than G. senegalensis the latter slept with other bushbabies more often than the former. This may have been due to the lesser bushbaby being the more selective species where sleeping sites were concerned. Acacia mellifera, which was not very common at Mosdene, was used as a sleeping tree by G. senegalensis 80% of the time and only seventeen different trees were ever used on the seventy-two occasions that the sleeping sites of the focal galago were found. In contrast, G. crassicaudatus regularly used Combretum erythrophyllum and Acacia karroo as sleeping trees, both of which were very numerous at Wallacedale, and a total of thirty-five different trees were used on the sixty-two times that the female was found. The larger galago would have fewer potential predators than the smaller and this is likely to be an important factor in the former's apparent lack of concern as to where it slept. However, in different habitats the size of sleeping groups may well change. G. crassicaudatus is usually reported to sleep in larger groups than G. senegalensis. A female's number of offspring will also

obviously affect the size of sleeping group found. In both species sleeping in groups had certain advantages: bonds between individuals using the same area were maintained; some allogrooming took place in the sleeping site before the galagos became active in the evening or after settling for the night. This would be particularly important for the lesser bushbaby which was alone for most of the night. Allogrooming enabled parasites to be removed from places that could not be reached when autogrooming. In addition, there is a suggestion that sleeping in groups may be an adaptation to avoid insect-borne diseases, each animal in the group having less chance of being bitten by an infected insect than if it were alone (Freeland, 1976). Similarly it may be an adaptation for escaping predation. Sleeping alone is more frequent in winter but this is probably due just to the absence of young offspring.

Bearder's (1969, 1975) figures for the time each species spent in contact with other galagos, though different from those reported in the present study, showed a similar degree of difference between the two species; G. senegalensis spending about 40% more of its time alone than G. crassicaudatus. There was a variety of factors that could have contributed to the intraspecific differences found in the studies. The most obvious was different methods of observation. Most of Bearder's observations on G. senegalensis were in the early morning and evening when the bushbabies tended to be together more than at any other time of the night (Bearder, 1969). For both species it is possible that groups of galagos were easier to find than solitary animals which may have biased

Bearder's figures towards less frequent sightings of individuals. This could not have occurred where data were based on follows of individuals rather than sightings. Differences in habitat could also have contributed to the variation in results. This is likely to be an important factor for G. crassicaudatus in particular, as the two populations of this species were using different resources. In Bearder's study (1975) fruits, seeds and flower secretions made up 33% of the galagos' diet during the year whereas they played little or no part in the present study (chapter 3). These resources were probably clumped, widely dispersed and unpredictable so that they would have attracted a number of bushbabies to them. Solitary foraging techniques would not be necessary for these resources so several galagos could feed at one time and then possibly remain grooming and resting together before moving away to forage elsewhere. Population density may have been different in the study areas; higher densities could increase time in contact between individuals. Another difference between the present study and those of Bearder was that the data for this study were collected from follows of females alone instead of from both sexes. However, females would be expected to spend more time with other galagos than would adult males and if a "group" exists at all it is that of mother and offspring. Therefore including males in the study should decrease time in contact with other animals not increase it.

There is evidently a basic social structure found in all the galagos but sociality can show a wide variation depending, essentially, on body size and resource distribution, the

latter causing seasonal variation within a population as well as differences between populations of the same species.

7. SUMMARY

Two nocturnal prosimians, Galago senegalensis and Galago crassicaudatus, were observed at two sites in the Northern Transvaal in South Africa. Detailed behavioural data were collected from a radio collared female of each species. Other bushbabies were trapped and marked to provide information on the social organisation and condition of the population. Faecal samples from a number of bushbabies were collected and analysed to obtain data on the diet of the species. The diet and behaviour, including social organisation, of the two species were compared in summer and winter.

Both species were found to use similar food resources, gum and arthropods. However, different proportions of each were used. The smaller bushbaby, G. senegalensis, used insects as its main food resource in both seasons though gum was used to quite a considerable degree in winter. The larger bushbaby, G. crassicaudatus, took mainly insects in summer but in winter these were replaced almost entirely by gum. In summer the size of arthropod prey taken depended on predator size. When environmental energy was low, as in winter, both species tended to take the same size range of prey items and this was smaller than that taken in summer. Dietary differences between species were explained by body size and consequent differences in metabolic rate. Optimal foraging theory was used to explain the seasonal and, to a certain extent, the species differences in diet.

There was no significant difference in the percentage

time devoted to each activity in each hour through the night by G. senegalensis in either season. For G. crassicaudatus the proportion of time in each hour devoted to insect foraging differed in summer and that devoted to gum feeding differed in winter. The total time devoted to each activity was dependent on the season and the species. The differences could mostly be explained in terms of animals of a different body size having different time-energy budgets which changed in response to changes in temperature and resource abundance. The distance travelled by both species was not constant in each hour in either season. The differences were probably due to differences in the ambient light levels.

Home range size was found to depend on body size to a certain extent but G. crassicaudatus had a heavily used area within its range which was similar in size to the whole area used by G. senegalensis. Different activities occurred in relatively discrete patches. These patches were spatially related to feeding patches. A semi-Markov model was used to explain the co-occurrence of feeding and non-feeding behaviours. However, some types of activity were excluded from particular types of feeding patch and it is probable that a hierarchical model of behaviour may be better used to explain the distribution of behaviours in space. Differences in the heights at which feeding behaviour occurred was related to the use of different resources.

