EARTHWATCH INSTITUTE FIELD REPORT

Project Title: Meerkats of the Kalahari

Principal Investigator(s): Prof. TH Clutton-Brock FRS; Prof. M Manser

Position/Affiliations: Large Animal Research Group, Department of Zoology,

University of Cambridge; Verhaltensbiologie, Zoologisches Institut, Universität Zürich

Research Site(s): Kuruman River Reserve, Northern Cape Province, South Africa

Local Management Status of the Research Site(s):
The site is privately owned and managed by the Kalahari Research Trust, a body comprising several scientists from the UK and South Africa

Scientific names of primary species being studied:
Suricata suricatta (Schreber 1776)

Key Research Objectives:

Meerkat Research

- Identify and quantify costs and benefits of cooperative behaviour
- Investigate differential levels of investment amongst individuals
- Determine what constrains breeding by subordinates
- Explore physiological mechanisms (hormonal, etc.) regulating cooperative behaviour
- Investigate the population dynamic consequences of co-operative breeding

Biodiversity and Conservation Work

- Investigate fundamental patterns of biodiversity within the Kuruman River Reserve
- Identify threats to the local environment, and take steps to neutralize these threats where possible
- Improve local understanding of, and appreciation for the natural environment

Community Development

- Promote sustainable development initiatives in the local community

Data Collection and Results

a) Give a concise account of the data you have collected during the past field season.

Our work over the past year has monitored a total of 50 breeding attempts by twelve different groups.

Figure 1. Dr Justin O'Riain uses the early morning sunning period to take "roll-call". Photo A. Ross

In addition to measuring the success of each attempt (including the number of pups produced, the number surviving to different ages and their growth rates at each stage), we have measured the relative contributions of all group members to each of five cooperative activities (lactation, babysitting at the natal burrow, pup feeding, burrow clearance and sentinel duty). We have also monitored changes in the weight of all helpers and have kept precise records of their movements and survival over the year. Samples of skin and blood have been collected from all surviving pups (to allow us to identify paternity) while faecal samples have been collected from most members of the study population for hormonal analysis.

Earthwatch volunteers also assisted three postgraduate students to collect data for their respective projects. For Anne Turbé, studying ranging behaviour and group-level decision making, EW volunteers regularly sampled GPS –coordinates during sessions with the meerkats, in order to produce tracks of group movements. For Linda Hollén, studying the ontology of vocal signalling behaviour, Earthwatch volunteers recorded data on vigilance behaviour, and conducted focals on meerkat pups to catch their individual responses to natural alarm calls. For Neil Jordan, studying olfactory communication, data was taken on the choice of latrine or defaecation sites, in order to discern whether meerkats positioned olfactory marks in such a way as to maximise the probability of discovery by other meerkats and/or protect the mark from the elements.

Figure 2. PhD student Linda Hollén records and analyses the vocalisations of pups at various stages of development: Photo: H. Bouchouareb

Figure 3. Safely within dashing watch a passing springbok. Ph

KRR ecological surveys
Earthwatch teams also provided a new opportunity to explore and catalogue the biodiversity of the newly established KRR reserve in which the meerkat project is based. Transect surveys were conducted throughout the reserve to record the distribution patterns and relative abundance of key ecological resources in different habitats: data were recorded on the position, size and level of utilisation of every tree, nest, termite mound and subterranean burrow in what cumulatively amounted to 604,500m^2 of surveyed land.

KRR plant diversity surveys
In other surveys, 100 randomly selected plants along approximately 300m line transects were identified to species level, in an attempt to (a) identify qualitatively different vegetation zones within the reserve, and (b) assess the relative abundance of known palatable/unpalatable plant species within these zones.

Figure 4. Members of EW team II investigate a communal nest built by sociable weavers Philetarius socius. Photo: B.Belcher

KRR bird diversity survey
Similarly, on bird walks through the reserve, regular scans were conducted to provide data on the distribution and relative abundance of bird species in different areas within the reserve.

Roadkill survey
For six of the thirteen teams in the 2003/4 season, the 245km stretch of road (95km tar; 150km gravel), from the rendezvous to the study site was surveyed for intensively surveyed for roadkill. Any roadkill spotted from the vehicle was investigated, identified to species level and its GPS co-ordinates were noted. In total 110 roadkilled mammals, comprising 17 species, were recorded in this study.

b) What progress have you made towards achieving your original objectives?

