Problems of Prioritizing Primate Species for Captive Breeding in Indian Zoos

Sally Walker & Sanjay Molur

Abstract

Captive breeding is a recognized conservation tool all over the world. In India there are over 180 public zoos, mini-zoos and deer parks holding animals, 97 of which hold 1753 individual Indian primates (CZA in litt.). Of the 14 species listed by the Central Zoo Authority in 2002, 7 species are threatened globally, 4 non-threatened and 3 Data Deficient (Hilton-Taylor, 2000); 3 are endemic to India.

Since appropriate, high-quality captive space and programme resources are limited, well-managed zoos in India must prioritize threatened and endemic species for conservation breeding, including newly designated species and subspecies under the recently revised taxonomy, which are endemic to India and even to small areas in India. The need for identification and prioritization has assumed great importance in the light of the recent taxonomic modifications within Asian primates and the increasing pressure on stressed habitats. This paper will focus on the revised taxonomy and the difficulties facing the zoo community in India as these new scientific investigations evolve.

Introduction

All over the world, captive breeding in zoological gardens, parks, and other similar facilities has been undertaken as a conservation tool. In India there is even a National Zoo Policy which states that 'the main objective of the zoos shall be to complement and strengthen the national efforts in conservation of the rich biodiversity of the country, particularly the wild fauna …' Supporting the conservation of endangered species by giving species, which have no chance of survival in the wild, a last chance of survival through coordinated breeding under ***ex situ*** conditions and raise stocks for rehabilitating them in the wild as and when it is appropriate and desirable' (CZA 1998). The Zoo Act itself states that 'All zoos shall participate in planned breeding programme of endangered species approved by the Central Zoo Authority in consultation with the Chief Wildlife Warden of the State. For this purpose, they shall exchange animals between zoos, by way of breeding loans, gifts etc. as per the directions of the Central Zoo Authority' (Gazette of India, 2001).

Article 9 (***Ex situ*** conservation) of the Convention on Biodiversity calls upon each party to a) adopt measures for the ***ex-situ*** conservation of components of biological diversity, preferably in the country of origin, b) establish and maintain facilities for ***ex situ*** conservation of and research on plants, animals and micro-organisms, preferably in the country of origin

of genetic resources, c) adopt measures for the recovery and rehabilitation of threatened species and for their reintroduction into their natural habitats under appropriate conditions and d) regulate and manage collection of biological resources from natural habitats for ***ex situ*** conservation purposes so as not to threaten ecosystems and ***in situ*** populations of species, except where special temporary ***ex situ*** measures are required (UNEP, 1994).

The World Zoo Conservation Strategy, states, 'Zoos can contribute directly to preventing of extinction of endangered species. ***Ex situ*** zoo populations can directly support the ***in situ*** survival of some species by providing the nucleus for re-establishment or reinforcement of wild populations in nature' (IUDZG/CBSG (IUCN, SSC 1993).

The IUCN Policy Statement (1987) on Captive Breeding, states that 'Establishment of self-sustaining captive populations and other supportive intervention will be needed to avoid the loss of many species, especially those at high risk in greatly reduced, highly fragmented, and disturbed habitats. Captive breeding programmes need to be established before species are reduced to critically low numbers, and thereafter need to be co-ordinated internationally according to sound biological principles, with a view to the maintaining or re-establishment of viable populations in the wild' (IUCN, SSC, CBSG 1987). The current Draft Statement, the IUCN Policy on the Management of ***Ex Situ*** Populations for Conservation, the final version of which will be ratified by IUCN in due course is even more specific : '… in some regions the threats to taxon survival are so severe that no hope exists for their long-term ***in situ*** maintenance. … we shall be unable to ensure the survival of an increasing number of threatened taxa without effectively utilizing a diverse range of complementary conservation approaches and techniques including, for some taxa, increasing the role and practical use of ex ***situ*** techniques' (IUCN SSC CBSG, in draft).