The social structure of the two species was very similar. Adult females had either exclusive use of a territory or shared it with one or more related females. Adult males were divided into two social classes; they were either dominant

'Central A' males or subordinate 'Central B' animals. 'Central A' males had territories overlapping those of several females in which the non-territorial 'Central B' males were tolerated.

Sociality was found to be different between the species.

G. crassicaudatus met and groomed more conspecifics and spent less time alone during the night than did G. senegalensis.

This was related to the length of time offspring stayed with their mother (a consequence of body size) and to the different foraging strategies adopted by the two species.

Both frequently slept with other animals during the day though

G. senegalensis was alone slightly less often than

G. crassicaudatus. This was suggested to be due to the comparative lack of suitable safe sleeping sites for the lesser bushbaby.

In the present study the behavioural adaptations of South African galagos were related to body size and resource abundance.

REFERENCES

- ALTMANN, J. (1974). Observational study of behaviour, sampling methods. Behaviour, 49 : 227 - 267.
- ALTMANN, S. A. (1974). Baboons, space, time and energy. American Zoologist, 14 : 221 - 248.
- ANDERSSON, A. B. (1969). Communication in the lesser bushbaby (Calago senegalensis moholi). Unpublished M.Sc. Dissertation, Witwatersrand University.
- ARMSTRONG, J. T. (1965). Breeding home range in the nighthawk and other birds; its evolutionary and ecological significance. Ecology, 46 : 619 - 629.
- BEARDER, S. K. (1969). Territorial and intergroup behaviour of the lesser bushbaby, Galago senegalensis moholi (A. Smith), in semi-natural conditions and in the field. Unpublished M.Sc. Dissertation, Witwatersrand University.
- BEARDER, S. K. (1975). Aspects of the ecology and behaviour of the thick-tailed bushbaby, Galago crassicaudatus. Unpublished Ph.D. Thesis, Witwatersrand University.
- BEARDER, S. K. and DOYLE, G. A. (1974). Ecology of bushbabies, Galago senegalensis and Galago crassicaudatus, with some notes on their behaviour in the field. In R. D. Martin, G. A. Doyle and A. C. Walker (eds.), Prosimian Biology. Duckworth : London.
- BEARDER, S. K. and MARTIN, R. D. (1979). The social organisation of a nocturnal primate revealed by radio tracking. In D. W. MacDonald and C. J. Amlaner Jr. (eds.), A Handbook on Biotelemetry and Radio Tracking, Pergamon Press : Oxford.
- BEARDER, S. K. and MARTIN, R. D. (in press). Acacia gum and its use by bushbabies Galago senegalensis (Primates : Lorisidae). International Journal of Primatology.
- BRODY, S., PROCTER, R. C. and ASHWORTH, W. S. (1934). Growth and development with special reference to domestic animals; part 34. Research Bulletin of the University of Missouri Agricultural Research Experiment Station, 20 : 32.
- BUDNITZ, N. (1978). Feeding behaviour of Lemur catta in different habitats. P. G. Bateson and P. H. Kopfer (eds.), Perspectives in Ethology, Volume 3. Plenum Press : New York.
- BURT, W. H. (1943). Territoriality and home range concepts as applied to mammals. Journal of Mammology, 24 : 346-352.

REFERENCES

- ALTMANN, J. (1974). Observational study of behaviour, sampling methods. Behaviour, 49 : 227 - 267.
- ALTMANN, S. A. (1974). Baboons, space, time and energy. American Zoologist, 14 : 221 - 248.
- ANDERSSON, A. B. (1969). Communication in the lesser bushbaby (Calago senegalensis moholi). Unpublished M.Sc. Dissertation, Witwatersrand University.
- ARMSTRONG, J. T. (1965). Breeding home range in the nighthawk and other birds; its evolutionary and ecological significance. Ecology, 46 : 619 - 629.
- BEARDER, S. K. (1969). Territorial and intergroup behaviour of the lesser bushbaby, Galago senegalensis moholi (A. Smith), in semi-natural conditions and in the field. Unpublished M.Sc. Dissertation, Witwatersrand University.
- BEARDER, S. K. (1975). Aspects of the ecology and behaviour of the thick-tailed bushbaby, Galago crassicaudatus. Unpublished Ph.D. Thesis, Witwatersrand University.
- BEARDER, S. K. and DOYLE, G. A. (1974). Ecology of bushbabies, Galago senegalensis and Galago crassicaudatus, with some notes on their behaviour in the field. In R. D. Martin, G. A. Doyle and A. C. Walker (eds.), Prosimian Biology. Duckworth : London.
- BEARDER, S. K. and MARTIN, R. D. (1979). The social organisation of a nocturnal primate revealed by radio tracking. In D. W. MacDonald and C. J. Amlaner Jr. (eds.), A Handbook on Biotelemetry and Radio Tracking. Pergamon Press : Oxford.
- BEARDER, S. K. and MARTIN, R. D. (in press). Acacia gum and its use by bushbabies Galago senegalensis (Primates : Lorisidae). International Journal of Primatology.
- BRODY, S., PROCTER, R. C. and ASHWORTH, W. S. (1934). Growth and development with special reference to domestic animals; part 34. Research Bulletin of the University of Missouri Agricultural Research Experiment Station, 20 : 32.
- BUDNITZ, N. (1978). Feeding behaviour of Lemur catta in different habitats. P. G. Bateson and P. H. Kopfer (eds.), Perspectives in Ethology, Volume 3. Plenum Press : New York.
- BURT, W. H. (1943). Territoriality and home range concepts as applied to mammals. Journal of Mammology, 24 : 346-352.