Our objectives normally take several seasons to accomplish so that it is not always easy to separate the contributions of particular seasons. However, the last year's work has played an important role in enabling us to:

- measure the contributions of different group members to different helping activities
- assess the costs of helping to the individual's growth and survival
- assess the extent to which the contribution of helpers reduce those of parents
- assess the frequency of cheating by different individuals
- measure hormonal changes in helpers and adults
- assess the relative breeding success of different males
- assess the impact of unusually high density in 2003 on survival, reproduction and emigration

KRR ecological surveys
With regards the biodiversity surveys: although significant areas have already been surveyed, further transects will be necessary in order to generate a sufficiently high-resolution picture of the distribution of ecological resources.

KRR plant diversity surveys
Similarly, while the plant diversity surveys have substantially broadened our knowledge of our local floral diversity, many further transects will be required, and in different seasons too, before we can clearly delineate vegetation zones or properly predict the relative capacities of the respective zones for supporting grazers or browsers.

Figure 5. Amy Ross (Team I) learns about Januariebos Gnidia polycephala from conservation student Marius van der Vyver. Photo: A. Ross

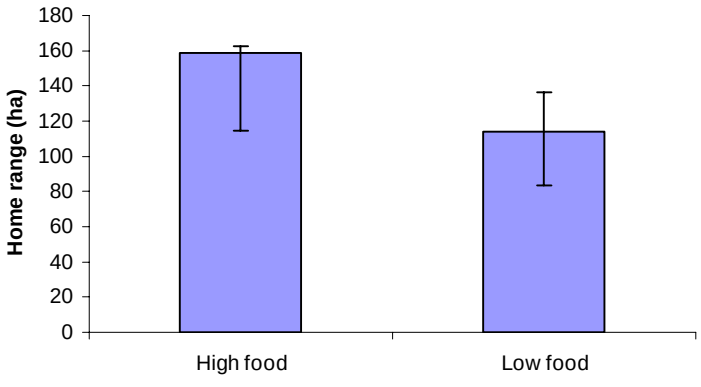
KRR bird diversity survey
As for the bird diversity scans, again our sampling thus far is insufficient for in-depth statistical analysis of species-wise habitat use patterns.

Roadkill survey
The roadkill data is beginning to reveal some important patterns, but before these results could be published, or used to campaign to reduce the incidence of roadkill, we would need at least one additional season of sampling.

Figure 6. Roadkill may have a significant effect on the local ecosystem. Photo: H. Bouchouareb

c) Please provide a summary of your results (even if they are preliminary).

Anne Turbé writes:
In humans, the larger your territory is, the more powerful you are. This pattern holds across many animal species, but little is known of what happens with meerkats groups. Through regular tracking of group movements, we have been able to measure changes in territory sizes over time. When linked to other behavioural data, it appears that for meerkats, it is not relative group size or success in border skirmishes that ultimately determine territory size – it is a matter of food. When food is scarce, where most species would travel



further, meerkats instead choose to work harder and travel less.

Figure 7. Meerkat home ranges shrink in times of low food availability. Median home range area is given in hectares for periods of high and low-food availability (wilcoxon matched paired test : z=8.00, n=10, p=0.047). Error bars are Inter-quartile ranges

Linda Hollén writes:
Preliminary analyses of the vigilance and alarm response data shows that young individuals engage less frequently in vigilance behaviour compared to older individuals. However, although young pups seldom detect predators themselves, and thus seldom emit alarm calls, they are nonetheless able from a very early age to respond to alarm calls in an adult-like way. Often (in 78% of observed cases) the pups take cues from more mature individuals before responding themselves. Pups also learn to respond to alarm calls signalling the approach of aerial predators before they learn to respond to terrestrial alarm calls.

Neil Jordan writes:
Through the collection and scoring of 477 meerkat faeces, Earthwatch volunteers contributed substantially towards my ongoing research on meerkat olfactory collection. Specifically, their data was used to evaluate the hypothesis that scent marks (e.g. faeces) are deposited in such a way so as to maximise the chances of them being discovered by their intended recipient(s). Preliminary results indicate that faeces are deposited non-randomly in relation to both boltholes and trees, both sites frequently visited by meerkats, thus the hypothesis is supported.

KRR biosurveys
Though most results of this work must necessarily remain hidden until in-depth analysis has been conducted, it has become clear that there is much fine-scale partitioning of habitat types within the KRR. Termite mounds in particular, a key food resource for aardvark Orycteropus afer, pangolin Manis temminckii and other scarce Kalahari animals, being highly aggregated into certain areas only. From the high relative abundance of non-palatable plant species featuring in our plant diversity transects, we have also been made aware of an apparently long history of over-grazing within certain areas of the reserve, that until recently was used for cattle and small-stock ranching.