Therefore, although zoos were not—either in India or anywhere in the world—created initially to save species, this is their stated goal today in most countries and in most important global documents. The role of research and education in ***ex situ*** facilities in strengthening ***in situ*** efforts is also given due importance. The conservation community at large is convinced that ***ex situ*** conservation is a valid conservation tool.

Indian Primates

Of the 14 species listed by the Central Zoo Authority in 2002 which uses the old taxonomy, 7 species are threatened globally, 4 non-threatened and 3 Data Deficient (Hilton-Taylor, 2000). 3 are endemic to India. ***Trachypithecus phayrei***, Phayre's leaf monkey, (held by Sepahijala Zoological park but not in the CZA database) makes a total of 15 primates with distribution in India held in Indian zoos.

Many changes in taxonomy and nomenclature (combined with one new distribution—for ***Macaca thibetana***) have been published recently which effectively increases the number of species from 15 to 21 and the number of subspecies to 12. Also, the changes effectively create 3 more endemic species for India: ***Semnopithecus dussumieri, Semnopithecus hypoleucos,*** and ***Semnopithecus priam*** (Groves, 2001).

Most primate species distributed in India are represented in the Indian zoos in varying numbers and sex ratios (CZA, 2002). Although, the Indian zoo community has formulated

breeding strategies involving systematic exchanges between zoos since 1982 (Walker 2000), these strategies have been created largely without system, science or objectivity. Although Indian zoo authorities are enjoined by legislation to participate in planned breeding programmes of endangered species approved by CZA and to exchange animals between zoos by direction of CZA, they are not, even now, suitably empowered practically and administratively to follow these strategies. State and municipal governmental officials, who control the zoos, change frequently and do not always comprehend the subtle requirements of zoos, including the importance of cooperation between them.

Until recently, it could be said quite confidently that certain primates, such as the Common langur, Rhesus macaque, and Bonnet macaque do not require a captive breeding programme as their numbers and distribution in the wild are sufficient, even over-abundant in some instances. In the last few years, however, scientific information about some primate species has led to a revision in primate taxonomy which has split certain primate species either into multiple species or into subspecies, depending on the taxonomic interpretation. The Common langur, for example, has been defined as 7 distinct species (Groves, 2001) or 9 distinct subspecies (Brandon-Jones ***et al.,*** 2002, unpub,) each of which are not common at all.

In 2000 a workshop organized by the IUCN SSC Primate Specialist Group reviewed the then current taxonomy in the context of other publications and generated the new primate taxonomy with a number of new subspecies. In 2001, Colin Groves' book, ***Primate Taxonomy*** was published which designated new species, some of which are upgrades of the new subspecies. Since then the 2000 paper (Brandon-Jones, ***et al.,*** 2000, unpub) has been revised and is undergoing further revision (Brandon-Jones ***et al.,*** 2002, unpub.) The Brandon-Jones 2002 taxonomy was selected for use by participants of a Conservation Assessment and Management Plan (CAMP) Workshop for South Asian Primates held in Coimbatore, India in March 2002. Their input may lead to further refinement of the paper as the author also attended the workshop. This is the way of taxonomy, which seems both friend and foe for the wildlife field scientist and zoo biologist!

As mentioned earlier, 7 species of the Common langur, ***Semnopithecus entellus*** have been identified by Groves.These are, illustrated in Table 1. (Groves is used as the yardstick in this paper because it is the most recently published taxonomy.) In the 2000 and 2002 unpublished papers by Brandon-Jones ***et al.,*** Groves' species are designated as subspecies. Whatever the differences between recent publications and papers, the names and taxonomic status of several primates definitely has changed. Whether they are species or subspecies does not change the fact that they are distinct populations, and ignoring that is not now a viable option for any scientist or scientific institution. The Convention on Biodiversity gives importance to subspecies and species, and ***ex situ*** solutions may be the last solutions for some.

In terms of prioritizing the ***Semnopithecus*** for captive breeding also, it makes no difference whether they are species or subspecies, but it very effectively demonstrates the increasing complexity involved in conservation planning. What does the zoo community do in such instances? Scientific evidence cannot be ignored, yet the implications of dealing with the changes are formidable.