- CHARLES-DOMINIQUE, P. (1971). Eco-éthologie des prosimiens du Gabon. Biologica Gabonica, 7 : 121 - 228.
- CHARLES-DOMINIQUE, P. (1977). Ecology and Behaviour of Nocturnal Primates. Duckworth : London.
- CHARLES-DOMINIQUE, P. (1978). Solitary and gregarious prosimians : evolution of social structure in primates. In D. J. Chivers and K. A. Joysey (eds.), Recent Advances in Primatology, Volume 3. Academic Press : London.
- CHARLES-DOMINIQUE, P. and BEARDER, S. K. (1979). Field studies of Lorisid behaviour : methodological aspects. In G. A. Doyle and R. D. Martin (eds.), The Study of Prosimian Behaviour, Academic Press : London.
- CLARK, A. B. (1978). Sex ratio and local resource competition in a prosimian primate. Science, 201 : 163 - 165.
- CLUTTON-BROCK, T. H. (1974). Primate social organisation and ecology. Nature, 250 : 539 - 542.
- CLUTTON-BROCK, T. H. (1975). Feeding behaviour of red colobus and black and white colobus in East Africa. Folia Primatologica, 23 : 165 - 207.
- CLUTTON-BROCK, T. H. and HARVEY, P. (1977). Primate ecology and social organisation. Journal of Zoology, 183 : 1 - 39.
- CROOK, J. H. (1970). Social organisation and the environment: aspects of contemporary social ethology. Animal Behaviour, 18 : 197 - 209.
- CROOK, J. H. and GARTLAN, J. S. (1966). Evolution of primate societies. Nature, 210 : 1200 - 1203.
- DAWKINS, R. (1976). Hierarchical organisation; a candidate principle for ethology. In P. P. G. Bateson and R. A. Hinde (eds.), Growing Points in Ethology. Cambridge University Press : Cambridge.
- DENHAM, W. W. (1971). Energy relations and some basic properties of primate social organisation. American Anthropologist, 73 : 77 - 95.
- DOYLE, G. A. (1979). Development of behaviour in prosimians with special reference to the lesser bushbaby, Galago senegalensis moholi. In G. A. Doyle and R. D. Martin (eds.), The Study of Prosimian Behaviour, Academic Press : London.
- DOYLE, G. A. and BEARDER, S. K. (1977). The galagines of South Africa. In Rainier of Monaco and J. H. Bourne (eds.), Primate Conservation, Academic Press : London.

- BOYLE, G. A. and BEKKER, T. (1967). A facility for naturalistic studies of the lesser bushbaby (Galago senegalensis moholi). Folia Primatologica, 7 : 161 - 168.
- DUNBAR, R. I. M. (1976). Some aspects of research design and their implications in the observational study of behaviour. Behaviour, 58 : 78 - 98.
- ERRILICH, A. (1968). Activity levels in prosimians. Folia Primatologica, 8 : 72 - 76.
- EISENBERG, J. F., MUCKENHIRN, N. A. and RUDRAN, R. (1972). The relation between ecology and social structure in primates. Science, 176 : 863 - 874.
- EMLEN, J. M. (1966). The role of time and energy in food preferences. American Naturalist, 100 : 611 - 617.
- EMLEN, J. M. (1968). Optimal choice in animals. American Naturalist, 102 : 385 - 390.
- EMLEN, J. M. (1973). Ecology : An Evolutionary Approach. Addison Wesley : London.
- EMLEN, J. M. and EMLEN, M. G. R. (1975). Optimal choice in diet : test of a hypothesis. American Naturalist, 109 : 427 - 435.
- FOSSEY, D. and HARCOURT, A. H. (1977). Feeding ecology of free-ranging mountain gorilla (Gorilla gorilla beringei). In T. H. Clutton-Brock (ed.) Primate Ecology. Academic Press : London.
- FREELAND, W. J. (1976). Pathogens and the evolution of primate sociality. Biotropica, 8 (1) : 12 - 24.
- GARTLAN, J. S. (1968). Structure and function in primate society, Folia Primatologica, 8 : 89 - 120.
- GAUTIER-HION, A. (1978). Food niches and coexistence in sympatric primates in Gabon. In D. J. Chivers and J. Herbert (eds.), Recent Advances in Primatology, Volume 1, Academic Press : London.
- GIBB, J. (1956). Food, feeding habits and territoriality of the rock pipit (Anthus spinoletta). Ibis, 98 : 506 - 530.
- GOODALL, A. G. (1977). Feeding and ranging behaviour of a mountain gorilla group (Gorilla gorilla beringei) in the Tshibinda-Kahuzi region, Zaire. In T. H. Clutton-Brock (ed.), Primate Ecology. Academic Press : London.
- GOSS-CUSTARD, J. D. (1977). Optimal foraging and the size selection of worms by redshank (Tringa totanus). Animal Behaviour, 25 : 10 - 29.

