

Classroom



In this section of Resonance, we invite readers to pose questions likely to be raised in a classroom situation. We may suggest strategies for dealing with them, or invite responses, or both. "Classroom" is equally a forum for raising broader issues and sharing personal experiences and viewpoints on matters related to teaching and learning science.

Anindya Sinha
National Institute of Advanced
Studies
Indian Institute of Science
Campus, Bangalore 560 012
India.
Email: asinha@hamsadvani.serc.
iisc.ernet.in

Anindya Sinha is an associate fellow at the National Institute of Advanced Studies, Bangalore. Although he holds a doctoral degree in molecular biology, he is currently a professional monkey-watcher! His research interests are mainly in the areas of social behaviour, evolution of intelligence, conservation biology and genetics.

Project Lifescape 10. The Macaques of India

Project Lifescape aims to make available user-friendly accounts of a set of about 1500 species and higher taxonomic categories of target taxa to nurture the study of living organisms as a part of teaching biology and other related subjects in India. These accounts would be in a standardised format to promote studies whose results would be comparable and could eventually feed into a nationwide programme of monitoring a range of taxa of conservation and economic significance. These accounts are expected to be as non-technical as possible. This part includes an article on macaques of India with a special reference to bonnet macaque.

Monkeys have always been intimately associated with the lives of the people of the Indian subcontinent. This relationship, however, can be amazingly variable. At one extreme it can take the form of Hanuman, the god of wind and physical prowess, who appears to be a deification of the common hanuman langur and is worshipped widely in northern India. At the other end, it could include the highly endangered hoolock gibbon, the only ape of the subcontinent, or the slow loris, a rare primitive



prosimian, both of which often end up as highly desirable food for some of the indigenous people of the north eastern Indian states. Somewhere in the middle lies the bonnet macaque, the common monkey of south India, which enjoys a rather unpredictable love-hate relationship with the local people whose crops and houses it occasionally raids, but whose temples it apparently guards from evil spirits.

Members of the order Primates – the prosimians, monkeys and apes (including human beings) – differ from all other mammals primarily in the structure of their hands and feet. The digits are usually long and consist of flattened terminal phalanges or finger bones, which bear nails rather than claws. The claw pads, typical of all other mammals, have been gradually lost during the course of evolution of the primates, and replaced by thickened skin, specialised for weight bearing, over all the ventral surface of the palms, soles and digits. This is a complex adaptation, virtually unsurpassed in any other group of mammals.

The Family Cercopithecidae, the largest of the primate families, includes all the Old-World monkeys of Africa and Asia and is represented by the different species of langurs and macaques in India. The langurs are very arboreal and spend most of their time on trees primarily feeding on leaves of different tree species. They usually have peculiar, greatly enlarged stomachs, which are specialised for the digestion of the rather large amounts of foliage that they consume daily. The macaques, on the other hand, include species that spend relatively greater proportions of their time on the ground, consuming a very varied omnivorous diet including leaves, fruits, grasses and insects.

Seven species of macaques are found in India; of these the rhesus and bonnet macaques are known most commonly for their abundant presence in a variety of ecological habitats throughout northern and southern India, respectively. In fact, both these species exhibit a remarkable tendency to leave their forest habitats to move towards human habitations, where they co-exist with



Bonnet macaques have often been described in the classical texts of southern India, and depicted in different forms; this sculpture of a bonnet 'family' is from Mahabalipuram, c. 7th century AD.

Seema



Hanuman langur

Other than the macaques, the hanuman langur is also found in close association with human beings.

Seema



the local people in a wide variety of non-forest habitats, including tea and coffee plantations, village agricultural areas, temples and fully urban settings. Naturally, this has often led to serious conflict between the monkeys and the people, who consider them to be pests; such situations continue to remain problematic even today.

Apart from the common rhesus and bonnet macaques, the other five Indian macaques are highly endangered and rather restricted in their distribution. These include the lion-tailed macaque, endemic to the tropical rainforests of the Western Ghats, the crab-eating or long-tailed macaque of the Nicobar islands, and three species found only in the north eastern states of the country – the Assamese macaque, the pig-tailed macaque and the stump-tailed macaque. Unfortunately, very few studies have been conducted on the status, distribution, and biology of these rare macaques, which are in urgent need of conservation. Detailed knowledge of the ecology and behaviour of the wild populations of these fascinating group of monkeys could provide us an unique opportunity to understand the forces of nature which have shaped the individual life-history patterns, and the social life and intelligence of these monkeys. It would indeed be tragic if we fail to protect them from our ravages and they disappear without telling us their stories, each unique in its own way.