Table 1: Taxonomic and Nomenclature Changes in Indian Primates

CZA Database	Scientific Name after Groves, 2001
Macaca fascicularis umbrosa	***Macaca fascicularis umbrosa***
Trachypithecus geei	***Trachpithecus geei***
Hylobates hoolock	***Hylobates (?Bunoithecus) hoolock hoolock*** (Harlan, 1834) Nominate subspecies in India
Macaca silenus	***Maaca silenus***
Trachypithecus phayrei	***Trachypithecus phayrei phayrei*** Nominate subspecies in India
Trachypithecus johnii	***Trachypithecus johnii***
Loris tardigradus	New name for Indian population ***Loris lydekkerianus*** with two subspecies: ***Loris lydekkerianus lydekkerianus*** (Cabrera, 1908) ***Loris lydekkerianus malabaricus*** (Wroughton, 1917)
Macaca speciosa	Name change: ***Macaca arctoides***
Macaca assamensis	Two subspecies added: ***Macaca assamensis assamensis*** (McClelland, 1839) ***Macaca assamensis pelops*** (Hodgson, 1840)
Nycticebus coucang	***Nycticebus bengalensis*** (Lacépède, 1800)
Trachypithecus pileatus	Four subspecies added: ***Trachypithecus pileatus pileatus*** (Blyth, 1943) Capped langur ***Trachypithecus pileatus brahma*** (Wroughton, 1916) Capped Langur ***Trachypithecus pileatus durga*** (Wroughton, 1916) Capped Langur ***Trachypithecus pileatus tenebricus*** (Hinton, 1923) Capped Langur
Macaca Mulatta	***Macaca mulatta***
Macaca radiata	***Macaa radiata radiata*** (E. Geoffroy, 1812) ***Macaca radiata diluta*** (Pocock, 1931)
Semnopithecus entellus	Seven species instead of one: ***Semnopithecus entellus entellus*** (Dufresne, 1797) ***Semnopithecus entellus Subspecies*** ***Semnopithecus ajax*** (Pocock, 1928) ***Semnopithecus dussumieri*** (I. Geoffroy, 1843) ***Semnopithecus hector*** (Pocock, 1928) ***Semnopithecus hypoleucos*** (Blyth, 1841) ***Semnopithecus priam*** (Blyth, 1844r) ***Semnopithecus schistaceus*** (Hodgson, 1840)
Macaca nemestrina	***Macaca leonina*** (Blyth, 1863)
(not listed by CZA)	***Macaca thibetana*** (Milne-Edwards, 1870)

Groves, Colin (2001) ***Primate Taxonomy,*** Smithsonian Institution, 348 pp.

The IUCN SSC Red List Committee used the unpublished 2000 paper in the 2000 Red List of Threatened Animals. In terms of assessment also, it doesn't make a difference whether these are species or subspecies—they are different populations and it is the genetic diversity in different populations that wants conserving. The population status as derived according to IUCN Red List Criteria is interesting.

These ***Semnopithecus entellus*** populations, if you will, were categorized as either Lower risk-near threatened or Data Deficient (IUCN Red List, 2000). According to the IUCN Policy

Statement on Captive Breeding, the time to start a captive breeding programme is before the wild population reaches very low numbers. Already, 4 of these were assessed as Lower risk-near threatened which means that they are 'close to qualifying for Vulnerable', a threatened category. Therefore, according to the IUCN Red List, 2000, the time to think of captive or conservation breeding is at hand.

However, in the 2002 CAMP Workshop with over 40 currently working South Asian primate field biologists all contributing very specific information, most of these populations were upgraded to threatened categories. The output of this workshop has yet to appear in its final form but there is scant reason to suspect that there will be many significant changes in the categories just derived. Therefore, the time to think of conservation breeding for most of these species actually is much overdue!