- GREIG-SMITH, P. (1964). Quantitative Plant Ecology, Methuen : London.
- HADDOW, A. J. and ELLICE, J. M. (1964). Studies on bushbabies (Galago spp.) with special reference to the epidemiology of yellow fever. Transactions of the Royal Society of Tropical Medicine and Hygiene, 58 : 521 - 538.
- HESPERHEIDE, H. A. (1975). Prey characteristics and predator niche width. In M. L. Cody and M. J. Diamond (eds.), Ecology and Evolution of Communities. Belknap Press : Harvard.
- HILL, W. C. O. (1953). Primates : Comparative Anatomy and Taxonomy, Volume 1. Edinburgh University Press : Edinburgh.
- HINDE, R. A. (1973). On the design of check-sheets. Primates, 14 : 393 - 406.
- HLADIK, C. M. (1975). Ecology, diet and social patterning in Old and New World primates. In R. H. Tuttle (ed.), Socioecology and Psychology of Primates, Mouton : The Hague.
- HLADIK, C. M. (1977). A comparative study of the feeding strategies of two sympatric species of leaf monkeys : Presbytis senex and Presbytis entellus. In T. H. Clutton-Brock (ed.), Primate Ecology, Academic Press : London.
- HLADIK, C. M. (1979). Diet and ecology of prosimians. In G. A. Doyle and R. D. Martin (eds.), The Study of Prosimian Behaviour, Academic Press : London.
- HLADIK, C. M. and CHARLES-DOMINIQUE, P. (1974). The behaviour and ecology of the sportive lemur (Lepilemur mustelinus) in relation to its dietary peculiarities. In R. D. Martin, G. A. Doyle and A. C. Walker (eds.), Prosimian Biology, Duckworth : London.
- JARMAN, M. V. and JARMAN, P. J. (1973). Daily activity of impala. East African Wildlife Journal, 11 : 75 - 92.
- JEWELL, P. A. (1966). The concept of home range in mammals. Symposia of the Zoological Society of London, 18 : 85 - 109.
- JEWELL, P. A. and OATES, J. F. (1969). Ecological observations on the loroid primates of African lowland forest. Zoologica Africana, 4 : 231 - 248.
- JOLLY, A. (1966a). Lemur Behaviour : a Madagascar field study. Chicago University Press, Chicago.

- JOLLY, A. (1966b). Observations on *Galago crassicaudatus*.
Unpublished paper sent to Dr. Sauer.
- JOLLY, A. (1972). The Evolution of Primate Behaviour.
Macmillan : New York.
- JORDE, I. B. and SPUHIER, J. N. (1974). A statistical analysis
of selected aspects of primate demography, ecology and
social behaviour. Journal of Anthropological Research,
30 : 199 - 224.
- KATSIR, Z. (1979). Chemical communication in *Galago crassi-*
caudatus. Unpublished M.Sc. Dissertation, Witwaters-
rand University.
- KAUFMANN, J. H. (1962). Ecology and social behaviour of the
coatí, *Nasua merica*, on Barro Colorado Island, Panama.
University of California Publications in Zoology, 60
(3) : 95 - 222.
- KAVANAU, L. (1977). How much light do animals like? New
Scientist, 82 : 530 - 532.
- KING, J. A. (1977). Behavioural comparisons and evolution.
In A. Oliverio (ed.), Genetics, Environment and
Intelligence, North Holland Biomedical Press : Elsevier.
- KINGDON, J. (1978). East African Mammals : An Atlas of
Evolution in Africa, Volume 1, Academic Press : London.
- KLEIBER, M. (1961). The Fire of Life, Wiley : New York.
- KLEIN, L. L. and KLEIN, D. B. (1977). Feeding behaviour of
the Colombian spider monkey. In T. H. Clutton-Brock
(ed.), Primate Ecology. Academic Press : London.
- KREBS, J. R., RYAN, J. and CHARNOV, E. L. (1974). Hunting by
expectation or optimal foraging? A study of patch
use by chickadees. Animal Behaviour, 22 : 953 - 964.
- KREBS, J. R. and DAVIES, N. B. (1979). Behavioural Ecology,
an Evolutionary Approach, Blackwell Scientific
Publications : Oxford.
- LE GROS CLARK, W. E. (1934). Early Forerunners of Man.
Balliere : London.
- LINBURG, D. G. (1977). Feeding behaviour and diet of rhesus
monkeys (*Macaca mulatta*) in a Siwalik forest in North
India. In T. H. Clutton-Brock (ed.), Primate Ecology.
Academic Press : London.
- MACARTHUR, R. H. and PIANKA, E. R. (1966). On the optimal
use of a patchy environment. American Naturalist, 100
603 - 609.

- MACKINNON, J. R. and MACKINNON, K. S. (1978). Comparative feeding ecology of six sympatric primates in West Malaysia. In D. J. Chivers and J. Herbert (eds.), Recent Advances in Primatology, Volume 1. Academic Press : London.
- MARTIN, R. D. (1967). Behaviour and taxonomy of tree-shrews (Tupaiaidae). Unpublished D.Phil. Thesis, Oxford University.
- MARTIN, R. D. (1968). Reproduction and ontogeny in tree-shrews (Tupaia belangeri) with reference to their general behaviour and taxonomic relationships. Zeitschrift für Tierpsychologie, 25 : 409 - 532.
- MARTIN, R. D. and BEARDER, S. K. (1979). Radio bushbaby. Natural History, 88 : 77 - 81.
- MASTERS, J. (1977). A preliminary laboratory investigation designed to test some predictions of optimal foraging theory : studies on G. crassicaudatus. Unpublished Honours Dissertation, Witwatersrand University.
- McFARLAND, D. J. (1976). Form and function in the temporal organisation of behaviour. In P. P. G. Bateson and R. A. Hinde (eds.), Growing Points in Ethology, Cambridge University Press : Cambridge.
- MCNAB, B. K. (1963). Bioenergetics and the determination of home range size. American Naturalist, 97 : 133 - 140.
- MILTON, K. and MAY, M. L. (1976). Body weight, diet and home range area in primates. Nature, 259 : 459 - 462.
- OATES, J. F. (1977). The guereza and its food. In T. H. Clutton-Brock (ed.), Primate Ecology, Academic Press : London.
- PARK, O. and KELLER, J. G. (1932). Studies in nocturnal ecology II : A preliminary analysis of activity rhythm in nocturnal forest insects. Ecology, 13 : 335 - 345.
- PETTER, J. and PETTER-ROUSSEAU, A. (1979). Classification of the Prosimians. In G. A. Doyle and R. D. Martin (eds.), The Study of Prosimian Behaviour, Academic Press : London.
- PINTO, D. (1972). Patterns of activity in three nocturnal prosimians : Galago senegalensis moholi, Galago crassicaudatus umbrosus and Microcebus murinus. Unpublished M.Sc. Dissertation, Witwatersrand University.
- PINTO, D., DOYLE, G. A. and BEARDER, S. K. (1974). Patterns of activity in three nocturnal prosimian species : Galago senegalensis, Galago crassicaudatus and Microcebus murinus under semi-natural conditions. Folia Primatologica, 21 : 135 - 147.

