

EARTHWATCH INSTITUTE FIELD REPORT

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Collaborating Institution(s): Max Delbrueck Center for Molecular Medicine Berlin, Germany; Paraclinical Department, Faculty of Veterinary Medicine, University of Peradeniya, Sri Lanka

Project Title: Sri Lanka's Temple Monkeys

Research Site: Polonnaruwa (07°56'N, 81°00'E) Sri Lanka

Status of the Research Site: Nature Sanctuary and Archaeological Reserve

Key Research Objectives: By way of better understanding social evolution, we aim to know what qualities of social groups contribute to the fitness (survival and reproductive success) of their individual members. The traits by which groups differ and that we can measure in relation to fitness concerns: group size, and history, quality of diet, and intergroup competitive ability in the local community that shares vital food and water resources. Additionally, we aim to examine variance in measures of individual health and development as well as in male reproductive success as determined from genetic paternity determinations.

Date report completed: June 29 2004

1. Field season highlights

Findings of special interest

A major objective of this research is to test hypotheses about the costs and benefits of social living in primates. Normally, female macaques are highly philopatric, leaving their group only under extenuating social and ecological circumstances. When individual females do decide (or are ostracised) to leave their family group and establish a new and independent one (through group fission) these events afford a unique opportunity to test the demographic consequences of such individual decisions. In theory, we would expect newly separated groups to eventually become extinct owed to a combination of social and ecological challenges that new groups face in an established community of social groups.

In the 2000-2003 season there occurred four new group fissions. The creation of new groups is of special interest because the qualities of these groups determine their ultimate survival. By measuring these qualities and relating them to the survival of its

constituent members we are in a position to test hypotheses concerning the advantages of social living.

Significant developments in the research

The above example about group fission adds to our database about the cost and benefits of group life. Unfortunately, there is progressively more habitat disturbance at the study site in the sense of garbage distributed by visitors. Garbage is a rich food source for macaques and is at the root of profound changes in the ecology, behavior and demography of macaques. This “development” is a negative one because it compromises our ability to test the natural relationship between behavior, ecology and survival. Although this change is not welcome and we are taking steps to try to contain and reverse it. Fortunately, we monitor 33 different social groups in our study, and some key groups were not affected by this disturbance and so offer an important test sample.

Use of volunteers in the fieldwork and accomplishments

In keeping with the methods as described in the Briefing, volunteers were trained in data collection techniques, divided into teams and given data collection tasks. Data collection protocols for volunteers involved the following: (i) home range charting, (ii) recording of behavior in relation to activity budgets, (iii) dietary intake, and (iv) intergroup encounter behaviors. Data from these protocols feed directly into our data bank used in testing hypotheses about the ecological costs and benefits of membership in groups that differ in their social, ecological and demographic qualities. After initial training volunteers were divided into teams, each team was assigned to investigate one macaque group. Normally, volunteers specialise either in home range mapping and group encounter observations or in observing and recording activity budget behaviors and dietary intake. In 2003-2004, about 466 hours of observation of ranging behavior were spread among 5 different macaque groups, but only two of these involved more than 100 hr of observation. Diet profiles involved 108 hours ranging from 3-28 hours of observation per group. Two key groups had 25 hours or more of diet data. Group encounters tend to be rare, but volunteer and projects staff recorded 13 different encounter events, all involving key fission groups.

Any local, national, and international benefits that have resulted from field work

Scientific data from our research contributes to knowledge of primate behavior, ecology and demography, and to social evolution. Given the disturbance at our site, it also reflects the behavioral and ecological adaptability of macaques when faced with a significant in their natural environment. The mere presence of the research staff and the interest shown by volunteers, and our conservation oriented approach sets an example to the local community about the value that is placed and invested in their wildlife. This scientific, educational and conservation activities on our part tends to stimulate interest and pride in the local community about their natural resources and fosters a more protective attitude towards Sri Lankan wildlife.