If the zoo community ignores new species or subspecies, it runs the risk of losing scientific credibility, a commodity that it has yet even to earn in the eyes of many critics. In years to come, ignoring these changes could result actually in the failure of reintroductions and the loss of an endemic species or subspecies for the country. For example, subspecies evolve as a result of conditions of the area in which they live. Some subspecies within a species come from very different habitat conditions which would affect their survival. For example, the Slender loris, in India formerly designated as ***Loris tardigradus***, is now ***Loris lydekkerianus lydekkerianus*** which is distributed in lowland dry forests, and ***Loris lydekkerianus malabaricus*** which inhabits the Western Ghats wet forests. Trying to reintroduce either of these into the other's habitat not only poses risks of polluting the gene pool but also poses a risk for their well-being and survival. It is as inappropriate as releazing the hard ground barasingha ***(Cervus duvaucelli duvaucelli)*** into the swamps of the wet ground barasingha ***(Cervus duvaucelli branderi).***

The alternative that is now attempting to identify zoo holdings precisely by the revised taxonomy and start captive programmes for all taxa which require it, will create an overwhelming set of new initiatives, and requirements for additional expertize, housing, staff, and equipment, and daunting expenses. This is a particularly bitter pill to swallow in the light of the ever present possibility of a return to some of the earlier systems over the passage of years and further advancement of taxonomic knowledge!

In this paper, the Central Zoo Authority inventory of primates has been contrasted with recent changes in nomenclature and taxonomy with an eye to point out the pitfalls of ignoring the issues created by these changes. Providing solutions to such problems is the mandate of the Central Zoo Authority and the sooner zoo policy-makers and strategists put their minds to these concerns, the better. Indian zoos are just now beginning to sex their animals and keep accurate, viable records, so the sorting out of subspecies and hybrids and the creation of a policy and strategy for addressing these issues will be vexing indeed.

Basic Management vis-à-vis New Initiatives

Thinking that the creation of new initiatives to deal with the complexities of the revised taxonomy is only part of the problem. In fact, one of the first things that will be required is simply to insure that basic management principles are followed more efficiently.

For example, there has been a long-standing

need to curtail breeding of common species in zoos, considered so important that it has been included both in the National Zoo Policy as well as zoo legislation in India. Now, given the recent taxonomic revisions, the need to curtail breeding of certain species is even more crucial because there is a danger of hybridization. The space and resource requirement for breeding programmes as opposed to just exhibition are much more when breeding multiple species. There will be scant space or resource to spend simply housing carelessly bred or acquired animals. Fortunately, large numbers are not required for maintenance of genetic diversity or conservation in ***ex situ*** populations if they are scientifically managed. Basic management and Indian zoo legislation and policy also requires that zoos refrain from overbreeding, inbreeding, and cross-breeding wild animals (CZA, 1998). More recent legislation requires that zoos manage their breeding programmes according to scientific standards (Anon., 2001).

Another basic zoo management task is keeping accurate and detailed records of the origin of individual animals, also reinforced by both policy and legislation in India. The increased knowledge of species as related to distinct habitat areas or even niches and its application in the taxonomic revisions has reinforced the existing requirement for the origin of each individual. It is not enough to know that the animal came from a particular zoo, or even a particular state. Now, in each and every instance, it is necessary to know a more specific locality at a fine scale as well as the habitat in this locality. Upgrading current records will be a mammoth and in some instances almost an impossible task. At the very least, however, this information could be obtained relatively easily for recently acquired animals if the zoos are appropriately informed and take care keep themselves informed.

Marking or permanent identification of individual animals, a requirement of good zoos for at least 3 decades now, but still not done in all the better Indian zoos, is now, even more essential to maintain the identity and the provenance of each animal, as well as its sex and age.

Other examples can be illustrated species by species. In the examples below, figures for zoo populations will be given seperately for 'Large, Medium, and Small' zoos (LMS zoos) and for 'Mini-Zoos and Deer Parks (MZDPs). This is a device for ranking zoos adopted by the Central Zoo Authority (Anon., 1992). Data for the LMS zoos is current, from the CZA database 2002. Data for the MZDPs is from the 1999 database as data for MZDPs is not updated with the same regularity as for the better zoos. In view of some of the taxonomic revisions, this practice may require a re-visit by the CZA. Some threatened or near- threatened species, once thought to be common may be languishing in MZDPs. They should be moved to LMS zoos and carefully monitored.