- POLLOCK, J. I. (1977). The ecology and sociology of feeding in Indri indri. In T. H. Clutton-Brock (ed.), Primate Ecology, Academic Press : London.
- PYZE, G. H., PULLIAM, R. and CHARNOV, E. L. (1977). Optimal foraging : A selective review of theory and tests. Quarterly Review of Biology, 52 (2) : 137 - 153.
- RAEMAËKERS, J. J. (1977). Gibbons and Trees. Unpublished Ph.D. Thesis, Cambridge University.
- RANDOLPH, M. (1971). Role of light and circadian rhythms in the nocturnal behaviour of Galago crassicaudatus. Journal of Comparative and Physiological Psychology, 74 : 115 - 122.
- RICHARD, A. (1977). The feeding behaviour of Propithecus verreauxi. In T. H. Clutton-Brock (ed.), Primate Ecology, Academic Press : London.
- RICHTER, C. P., HOLT, L. E. and BARELANE, B. (1938). Normal growth and reproduction in rats studied by the self selection method. American Journal of Physiology, 122 : 734 - 744.
- RODMAN, P. S. (1977). Feeding behaviour of orang-utans of the Kutai Nature Reserve, East Kalimantan. In T. H. Clutton-Brock (ed.), Primate Ecology, Academic Press : London.
- ROSS-ASHBY, W. (1956). An Introduction to Cybernetics. Methuen : London.
- ROZIN, P. (1976). The selection of food by rats, humans and other animals. In R. A. Hinde, C. Beer and E. Shaw (eds.), Advances in the Study of Behaviour, Volume 6, Academic Press : New York.
- RUHRAN, R. (1978). Socioecology of the blue monkey (Cercopithecus mitis stuhlmanni) of the Kibale Forest, Uganda. Smithsonian Contributions to Zoology, 249.
- SANDERSON, I. T. (1957). The Monkey Kingdom. Doubleday : New York.
- SAUER, E. G. F. and SAUER, E. M. (1963). The South-West African bushbaby of the Galago senegalensis group. Journal of the South West African Scientific Society, Windhoek, 16 : 5 - 36.
- SCHOENER, T. W. (1968). Sizes of feeding territories among birds. Ecology, 49 : 123 - 141.
- SCHOENER, T. W. (1969). Models of optimal size for solitary predators. American Naturalist, 103 : 277 - 313.

- SCHOENER, T. W. (1971). Theory of feeding strategies. Annual Review of Ecology and Systematics, 2 : 369 - 404.
- SEIN, W. S. and KAY, R. F. (1977). An analysis of chewed food particle size and its relationship to molar structure in the primates Cheirogaleus medius and Galago senegalensis and the insectivoran Tupaia glis. American Journal of Physical Anthropology, 47 : 15 - 20.
- SIMPSON, G. G. (1945). The principles of classification and a classification of mammals. Annals of the New York Academy of Sciences, 85 : 1 - 350.
- SMITH, C. C. (1977). Feeding behaviour and social organisation in howling monkeys. In T. H. Clutton-Brock (ed.), Primate Ecology. Academic Press : London.
- SNEDECOR, G. W. and COCHRAN, W. G. (1967). Statistical Methods. Iowa State University Press : Iowa.
- SOUTHERN, H. N. (1955). Nocturnal animals. Scientific American, 193 (4) : 88 - 98.
- SPUHLER, J. N. and JORDE, L. B. (1976). Primate phylogeny, ecology and social behaviour. Journal of Anthropological Research, 32 : 376 - 405.
- STORRER, R. W. (1966). Sexual dimorphism and food habits in three North American accipiters. Auk, 83 : 423 - 436.
- STRANGEWAYS-DIXON, J. (1961). The relations between nutrition, hormones and reproduction in the blowfly (Calliphora erythrocephala), 1 : Selective feeding in relation to the reproductive cycle, the corpus allatum volume and fertilization. Journal of Experimental Biology, 38 : 225 - 235.
- STRUHSAKER, T. T. (1970). Notes on Galagoides demidovii in Cameroon. Mammalia, 34 : 207 - 211.
- SUSSMAN, R. W. (1977). Feeding behaviour of Lemur catta and Lemur fulvus. In T. H. Clutton-Brock (ed.), Primate Ecology. Academic Press : London.
- TATTERSALL, I. (1978). Behavioural variation in Lemur mongoz. In D. J. Chivers and K. A. Joysey (eds.), Recent Advances in Primatology, Volume 3, Academic Press : London.
- TATTERSALL, I. and SUSSMAN, R. W. (1975). Observations on the ecology and behaviour of the mongoose lemur, Lemur mongoz mongoz Linnaeus (Primates, Lemuriformes), at Ampijoroa, Madagascar. Anthropological Papers of the American Museum of Natural History, 52 (4) : 195 - 216.