Results

At the beginning of 2003 we had two newly formed groups in the study population and additional ones from earlier years. New groups are special interest because the qualities of these groups determine their ultimate survival. By measuring these qualities and

relating them to the survival of its constituent members we are in a position to test hypotheses concerning the costs and benefits of social living. With the help of Earthwatch volunteers we documented the home ranges, activity budgets, diets, and intergroup relations of some of these new groups. Because of recent human encroachment and disturbance to the site, not all macaque groups were suitable for volunteers to follow.

Volunteers recorded macaque activity budgets while following focal adult females through the forest. Mutually exclusive activity states were: forging, drinking, resting, sleeping, grooming, travelling, playing and nursing. Of these, foraging is of major interest because it involves time spent in searching for food and consuming it. The data show a fairly large range among groups from 17.4% to 27.9%. None of these groups showed a high proportion of their activity budget devoted to forging. Probably this was owed to the fact that all of the focal groups spent a portion of their daily foraging on garbage.

Dietary intake from natural sources is a reflection of seasonal trends in plant activity (phenology) which in turn is rainfall dependent. Volunteer observations began in March and continued in late June, through July, August and September. March is the end of the winter rainy season when the forest was still lush and free water was plentiful. The macaque's diet typically comprised mostly fruits, the highest nearly 20% from a common shrub *Zyziphus*. This was supplemented by fruit from 14 other plants, mostly figs, leaf shoots from 12 plant species as well as herbs. Leaf shoots and herbs took up 17% of foraging time in March. June through September was the dry season with the peak of the drought in June and July. The fruits of figs *F. amplissima* contributed to diets June through August at a consistent level 11-25% of foraging time, but virtually absent in September. Diets were enriched with fruits of banyan *F. bengalensis* in June, and from *Schleicheira* in early July. Fruits of *Cordia* predominated in late July into August. Heavy rains for two days in mid August stimulated phenology and brought leaf flush as well as fruit of the common shrub *Glycosmis*. Sugar rich *Glycosmis* fruit were important in the diet of Group M1 but not D2 in late August reflecting habitat differences between these groups. Diets in September were predominantly fruit reflecting the dry conditions at this time of the year. The diets of all groups were influenced by access to garbage and paddy grains along the road sides. In September these anthropogenic food sources accounted for 25 to 62% of foraging time. In other words, during the driest time of year, when natural forest foods were rare, the macaques adapted to foraging on either garbage or paddy seeds depending on the availability of these foods in the home ranges.

Range use by three groups H2, D2 and M1 in September illustrated principle that range size is partly a function of group size. All 5 groups retained some of the range area of their original parental groups prior to fission. But the subordinate splinter groups occupied habitat with lesser foraging opportunities, in particular access to lucrative garbage.

We capitalized on opportunities by focusing our study attention on special events as they occur in the field. Ancillary observations in March suggested that females after birth engage in more resting than usual. In June, July, & August we noted that subordinate females (in groups D2, H1, H2 and M1), as well as social groups, expended time to meet their daily energy needs than did dominant ones in support of our hypothesis that low rank has negative effects of foraging efficiency.

Finally, the detailed results from Earthwatch volunteer observations were summarized and discussed for each team on the last Friday of each team's term. Every volunteer was given a detailed printed report of research results pertaining to their team's recordings of behavior and ecology of their assigned focal groups and macaque individuals. This report included summaries and discussions of home range map and use patterns, diet profiles, activity budgets, forest layer use differences, group encounters and ancillary observations. Copies of these reports have been sent to Earthwatch.

Partnerships

Seven persons from three international institutions as follows:

Three veterinary students or recent graduates participated in our field research in 2003. The focus of their research centred on biomedical measures, and involved studies of hematology and protozoan parasites. The collaboration included the following persons: Professor Neil Horadagoda, Head, Paraclinical Dept., Veterinary Faculty, University of Peradeniya, and Drs. A. Arlukanthan, Dr. R. Rajapakse, Ms. D. Ekanayake, Ms. Tharanagani Herath and Ms. Madura Sanjeevani also from the same Paraclinical Department.