Common langur

The Common langur, ***Semnopithecus entellus***, can no longer be called as such appropriately. There are at least 7 species where formerly there was one. Common langurs can be found in 25 LMS zoos and in 13 MZDP, totally 38 facilities throughout India. The Common langur that we are accustomed to is already in plenty with a zoo population of 59.37.5.102 in LMS zoos and 21.14.12.47 in MZDPs, a total of 149 individuals. However, it is safe to assume that some of these 149 individuals belong to more than one of the now 7 species,

as they originate from and are maintained throughout the length and breadth of India. Therefore, instead of zoos holding 149 individuals of the same species that are abundant in nature, they are very likely holding a number of individuals of different threatened species and subspecies. In the recent CAMP Workshop all but one of these different populations of the Common langur were assessed as threatened.

Moreover, identification of these recently designated species depends for the time being on knowledge of their origin, another basic management requirement. In future it may be possible to identify some of them on the basis of their pelage (a rough key is being created by Dr Douglas Brandon-Jones specifically for this purpose) or by DNA fingerprinting under the CZA project with the Centre for Cellular and Molecular Biology (CCMB). However, establishing the provenance even of high profile animals such as tigers and lions has been a nightmare in the Indian zoo community, so collection of reliable information about the origin of every Common langur will demand a quantum leap in commitment to conservation from the zoo community.

Moreover, as exchanges and movement of the Common langur has taken place between zoos in different parts of the country, widespread hybridization is possible. We asked Dr Colin Groves what Indian zoos should do to address the changes under such circumstances and his recommendations were:

- Find out which really are hybrids; trace their actual origin, where they were caught in the wild, and their genealogies as far as possible.
- Try to keep the different breeding groups separate until it has been determined which are conspecific (and, if possible, which are consubspecific).
- The hybrids can be retained for display but should not be mixed with the 'pure' gene-pools. (Hybrids have uses even for research, e.g., inheritance of species-specific differences, not least in behaviour).
- When background information (including status in the wild) has been collected, known hybrids can be sterilized (Groves, in litt.).

Rhesus macaque

The Rhesus macaque ***(Macaca mulatta)*** is one of the most numerous of primate species in Indian zoos; it is held in 44 LMS zoos (196.201.75.472) and 31 MZDPs (24.23.54.101) with a total number of 573 individuals (CZA in litt.). The Rhesus macaque is considered a pest in some areas due to its large numbers in the wild, its adaptation to and invasion of towns and cities, and its aggressive nature. Groves (2001) recognizes 3 subspecies of the Rhesus macaque: ***Macaca mulatta mulatta*** which is found in India, Nepal, Bhutan and Burma; ***Macaca mulatta villosa*** which is found in India in Southern Kashmir, Northern Punjab and Kumaon; and ***Macaca mulatta vestita*** distributed in India in Khafristan and Chitral. The relative value of subspecies varies from scientist to scientist but the Convention on Biodiversity includes both species and subspecies in its mandate. If every species and subspecies is intrinsically and potentially valuable, it is not wise for zoos to ignore subspecies. In the case of the Rhesus macaque, a captive breeding programme may not be necessary, even under the revised taxonomy, but a programme of not breeding these taxa is most certainly advisable until the identification of subspecies and indeed,

their validity, can be undertaken. Not breeding Rhesus macaques in zoos was a good idea even before the taxonomic revision; now it is an exceptionally good idea!

Bonnet macaque

The Bonnet macaque, formerly ***Macaca radiata***, is now ***Macaca radiata radiata*** found only in India, south to Palni Hills, southeast as far as Tenmali, inland of Pondicherry, and ***Macaca radiata diluta*** distributed only in India in southeastern coast to the southern tip, north of Kambarn (soutwestern foot of Palni Hills) and east of Pondicherry (Groves, 2001). The Bonnet macaque can compete with the Rhesus macaque in numbers with 244.200.163.607 in 35 LMS Zoos and 27.18.41.86 in 31 MZDPs, with a total of 46 zoos and 693 individual animals. What was said of the Rhesus macaque (above) regarding captive breeding, is equally true of the Bonnet macaque. Neither figured under the threatened category when assessed in the recent workshop but ***Macaca radiata diluta*** was assessed as Near threatened.