Figure 8. Team leader Adin Ross-Gillespie inspects a termite mound for aardvark damage. Photo: B. Belcher

Roadkill survey
One interesting result to emerge from the roadkill study is that of the 17 mammalian species found, one species alone, the bat-eared fox Otocyon megalotis, accounted for

44% of all roadkills. This percentage seems alarmingly high, since it is extremely unlikely that bat-eared foxes account for 44% of all mammals small enough to get through the ubiquitous stock fences and onto the road. Based on spotlight sightings during night-drives within the KRR, we would have anticipated that bat-eared foxes should be less common in the roadkill record than, say, the common spring hare Pedetes capensis. It was also disturbing to note that scarce animals, such as the pangolin Manis temminckii, the aardvark Orycteropus afer and aardwolf Proteles cristatus, were amongst those that fell victim to speeding vehicles.

Figure 9. The rarely seen pangolin, *Manis temminckii,* is one of many animals killed by speeding vehicles. Photo: A.Brewer

Significance/Benefits of Research

a) What is/are the significance/benefits of your research at the following levels?

- local (in the area of the research site)

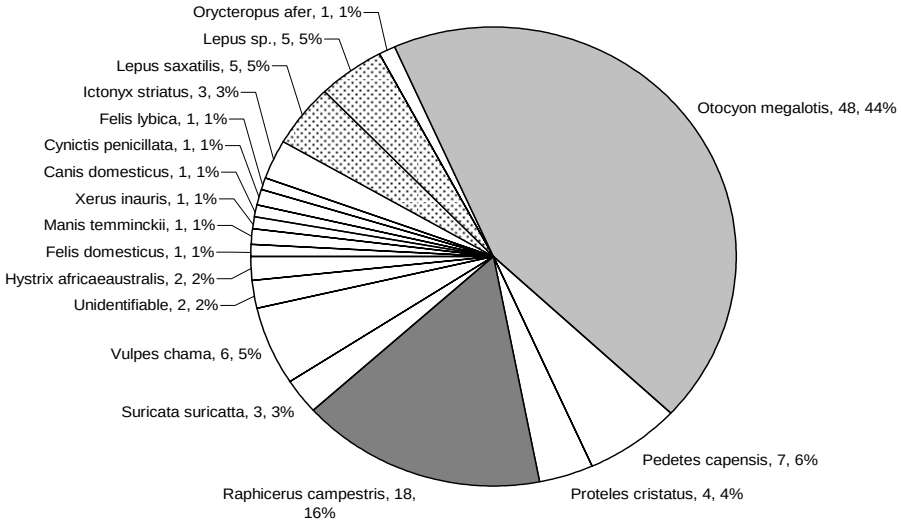


Figure 10. Mammalian roadkills between Upington and the Kuruman River Reserve (approx 95km tar road + 150km gravel road) Data are cumulative totals across 6 sampling trips during 2004 (16/03, 06/04, 20/04, 11/05, 25/05 and 15/06).

Roadkill survey

Our results may help to highlight the seriousness (or not?) of roadkill as a threat to the ecology of the southern Kalahari. If the data suggests that serious action is warranted, it may provide the grounds on which to appeal to local authorities for greater enforcement of speed limits, or launch awareness campaigns urging motorists to drive more carefully for their own safety and for the safety of local wildlife.

- National

Meerkat research
Our joint research with the Universities of Pretoria, Stellenbosch and Cape Town has provided opportunities for collaborative research at our study site which have been welcomed by all three institutions. Our research also plays an important role in documenting ecological changes in the Kalahari where long-term biological studies are very scarce.

KRR biosurveys
Our survey data may provide a basis for further studies on aspects of general Kalahari ecology, either within the KRR or as part of a wider study. Also, we are always on the lookout for taxa new to the area (plants, invertebrates, etc.), and this information may be ultimately benefit biogeographers, taxonomists or systematists. As an example, on one transect we discovered a bizarre and exciting solifugid, which has been submitted to a national museum where it is currently pending identification.

- international

Our work is helping to extend our understanding of the biology of cooperative breeders and the evolution of cooperation. On the one hand, this provides insight into the unusual problems faced by attempts to conserve cooperative breeders which commonly show positive correlations between reproductive success and population density instead of negative ones like most animals. These, in turn, cause temporary reductions in population size to have long lasting effects and increase the risk of group extinction. By providing an understanding of these processes, our work suggests how conservation policies should best be organised to deal with the problems of cooperative breeders.
On the other hand, our work provides close insight into the causal and evolutionary mechanisms that maintain animal cooperation which is relevant to understanding the evolution of cooperation in early humans and may even shed some light on the factors affecting cooperative behaviour in human populations today.