In this article, I give a detailed description of the bonnet macaque, the ‘common performing monkey’ of southern India. In a subsequent piece, I will provide accounts of the other Indian macaques and highlight some important aspects of their biology.



Bonnets can usually be individually recognised by certain prominent facial or body features; this is an old male with a prominent hunch.

Anindya Sinha

The Bonnet Macaque

Macaca radiata: Cercopithecidae

Order: Primates

Morphological Characters

The common ‘red-faced’ monkey found virtually everywhere in southern India, the bonnet macaque is a medium-sized, long-



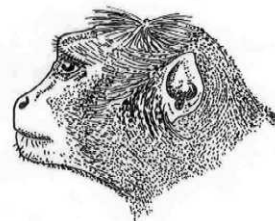
tailed monkey typically characterised by a whorl of long hairs on the crown radiating outward and backward to form a small cap with a distinct centre-parting in front (thus giving the species its distinctive name!). The dorsal parts of the body and the tail are olive brown to greyish-brown in colour, while the ventral parts are more whitish. The face is bare, pale pink to flesh-coloured. A typically broad forehead patch, lighter in colour than its surroundings, bifurcates the forehead longitudinally; the variations in the shape and colour of this patch allows one to easily identify specific individuals in a group of bonnet monkeys. Although the sexes look rather similar, males are more heavily built and have relatively larger heads.

Size: Head and body length – males: 50-60 cm, females: 34-52 cm; tail length – males: 50-70 cm, females: 48-62 cm; weight – males: 5.5-11.5 kg, females: 3-5.5 kg.

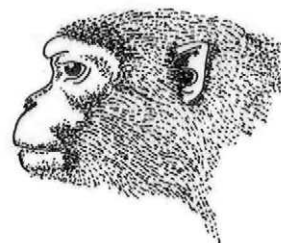
Of the two subspecies, *M. r. diluta* appears to be, on average, smaller in size than *M. r. radiata*. It can also be distinguished by its coat colour, which, although very variable, is usually paler. The fore part of the bonnet tends to consist of much longer, drooping hairs and is usually more yellowish in colour, with the same colour often being present on the shoulders and the lower back. The underside of the body of this subspecies usually varies from dirty white to buff.

Related Species

In appearance, the bonnet macaque most closely resembles the toque macaque (*Macaca sinica*), found exclusively in Sri Lanka, but lacks the pronounced whorls of hair on the cheeks typical of the latter. The monkey from which the bonnet macaque needs to be distinguished most, however, is the rhesus macaque (*Macaca mulatta*) of north India. The rhesus is a relatively heavier monkey and has a squat, thickset body with distinct orange-red fur on its loins and rump; the hairs on its crown also radiate backwards from the forehead without the neat centre parting, so obvious in the bonnet macaque.



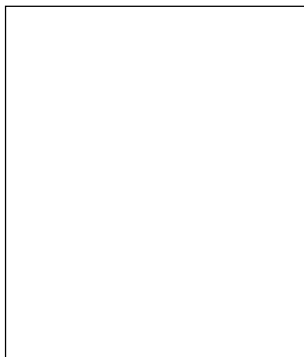
Macaca radiata



Macaca mulatta

Lateral view of (a) bonnet and (b) rhesus macaques showing their distinctive profiles; the former can be clearly distinguished by its prominent bonnet.

K A Subramanian



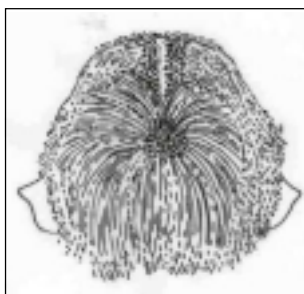
Distribution

Distribution

Bonnet macaques are abundant all over peninsular India, extending as far north as Mumbai on the west and the Godavari river on the east. South of the Godavari, however, populations of rhesus macaques appear to be displacing bonnet macaques and pushing them further south by virtue of their supposedly more aggressive nature. In fact, it is believed that the range of rhesus macaque now extends almost to the river Krishna. The exact distribution patterns of the two species in these areas and in the states of Maharashtra and Madhya Pradesh need to be studied urgently. It would also be interesting to try and observe the actual nature of interactions between them – this has never been done before!