- VINCENT, F. (1969). Contribution à l'étude des prosimiens Africaines. Le Galago de demidoff : reproduction (biology, anatomy, physiology) et comportement. Unpublished Ph.D. Thesis, Paris University.
- WASER, P. (1977). Feeding, ranging and group size in the mangabey Cercocebus albigena. In T. H. Clutton-Brock (ed.), Primate Ecology. Academic Press : London.
- WEATHER BUREAU (1954). Climate of South Africa, Part 1 : Climate Statistics. Government Printer : Pretoria.
- WEATHER BUREAU (1964). Climate of South Africa, Part 9 : Average monthly rainfall. Government Printer : Pretoria.
- WEATHER BUREAU (1965). Climate of South Africa, Part 8 : General Survey Government Printer : Pretoria.
- WERNER, E. E. and HALL, D. J. (1974). Optimal foraging and the size selection of prey by bluegill sunfish (Lepomis macrochirus). Ecology, 55 : 1042 - 1052.
- WILSON, D. S. (1976). Deducing the energy available in the environment : an application of optimal foraging theory. Biotropica, 8 (2) : 96 - 103.
- WILSON, E. O. (1975). Sociobiology : the New Synthesis. Harvard University Press : Cambridge.
- WYATT, J. R. and ELTRINGHAM, S. K. (1974). The daily activity of the elephant in the Rwenzori National Park, Uganda. East African Wildlife Journal, 12 : 273 - 289.

Appendix IIndigenous Species of the Acacia Thornveld at MosdeneAcacia hebacladaDiospyros lycoidesAcacia karrooEuclea undulataAcacia luederitziiFaurea salignaAcacia melliferaGrewia spp.Acacia niloticaMaytenus heterophyllaAcacia robustaPeltophorum africanumAcacia tortilisRhus lanceolataBurkea africanaRhus pyroidesBoscia foetidaSecuridaca longipedunculataBoscia albitruncaSpirostachys africanaCarissa bispinosaStrychnos sp.Combretum hereroenseTerminalia sericeaDichrostachys cinereaZizyphus mucronata

Appendix 2

Indigenous Species of the Riparian Bush at Wallacedale

Acacia ataxacanthaDoryalis zeyheriAcacia karrooEhretia rigidaAcacia niloticaEuclea sp.Acacia tortilisGrewia flavescensAcacia woodiiLonchocarpus capassaAcalypha glabrataPlectroniella armataCassia abbreviataPeltophorum africanumCombretum erythrophyllumRhus pyroidesCombretum hereroenseRhus rehmanniCombretum spp.Securinea virosaDichrostachys cinereaZizyphus mucronataDiospyros Lycoides

Appendix 3

Weights of adult Galago senegalensis trapped in the study site at Mosdene.

NAME	SEX	DATE TRAPPED	WEIGHT	NAME	SEX	DATE TRAPPED	WEIGHT
Carmen	F	JUL '77	175g	Smudge	F	APR '77	170g
Emma	F	JUL '78	176g	Trudi	F	MAR '77	169g
Jenny	F	MAR '77	169g			MAY '77	194g
		MAY '77	166g			JUL '77	189g
		JUL '77	171g	Jeremy	M	APR '77	196g
Kali	F	MAY '77	160g			JUN '77	187g
		JUL '77	158g	Oberon	M	APR '77	200g
		FEB '78	161g			MAY '77	181g
		JUL '78	164g			JUN '77	200g
Katrina	F	JUL '78	154g	Philip	M	MAR '77	178g
		SEP '78	177g			APR '77	182g
Lisa	F	JUL '77	161g	Sula	M	MAR '77	202g
		NOV '77	178g			JUL '77	186g
		FEB '78	168g			DEC '77	202g
		JUL '78	172g			SEP '78	207g
Luna	F	MAY '77	164g	Titus	M	MAR '77	201g
Lydia	F	APR '77	162g			JUN '77	194g
		MAY '77	174g			AUG '77	200g
		JUL '77	164g			FEB '78	200g
		NOV '77	190g			JUL '78	200g
		DEC '77	183g	Tocolosh	M	NOV '77	187g
		JUL '78	182g			DEC '77	185g
						FEB '78	196g

F = Female

M = Male

Bearder (1969) classified adult females as being 200+ days old and weighing between 150-260gm. Adult males were classified as being 300+ days and weighing 180-300gm.

Appendix 4

Weights of Adult Galago crassicaudatus Trapped in the Study Site at Wallacedale

NAME	SEX	DATE TRAPPED	WEIGHT	NAME	SEX	DATE TRAPPED	WEIGHT
Diana	F	JAN '78	1200g	Maria	F	MAR '77	1240g
		JUN '78	1500g			NOV '77	1300g
						JAN '78	1320g
Mandy	F	OCT '76	1120g	BOY	M	OCT '76	1350g
		NOV '77	1300g			MAR '77	1560g
Tip	F	MAR '77	1220g			NOV '77	1400g
		NOV '77	1220g			MAY '78	1800g
		MAY '77	1180g				
		JUN '78	1340g	Bruce	M	MAR '76	1460g
Grey	F	OCT '76	1220g	Curly	M	MAR '77	1460g
		MAR '77	1330g			JAN '78	1500g
		MAY '77	1400g			MAY '78	1800g
Katie	F	OCT '76	1400g	Greg	M	OCT '76	1300g
		JUL '77	1090g	Joel	M	OCT '77	1400g
		JUN '78	1300g			JAN '78	1600g
Vered	F	MAR '77	1240g	21	M	MAR '77	1480g
		MAY '77	1230g	Paul	M	NOV '77	1460g
Jessica	F	MAY '77	1200g	Puck	M	OCT '76	1340g
		NOV '77	1120g			JUN '77	1410g
		JUN '78	1340g			NOV '77	1520g
Gill	F	JUN '77	1200g			JUN '78	1800g

F = Female

M = Male

Females of $1\frac{1}{2}$ years and over and males of 2 years and over were considered as adult animals in this species.