Slender loris

What was called ***Loris tardigradus*** in India is now called ***Loris lydekkerianus.*** It is found in both India and Sri Lanka. In India there are 2 subspecies distributed in two different habitat types, as mentioned earlier. Only three LMS zoos hold this species with 4.0.1.5 individuals. The fact that there are so few Slender loris in so few zoos today when a virtual multitude of them have been passed to zoos from animal dealers, confiscations, etc. over the years (Walker, pers. observation) is indicative of the fragility of this animal and its need for appropriate climate and surroundings. At least, if the origin of current holdings can be traced and correctly identified, then future acquisitions from rescues or confiscations will not be difficult to trace and place.

Capped langur

The Capped langur is listed as ***Presbytis pileatus*** in the CZA database but is now named as ***Trachypithecus pileatus.*** There are currently 4 subspecies of ***Trachypithecus pileatus, Trachypithecus pileatus pileatus, Trachypithecus pileatus brahma, Trachypithecus pileatus durga*** which are distributed within the northwestern limit of the Indo-Burmese hotspot (Groves, 1991).

All of the subspecies of ***Trachypithecus pileatus*** have been categorized as Endangered in the IUCN List 2000, due to population decline of more than 50% in the past and the continuing decline and small population number. In the 2002 CAMP, 3 were categorized as threatened and one as Data Deficient.

Currently 14 LMS zoos hold 9.7.0.16 Capped langurs for which subspecies have not been identified as yet. These zoos span the length and breadth of India and even when classified as one species, care should be taken to insure that these animals are kept in zoos located in areas at least somewhat similar to their home range. It is interesting to note that of the 14 zoos, 12 hold single animals, 7 zoos hold single males, 5 zoos hold single females and only 2 zoos hold pairs (CZA 2002 in litt.). Before the issue of revised taxonomy came along, one might have bemoaned this sad state of affairs as it is normally a disgrace for a zoo to hold single animals. Now, however, it is a blessing until the Indian zoo community identifies these subspecies. For the welfare of the animals, at least, one would hope that zoos could put more of them together even

in adjoining cages, simply for the sake of satisfying the behavioural needs of highly social primates.

Assamese macaque

Macaca assamensis is now 2 subspecies instead of 1 species. ***Macaca assamensis assamensis*** is found in India, north along Dihang or middle Brahmaputra and ***Macaca assamensis pelops*** is found in Central Nepal and Sikkim in India, northernmost West Bengal and the Sunderbans. It is numerous in zoos although not as much as the 2 above-mentioned macaques. There are 52.37.10.99 in 12 LMS zoos and 5.3.4.12 in 5 MZDPs, a total of 111 animals (CZA 2002 in litt.). Both ***Macaca assamensis*** have been categorized Vulnerable in the IUCN Red List 2000, and as Endangered in the 2002 CAMP workshop therefore, sorting out its fate with regard to the different subspecies should be a higher priority than for the other macaques with very numerous species in zoos.

The taxonomy of other species of primates in Indian zoos, e.g. Slow loris, ***Nycticebus bengalensis***, Hoolock Gibbon, ***Hylobates (?Bunopithecus) hoolock hoolock***; Golden langur, ***Trachypithecus geei,*** Nilgiri langur, ***Trachypithecus johnii***, Crab-eating macaque ***Macaca fascicularis umbrosa***, Pig-tailed macaque, ***Macaca leonine;*** Stump-tailed macaque***, Macaca arctoides; and*** Phayre's leaf monkey, ***Trachypithecus phayrei phayrei***, has not been affected by the recent revisions and, thus, have not been discussed.