In the Nilgiri and Anamalai ranges, bonnet macaques have been sighted at altitudes ranging to about 2000 m. Although found in a variety of ecological habitats and climatic zones including dry scrub jungles, dry and moist deciduous forests and wet evergreen rainforests, bonnet macaques are relatively more common in rural and suburban areas than in the interior of forests.

Of the two subspecies of bonnet monkeys, *M. r. radiata* is more widespread, while *M. r. diluta* appears to be restricted only to south Kerala (Thiruvananthapuram region) and the southern districts of Tamil Nadu (including Tirunelveli district). It must be pointed out, however, that there have been no studies yet which have examined any aspect of their comparative distribution, ecology or biology, and also whether they can hybridise with each other. These are the investigations that need to be carried out if we are to conclusively establish the occurrence of these two subspecies – so far this has been postulated only from an examination of the coats of dead specimens!



Macaca radiata

Top view of the head of a bonnet macaque showing the typical pattern of radiating hairs, which gives the species its common name.

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General Habitat

This is the most common species of monkeys found everywhere in peninsular India – at home in the forest and in the city, both in the hills and on the plains. Groups, ranging in size from about

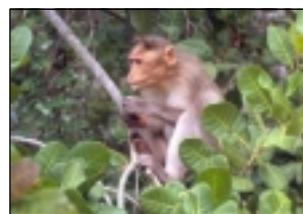


5 to 75 individuals, can be readily observed moving and feeding together, usually on trees, but often on the ground – especially around human habitations. These troops are highly organised and consist of individuals of both sexes and all ages, occupying well defined and vigorously defended territories, usually 1 km² in area but sometimes even extending to about 5 km². Each troop typically consists of one to several adult males and females, and a variable number of subadults, juveniles and infants of both sexes. We still do not understand completely what factors – ecological and behavioural – influence and determine the size, composition and home ranges of bonnet monkey troops. It is definitely known, for example, that troops that live in human habitations tend to be much larger than those that live in forested areas, but the precise ecological factors such as availability of food and suitable resting sites, proximity to water sources, predation pressures, or the presence of other troops of bonnet monkeys in the vicinity, that may be important in this regard are unknown.

Active and agile during the cooler hours of the day, bonnet monkeys generally huddle together and sleep in small groups under the midday sun and during the nights, invariably on tall trees or on other elevated objects (such as the roofs of temples). It is interesting that, around human habitations and in cultivated areas, they invariably inhabit banyan trees (*Ficus benghalensis* and *F. benjamina*), often to the extent that if there are no banyan trees, there will probably be no monkeys! On the other hand, in forested areas where the macaques face the risk of being predated upon by leopards, wild dogs or other carnivores, they prefer tall trees overhanging a river, pond or some other water body. It is felt that this may be a strategy to minimise potential danger from at least one direction, but this hypothesis needs to be tested.

Food

Bonnet macaques are voracious feeders and are omnivorous. Their vegetarian food ranges from grass blades to a variety of



In their feeding habits, bonnets are generalists, feeding on a variety of plant species; this young male is gorging on ripe cashew fruits.

Anindya Sinha



Bonnets live in closely-knit social groups, with all individuals feeding together, often on the ground.

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leaves, young shoots, flowers, fruits, nuts and seeds. Mango, wild figs, tamarind, blackberry and cashew are some of their favourite fruits; leaves, flowers and fruits of neem, gulmohar, and pongamia are also eaten. When non-vegetarian, bonnet macaques hunt for arthropods like grasshoppers and lepidopteran pupae, as well as spiders. Bird nests are sometimes raided for eggs, while broken honey bee combs are sucked for honey and the larvae rapidly picked up.

It is remarkable that these monkeys have learnt to exploit a tremendous variety of food sources and this may be the primary reason why bonnet macaques can be found in any kind of ecological habitat. Studies on their feeding habits have revealed, for example, that they can use about 86 species of plants as food in dry deciduous forests, and about 39 species in tropical evergreen forests. Although the monkeys in these habitats clearly use different species of plants as food, it is far from clear how individual monkeys learn which plant species can serve as food, and whether feeding differences exist even among different individuals within the same troop. Investigations into such questions of fundamental importance can be carried out even in the towns and cities of southern India where we know from everyday experience how adaptable bonnet monkeys are when they raid our markets and kitchens for food.