Appendix 4

Weights of Adult Galago crassicaudatus Trapped in the Study Site at Wallacedale

NAME	SEX	DATE TRAPPED	WEIGHT	NAME	SEX	DATE TRAPPED	WEIGHT
Diana	F	JAN '78	1200g	Maria	F	MAR '77	1240g
		JUN '78	1500g			NOV '77	1300g
Mandy	F	OCT '76	1120g			JAN '78	1320g
		NOV '77	1300g	BOY	M	OCT '76	1350g
Tip	F	MAR '77	1220g			MAR '77	1560g
		NOV '77	1220g			NOV '77	1400g
		MAY '77	1180g			MAY '78	1800g
		JUN '78	1340g	Bruce	M	MAR '76	1460g
Grey	F	OCT '76	1220g	Curly	M	MAR '77	1460g
		MAR '77	1330g			JAN '78	1500g
		MAY '77	1400g			MAY '78	1800g
Katie	F	OCT '76	1400g	Greg	M	OCT '76	1300g
		JUL '77	1090g	Joel	M	OCT '77	1400g
		JUN '78	1300g			JAN '78	1600g
Vered	F	MAR '77	1240g	21	M	MAR '77	1480g
		MAY '77	1230g	Paul	M	NOV '77	1460g
Jessica	F	MAY '77	1200g	Puck	M	OCT '76	1340g
		NOV '77	1120g			JUN '77	1410g
		JUN '78	1340g			NOV '77	1520g
Gill	F	JUN '77	1200g			JUN '78	1800g

F = Female

M = Male

Females of $1\frac{1}{2}$ years and over and males of 2 years and over were considered as adult animals in this species.

Appendix 5

Single subject research

Experimental design in the behavioural sciences normally requires the use of a number of subjects to provide an estimate of behavioural variability in the population. The use of estimates of variability based on between subject differences is appropriate only when the experimental situation is controlled in such a way as to provide a uniform set of independent variables for each subject. The use of between subject estimates of behavioural variability would require the assumption of an identical environment for each subject and this criterion cannot be met in field studies.

In the place of the usual multiple subject approach to data collection the present study used repeated observations of a single animal to provide estimates of variability in a particular environment. The use of single subject repeated measures designs violates a number of assumptions that are important in many statistical tests, particularly the assumption of independence. However, the violation of this assumption is most likely to lead to type II errors (the acceptance of the null hypothesis when it is false, Snedecor and Cochran, 1967) so any significant differences found in the results will be made more, and not less, valid. Ideally a second female in each species should have been used as a replication in the study but still the data would have been analysed separately for the two animals within a species.

Studying sympatric populations of the two species would have provided a more similar environment in terms of resource

availability but in this situation the way the animals used the resources would be different due to competition and the resultant niche divergence. The allopatric populations chosen were as similar as possible in terms of food resources used as this was thought to be a very important factor in structuring behaviour. The individuals selected were also as similar as possible; both were multiparous females that were known to have been in the area for several years. Neither area was isolated so there was no reason why abnormal social organisations should have been found.

Appendix 6

The definitions of behavioural categories are listed below. Only those behaviours observed in the field are defined.

FEEDING: The actual ingestion of a particular resource. In the case of insect-feeding, handling time was included in this category.

FORAGING: The searching for resources.

INSECT-FORAGING: If the animal was looking up and around and grabbing at objects, often at the end of branches, or if it was searching through the grass or dead leaves on the ground.

GUM-FORAGING: When the animal was moving fairly slowly, looking down at or sniffing along a branch.

TRAVEL: Fairly rapid, directed movement, usually between trees.

MOVING: A relatively slow progression over a short distance, usually within one tree.

GROOMING: Scraping with the teeth or licking at fur. In contrast to many other primates, hands are not used for grooming by galagos.

AUTOGROOMING: Self-directed grooming (Fig. 32).

ALLOGROOMING: Other galagos groomed or were groomed by the focal animal (Fig. 32).

RESTING: Sitting motionless, sometimes with the eyes closed.