These studies also drew in Dr. O. Palmer and J. P. Dubey, US Food and Drug Administration USA, for the molecular characterisation of *Toxoplasma* and *Cryptosporidium* protozoan parasites.

Dr. Richard Stevens, School of Public Health, UC Berkeley, for studies of chlamydiae infection in wild primates.

Data will analysed then published in professional journals within three years. One manuscript has been submitted, another is being edited.

Future research plan

The research plan is to continue basically the same research plan as had been established for the last two years.

The human disturbance factor has prompted me to establish a new NGO "The Association for the Conservation of Primate Diversity" which, among a broad range of objectives, is also intended as a vehicle to draw in conservation monies for addressing habitat management initiatives. Nine persons including local leaders in business, banking, education, conservation and outreach social programs were recruited as subscribers to this new NGO. The NGO has been incorporated as a Limited Company by the registrar of Companies of the Government of Sri Lanka.

New biomedical findings from wild toque macaques have expanded the search for molecular characterisation of some pathogens.

Publications

Scientific papers (peer reviewed):

Ekanayake, D. K., Horadagoda, N. U., Sanjeevani G. K. M., Arulkanthan, A., Gunatilake K. A. S., Dittus, W. P. J. (2003). Hematology of a natural population of toque macaques (*Macaca sinica*) at Polonnaruwa, Sri Lanka. *American Journal of Primatology* 61:13-26.

Ekanayake, D. K., Rajapakse, R. P. V. J., Dubey, J. P., Dittus, W. P. J. 2003. Seroprevalence of *Toxoplasma gondii* infection in a natural population of toque macaques (*Macaca sinica*) at Polonnaruwa, Sri Lanka. *Proceedings of the Peradeniya University Research Sessions, Sri Lanka. (October 23, 2003), vol 8: 207*

Molur Sanjay, Douglas Brandon-Jones, Wolfgang Dittus, Ardith Eudey, Ajith Kumar, Mewa Singh, M.M. Feeroz, Mukesh Chalise, Padma Priya, Sally Walker (2003). *Status of South Asian Primates: Conservation Assessment and Management Plan (C.A.M.P.) Workshop Report, 2003. Zoo Outreach Organization / CBSG-South Asia: Coimbatore, India, 426pp. ISBN: 81-88722-03-0 (Paperback); 81-88722-04*

Scientific papers (in progress/press):

Ekanayake DK, Horadagoda NU, Sanjeevani GKM, Arulkanthan A, Gunatilake KAS, Dittus WPJ. (in prep for 2004). *Cyrtosporidium* infection in a natural population of nonhuman primates at Polonnaruwa, Sri Lanka.

Dittus WPJ. (in press 2004) Demography: window to social evolution. In: *Macaque Societies: a Model for the Study of Social Organization*. Edited by Bernard Thierry, Mewa Singh & Werner Kaumanns. Cambridge University Press: Cambridge. Pp 87-116.

Dittus, W. (in press 2004/05). Toque Macaques of Sri Lanka. In "The Mammals of South Asia" Eds. A. J. T. Johnsingh and R. Sukumar. Permanent Black Press, New Delhi.

Presentations:

Lecture (Sep 03): "Primate Behaviour & Ecology", Polonnaruwa General Hospital Medical Officer's Association, Sri Lanka.

Nov 03. Conservation outreach program, Polonnaruwa Royal Primary School.

Lecture (Dec 03): "Primate Reintroductions in Sri Lanka." South and South-East Asian Reintroduction Specialist Group, Colombo, Sri Lanka.

Lecture (Feb 04): "Primates of Sri Lanka: Behavior and Ecology" University of Peradeniya Zoologists Association.

Lecture (Feb 04): "Primates of Sri Lanka: Behavior and Ecology" University of Innsbruck Field Ecology Group visit to Sri Lanka.

Lecture (March 04) "Primates of Sri Lanka", Trinity College, Kandy, Sri Lanka.

Popular articles or films completed:

2003/4. Michaela's Wild Challenge: Temple Monkey Study". Two Hand Productions, Surrey, UK

Acknowledgements

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