Social Behaviour

Bonnet macaques are extremely social with most individuals actively interacting with each other. Adult females usually remain in the group where they were born throughout their lives, and during adulthood, form strong dominance hierarchies with daughters occupying dominance ranks just below those of their mothers. Friendly interactions between females usually occur at high levels with grooming being exchanged between genetic relatives as well as unrelated individuals. The exact patterns of grooming and other friendly behaviour displayed by individuals in different positions in the dominance hierarchy are, however, extremely variable across different troops. Adult



Bonnet individuals spend significant periods of time grooming each other, often huddled together in social groups.

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males, on the other hand, form unstable dominance hierarchies through direct aggression and coalitions; most coalition partners usually display high levels of friendly behaviour towards each other.

Individual monkeys exhibit a variety of vocalisations and non-vocal gestures when communicating with each other. Although the exact patterns of gestural and vocal communication exchanged between different individuals have hardly been studied, these seem to facilitate the active development of friendship between particular individuals, as well as other kinds of social relationships. Since there are usually many kinds of calls exchanged by bonnet monkeys in different social situations, an extremely valid and important question that needs to be addressed is whether such a species could indeed have some rudimentary form of a language.

Breeding

Sexual maturity is attained in both sexes at about three to four years of age, but males attain social maturity only two to three years later. Subadult males, who have reached puberty, and adult males often leave the troop where they were born and emigrate – either singly or in small groups – to new troops that they subsequently join. It is interesting that bonnet males almost invariably emigrate during the breeding season, a clear indication that opportunities for mating could be the primary motivation for them to move. Females come into oestrus approximately once a month except during pregnancy and lactation, but do not exhibit any prominent sexual swelling. Mating occurs sporadically throughout the year but usually peaks in October–November, the principal breeding season. It has usually been seen that within the troop, dominant males tend to guard sexually receptive females, while subordinate males mate opportunistically. Both sexes appear to exhibit mate choice, males by attending to certain females, and females by allowing certain copulations to proceed to completion. What makes particular individuals attractive to the members of the



Bonnets are good primatologists! This adult male is keenly observing a social interaction between several other individuals of his troop.

Anindya Sinha



Aggression often breaks out between individuals during competition for food and for grooming or mating partners; different kinds of gestures and acts are used, including open-mouth threats, shown here.

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Bonnet infants become independent by about the age of one year, although they continue to associate with their mothers and other infants of their age.

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opposite sex when they seek mating partners? It has been observed that new males who have joined the troop are much more attractive sexual partners for the adult females in the troop, but other qualities that make such males or some resident males preferred mating partners remain to be discovered. Again, what qualities of females make them attractive as mates? Is it their position in the dominance hierarchy? Or, is it some particular behavioural attribute, for example – a propensity to allogroom at high levels? Observational studies on individual attributes and behavioural strategies can go a long way in answering questions of this nature.

The gestation period has been measured in captive monkeys to range from 153 to 169 days. Births occur mainly from late January to late April, but occasionally in May–June. Parental care is exclusively provided for by the mothers, although some adult and subadult males often appear to be protective of certain male infants. Weaning, or the process by which the infant becomes nutritionally independent of its mother's milk, usually occurs at 8 to 12 months of age, but it occurs gradually in stages. This period is also marked by processes of socialisation whereby the growing infants gradually integrate themselves as independent members of the troop, although they still prefer to interact mainly with their mothers or other juveniles of the same age. The development of independence can, however, follow variable paths – and detailed studies on different infants and their socialisation strategies can throw light, not only on the development of personality in these individuals – a completely neglected area of research – but also on the nature of social strategies followed subsequently by these individuals during adulthood.

Population Assessment

The last extensive census, carried out in the period 1977–1980 by the Zoological Survey of India, has estimated the bonnet macaque population in the four southern states of India to consist of about 1,70,000 individuals, with about 81,000 monkeys



in Karnataka, 64,000 in Andhra Pradesh, 16,000 in Tamil Nadu and 11,000 in Kerala. What remains unknown, however, is the rate of decline of many of these populations that seems inevitable given the intensification of agriculture in rural areas and the increasing intolerance towards the species in urban localities.

Systematic surveys for macaques can be easily carried out anywhere since, in most cases, the local people seem to be aware of the troops that inhabit that particular area. In the forests, simple line transects can be conducted to evaluate the population density of troops. In such natural environments, bonnet macaques invariably live in proximity to some water body, with large trees overhanging a river being favourite roosting sites. The size and age-sex composition of macaque troops can also be conveniently determined since troops can be easily followed and habituated by a non-threatening human observer.