Conclusion

The Central Zoo Authority has made a mammoth effort to bring science and system into the zoo community, which has cost a great deal of money. For so many reasons, the Indian zoo community still falls very short of the quality required to be conservation relevant. Since the inception of the Central Zoo Authority, the government has under-estimated the size of the task and the degree of expertize required to achieve even a small success.

One of the reasons for this sluggish progress in Indian zoo-dom is the need to please so many different groups of people, the international zoo community with its advanced technology, the lakhs of visitors with their recreational requirements, the animal welfare community with their often fanatical obsession with individual animals at the expense of populations and conservation goals, the scientific and conservation community which can be simply formidable in their criticism and inability to understand the difficulties of running a public facility as required of a scientific institution, ***ad infinitum***. Many of those communities are not going to care a whit for the question of subspecies and others will demand nothing short of perfection.

In the end, it may not be possible for the zoo community, with its imminently public agenda, to achieve the level of detail required for genuine conservation at the levels required. In the past, however, other departments have tried to take on the task of breeding threatened species, and failed far more miserably than zoos. The Central Zoo Authority has taken the first steps towards transforming zoos into genuine conservation organizations, e.g. legislation, studbooks, and the creation of a Conservation Centre for biotechnology and related conservation sciences. The direction is correct but the scope and speed of change is far too slow to meet the needs of species and subspecies in the next few decades. Taxonomic revisions are not likely to become simpler. More people are taking up wildlife studies

seriously and the more they study species in their habitats, the more they report how subtle and delicate are species, subspecies and ecosystems. Indian zoos, in fact, could have played a very useful role in solving taxonomic issues in the recent CAMP workshop had their records been well maintained. The Indian zoo community can strive to be ready to play this role in the South Asian Primate CAMP Review which will take place in about 5 years.

Those who believe in the basic tenets of biodiversity, that every species and subspecies is actually and potentially valuable, must assist the zoo and wildlife community in making a case for sufficient establishment for a meeting these crucial needs.

References

Anon., (1991). 'Indian wildlife amendments: the Zoo Act,' ***Gazette of India***, October, 1991.

Anon., (1997) 'The Indian Wildlife Protection Act 1972–1991, amended up to 1991.' Nataraj Publishers, Dehra Dun.

Anon., (1999). Central Zoo Authority Database for Mammals for 1999.

Anon., (2001). 'Amendments to the Zoo Act,' ***Gazette of India***, July 2001.

Anon., (2001). 'Inventory of Animals in Indian Zoos 2000–2001.' Central Zoo Authority, New Delhi, 314 pp.

CZA (MOEF/GOI) (1992). 'Recognition of Zoo Rules.' Central Zoo Authority, New Delhi, 20 pp.

CZA (MOEF/GOI) (1998). 'Zoos—Instrument for Conservation: National Zoo Policy and Statutes and Guidelines related with Zoo Management.' Central Zoo Authority, New Delhi, 42 pp.

Hilton-Taylor, C. (2000. 2000 IUCN Red List of Threatened Species. SSC, IUCN, Cambridge, 72 pp. + CD.

IUDZG/CBSG (IUCN, SSC) (1993). 'The World Zoo Conservation Strategy: The Role of the Zoos and Aquaria of the World in Global Conservation.' Chicago Zoological Society. Brookfield. 76 pp.

IUCN SSC Captive Breeding Specialist Group (1987) IUCN Policy Statement on Captive Breeding. Gland, 4 pp.

Molur, S., P.O. Nameer, and S. Walker (1998). 'Report of the Conservation Assessment and Management Plan Workshop on Indian Mammals (BCPP Endangered Species Prioritisatio'). ZOO/CBSG, India, Coimbatore.

Walker, S. (2000). 'From Menageries to Conservation Centres—Indian Zoos after Independence,' pp. 126–197. In: Acharjyo, L.N. & B.S. Prusty, Eds., ***Indian Zoo Yearbook, vol. III, 2000.*** Indian Zoo Directors' Association & Central Zoo Authority, 209 pp.