PLAYING: The animals would chase each other over short distances or wrestle together but the interactions were always silence. Partners in these bouts were usually infants, juveniles or infants and juveniles, though older animals would

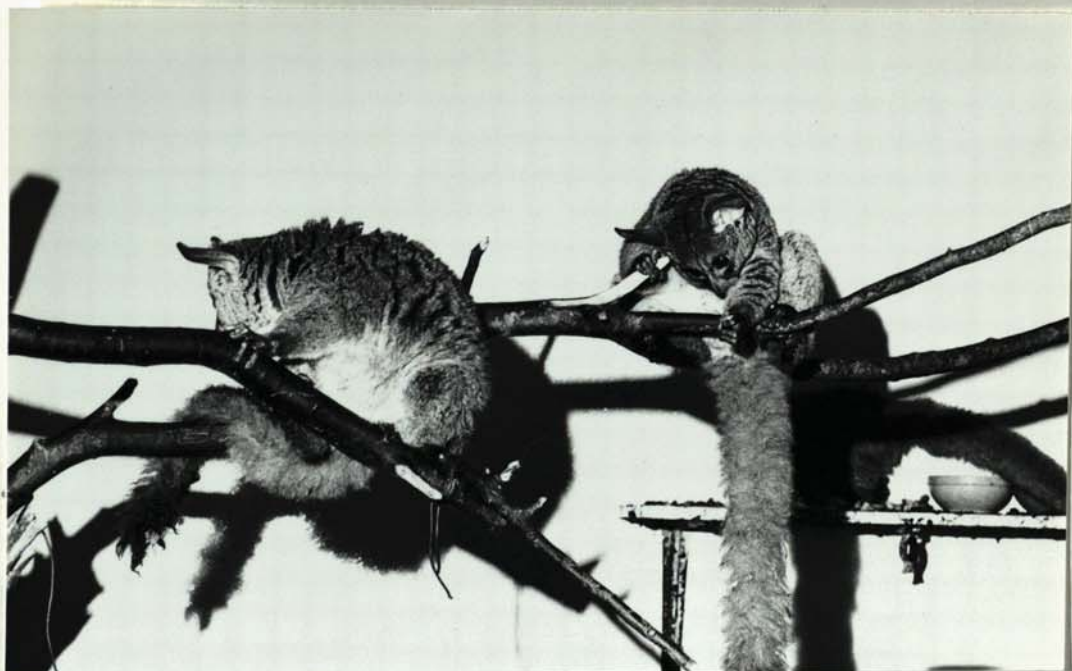


Figure 32. (a) Autogrooming and (b) allogrooming by G. crassicaudatus (in the laboratory).

play with younger ones occasionally.

AGONISTIC INTERACTIONS: Both fights and chases were seen.

These were distinguished from play bouts by the aggressive calls (Andersson, 1969; Bearder, 1975) which accompanied the interactions. Fierce fighting as described by Andersson (1969) was never seen.

MARKING BEHAVIOUR

Urine-washing: The hand and foot on one side of the body are raised simultaneously. The hand is cupped beneath the ano-genital region and a few drops of urine discharged onto it. The hand then rubs or grasps the sole of the foot. This may be repeated using the other hand and foot.

Hind-foot Rubbing: Rapid scraping of the under surface of the hind foot along a branch or tree trunk. Only G. crassicaudatus was seen to behave in this way.

Chest Rubbing: The bushbaby lowers its chest to a branch and pushes backwards and forwards with a sliding movement, wrapping both arms round the branch where necessary to keep itself in position. It has been reported in both species (Andersson, 1969; Bearder, 1975; Katsir, 1979) but was observed only in G. crassicaudatus in this study.

Chin Rubbing: Rubbing the chin, side of the mouth or other parts of this face on a surface, usually the end of a branch. Andersson (1969) reports this in G. senegalensis but it was only seen in the thick-tailed bushbaby in the present study.

Ano-genital Rubbing: Both male and female G. crassicaudatus were seen to lower their hindquarters and rub their ano-genital regions against or along a branch. This has not been reported to occur in G. senegalensis.

play with younger ones occasionally.

AGONISTIC INTERACTIONS: Both fights and chases were seen.

These were distinguished from play bouts by the aggressive calls (Andersson, 1969; Bearder, 1975) which accompanied the interactions. Fierce fighting as described by Andersson (1969) was never seen.

MARKING BEHAVIOUR

Urine-washing: The hand and foot on one side of the body are raised simultaneously. The hand is cupped beneath the ano-genital region and a few drops of urine discharged onto it. The hand then rubs or grasps the sole of the foot. This may be repeated using the other hand and foot.

Hind-foot Rubbing: Rapid scraping of the under surface of the hind foot along a branch or tree trunk. Only G. crassicaudatus was seen to behave in this way.

Chest Rubbing: The bushbaby lowers its chest to a branch and pushes backwards and forwards with a sliding movement, wrapping both arms round the branch where necessary to keep itself in position. It has been reported in both species (Andersson, 1969; Bearder, 1975; Katsir, 1979) but was observed only in G. crassicaudatus in this study.

Chin Rubbing: Rubbing the chin, side of the mouth or other parts of this face on a surface, usually the end of a branch. Andersson (1969) reports this in G. senegalensis but it was only seen in the thick-tailed bushbaby in the present study.

Ano-genital Rubbing: Both male and female G. crassicaudatus were seen to lower their hindquarters and rub their ano-genital regions against or along a branch. This has not been reported to occur in G. senegalensis.



Figure 33. G. senegalensis urine-washing.

Appendix 7Analysis of Acacia karroo gum

	<u>g/100g</u>
Moisture	18,1
Fat	0,1
Ash	3,2
Protein	0,8
Fibre	0,2
Carbohydrate	77,6

	<u>mg/100g</u>
Calcium	965,0
Magnesium	110,0
Potassium	103,0
Sodium	3,3
Copper	0,2
Iron	0,4
Zinc	0,2
Phosphorus	10,0
Thiamine	0,1
Riboflavin	0,1
Nicotinic Acid	0,007

	<u>kJ/100g</u>
Energy Value	1321,0

Analysed by A. S. Wehmeyer
 National Food Research Institute
 C.S.I.R., South Africa.