Human Significance

Bonnet macaques are famous for primarily two reasons – first, their amazing ability to successfully adapt to almost any kind of environment and second, the intense love-hate relationship that they enjoy with the people of southern India! Although shy in their natural forest environment, macaque troops inhabiting human habitations are not in the least afraid of people and systematically raid houses, shops, cultivated fields and temples for food. They appear to be particularly partial towards maize and ragi fields, as well as areca and coffee plantations. These escapades are usually tolerated with some measure of resignation and even, indulgence; the legendary involvement of the monkey army in battling the forces of evil in the epic *Ramayana* may insulate the macaques from being punished to a large extent! This may also ensure that in temples, and even in towns, they are actively fed, often with groundnuts and plantain. It is noteworthy that even the tribal populations of the Western Ghats, who have traditionally used other primates as part of their diet, do not usually hunt bonnet macaques. A more modern form of exploitation of these macaques is their use as subjects of medical

The legendary involvement of the monkey army in battling the forces of evil in the epic *Ramayana* may insulate the macaques from being punished to a large extent.

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and scientific research in a number of research institutions in India. In this regard, it is hoped that this does not lead to a decimation of bonnet macaque populations as has happened to the rhesus macaque in northern India in the last three decades.

One problem that needs to be urgently addressed is that of human–bonnet monkey conflict in urban areas. Attempts have often been made to solve this problem by capturing the offending troops and translocating them to other non-urban areas. The unique psychology of this species (like many other macaques), however, usually compels it to move into human habitations again and quickly adapt to the prevailing conditions there. Given the abundance of bonnet macaques in any favourable environment, other groups soon move into areas vacated by the captured troops. It is also difficult to identify suitable areas where the captured groups can be introduced since this, more often than not, results in transferring the problem to someone else. Moreover, translocation into protected areas, as is often practised by the local administration, is completely inadvisable for fear of exposing the local bonnet populations to foreign infections and disease.

Perhaps the most practical solution to the problem of urban bonnet monkeys is to develop management strategies *in situ*. It might be possible, for example, to examine the effect of introducing local feeding stations with the aim of attracting monkeys away from raids on residential areas. A protocol of capture, sterilisation and re-introduction of the monkeys into the same localities has also been sporadically practised but its effect on the socioecology of the troops or the nature of their subsequent interactions with the local people never examined.

It is therefore clearly imperative that more detailed ecological and behavioural studies of wild, semi-urban and urban bonnet monkeys are initiated urgently. Such studies are essential if successful management strategies are to be developed for the species, not only in protected forest areas where the monkeys tend to interact increasingly with tourists, but also in rural and



urban areas where rapidly growing human populations are coming into serious conflict with the macaques with very little or almost no hope for the survival of the monkeys.

Suggestions for Student Projects

The above description of the bonnet macaque clearly shows that although this is a species that the people of southern India interact with very frequently in their everyday lives, very little is actually known about the species. I have already indicated some of the questions that need to be addressed if one were to study bonnet monkeys closely and understand their lives better.

Some aspects of the ecology and behaviour of the bonnet macaque that could be addressed by a simple study include an understanding of (1) the ranging patterns and food plants of bonnet macaques in different ecological habitats; (2) the role of bonnet macaques in seed dispersal; (3) the social behaviour of bonnet monkeys; (4) the ecological and behavioural adaptations of the two subspecies of bonnet macaques in their respective environments; (5) the interactions of bonnet macaques with other species of primates (common langur and rhesus macaque, for example) or other mammals (spotted deer, for example) during ranging and communal feeding; and (6) the behavioural changes shown by bonnet monkeys following intensive interactions with human beings.

Local Names

Mucha, Kapi and Korda (Coorgi); Bandar (Hindi); Manga, Kothi, Kapi, Maungya and Kemp manga (Kannada); Mankad (Konkani); Kapi, Kurangu, Markadan and Vella manthi (Malayalam); Makad, Lal manga, Vanar and Kerda (Marathi); Kurangu (Tamil); Kothi (Telugu); Kodan (Toda).

Further enquiries and offers of help relating to Project Lifescape may be directed to
Madhav Gadgil, Centre for Ecological Sciences, Indian Institute of Science,
Bangalore 560 012; Email: madhav@ces.iisc.ernet.in.

Suggested Reading

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