Figure 11. Demographic data on meerkats may help scientists to better conserve other co-operatively breeding species such as critically endangered African wild-dogs Lycaon pictus, which by virtue of their enormous territories are notoriously difficult to study.

(For example, do your findings, or do you expect your findings will contribute to management strategies or biodiversity conservation action plans at any of these levels?)

b) How do your findings contribute to issues of sustainability?

KRR biosurveys

Data collected in our surveys includes information on the distribution and abundance of camelthorn Acacia erioloba trees. Over wide parts of their range, these trees are being heavily exploited for the domestic firewood industry, despite concerns over the sustainability of this practice. Our data may be useful in providing a scientific grounding for these concerns.

Figure 12. The camelthorn, Acacia erioloba, a keystone species in the Kalahari ecosystem, is heavily exploited in parts of its range as a source of firewood. Photo: A. Ross

Dissemination of Results

a) Have you provided details of results from your research to or within:

- Scientific papers (indicate status; e.g., peer reviewed or in progress/press)
    - Please provide full references

Over the past year, members of the project have published or had accepted ten papers in mainline scientific journals:

Young, A.J. 2003. Subordinate tactics in cooperative meerkats: breeding, helping and dispersal. PhD thesis: University of Cambridge.

Russell, A.F., Sharpe, L.L., Brotherton, P.N.M. and Clutton-Brock, T.H. 2003. Cost minimization by helpers in cooperative vertebrates. PNAS 100: 3333-3338.

Carlson, A.A., Nicol, L., Young, A.J., Parlow, Al.F. and McNeilly, A.S. 2003. Radioimmunoassay of prolactin for the meerkat (Suricata suricatta), a cooperatively breeding carnivore. General and Comparative Endocrinology 130: 148-156.

Russell, A.F., Brotherton, P.N.M., McIlrath, G.M., Sharpe, L.L. and Clutton-Brock, T.H. (2003) Breeding success in cooperative meerkats: effects of helper number and maternal state. Behavioural Ecology 14: 486-492.

Griffin, A.S., Pemberton, J.M., Brotherton, P.N.M., McIlrath, G.M., Gaynor, D., Kansky, R. and Clutton-Brock, T.H. (2003) A genetic analysis of breeding success in the cooperative meerkat (Suricata suricatta). Behavioral Ecology 14: 472-480.

Clutton-Brock, T.H., Russell, A.F. and Sharpe, L.L. 2003. Meerkat helpers do not specialise in particular activities. Animal Behaviour 66: 531-540.
Carlson, A.A., Young, A.J., Bennett, N.C., McNeilly, A.S. and Clutton-Brock, T H. In press. The reproductive physiology of cooperatively breeding meerkats: disentangling the effects of dominance and inbreeding avoidance. Hormones and Behavior.

Clutton-Brock, T.H., Russell, A.F. and Sharpe, L.L. In press. Behavioural tactics of breeders in cooperative meerkats. Animal Behaviour.

Clutton-Brock, T.H., Russell, A.F., Sharpe, L.L. & Jordan, N.R. In press. 'False-feeding' and aggression in meerkat societies. Animal Behaviour

Russell, A.F., Carlson, A.A., McIlrath, G.M., Jordan, N.R. & Clutton-Brock, T.H. In press. Adaptive size modification by dominant female meerkats. Evolution.

- Management plans and reports (in progress or completed)
    - By who, for whom, and used by which agencies

- Presentations (given or planned)
    - Who was the audience? How many people attended?

In December 2003, Tim Clutton-Brock gave the Tinbergen Lecture to the Association for the Study of Animal Behaviour as well as a plenary talk to a Benelux Symposium in Leiden and Drs Young, Russell and Ms Turbé gave talks on their work on meerkats to the International Society of Behavioural Ecologists in Jyväskylä, Finland.

- Popular articles or films (in progress or completed)

No popular articles were published this year but a popular book is planned. In addition, Oxford Scientific Films plan to make a series of thirteen half-hour programmes on the work of the project during 2004/5.

- Books, chapters, illustrations

Tim Clutton-Brock is currently engaged in writing a book synthesising our understanding of mammalian societies which will be of interest both to scientists and to the general public.