Walker, S. & S. Molur. (1999). 'Endemic Mammals in Indian Zoos,' Central Zoo Authority Database and ZOO/CBSG, India BCPP CAMP Workshop Report, pp. 4–18. In Zoos' Print, 14.7.7, 33 pp.

United National Environment Programme (UNEP) (1994). Convention on Biological Diversity. Interim Secretariat for the Convention on Biological Diversity, Switzerland, 34 pp.

Table 2. Degree of Endemicity
Indian Primates with Political Distribution and Assigned Value

Scientific	# Value	Political Distribution
Macaca silenus Lion-tailed macaque	1	W. Ghats, Kerala, Karnataka, Tamil Nadu
Trachypithecus johnii Nilgiri langur	1	W. Ghats—Kerala, Tamil Nadu, Karnataka up to Coorg Hills
Macaca radiata Bonnet macaque	1	Peninsular India up to 21˚N
Endemic to South Asia		
Hylobates hoolock Hoolock gibbon	2	India (Assam, Arunachal Pradesh, Meghalaya, Tripura, Mizoram, Northeast India). Myanmar and Bangladesh
Trachypithecus geei Golden langur	2	India (Assam and Bhutan
Semnopithecus entellus Common langur	2	India (Throughout India except western part of Gujarat), Pakistan, Sri Lanka, Nepal
Loris tardigradus Slender loris	2	India and Sri Lanka
Trachypithecus pileatus Capped langur	2	India (Assam, Meghalaya, Nagaland, Arunachal Pradesh), Bangladesh, and Myanmar
Endemic to Asia		
Macaca fascicularis umbrosa Crab-eating macaque	3	India (Andaman & Nicobar Islands), Myanmar, Sumatra, Java, Borneo, Philippines, Vietnam to Malaysia
Macaca nemestrina Pig-tailed macaque	3	India (Meghalaya, Nagaland, Tripura); Southeast Asia up to Bornea
Trachypithecus phayrei Phayre's langur	3	India (Northeast) Bangladesh, Myanmar, Southeast Asia, China
Macaca mulatta Rhesus macaque	3	India (Whole of northern India [North of Godavari] up to Assam), Myanmar, Indochina
Macaca arctoides Stump-tailed macaque	3	India (Nagaland, Arunachal Pradesh, Meghalaya, parts of Assam, Tripura) China, Tibet, Myanmar, Thailand
Macaca assamensis Assamese macaque	3	Northeastern India (Himalaya from Mussori eastward to hills of Assam and forests of Arunachal Pradesh), Myanmar, Banglandesh, Southeast Asia
Nycticebus coucang Slow loris	3	India (Northeastern India), Myanmar, Bangladesh, Southeast Asia

Table 3. Threat Status assessed at National Level Indian Primates and Assigned Value

Name	Status	Value	Status Description
Macaca fascicularis umbrosa	CR/N	1	A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future, as defined by any of the criteria (A to E).
Trachypithecus geei	CR/N	2	
Hylobates hoolock	EN/N	2	A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future, as defined by any of the critiera (A to E) in the subsequent pages.
Macaca silenus	EN	2	
Trachypithecus phayrei	EN/N	2	
Trachypithecus johnii	VU	3	A taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future, as defined by any of the criteria (A to E).
Loris tradigradus	LRnt/N	4	Lower Risk Near Threatened: Taxa which do not qualify for any of the threat categories but are close to being threatened.
Macaca arctoides	LRnt/N	4	
Macaca assamensis	LRnt/N	4	
Nycticebus coucang	LRnt/N	4	
Trachypithecus pileatus	LRnt/N	4	
Macaca mulatta	LRIc/N	5	Lower Risk Least Concern: Taxa which do not qualify for near threatened.
Macaca radiata	LRIc	5	
Semnopithecus entellus	LRIc/N	5	
Macaca nemestrina	DD/N	3	Data Deficient: Taxa for which there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on distribution and/or population status. It may be well studied, and its biology well known, but appropriate data on abundance and/or distribution is lacking. Not a category of threat or Lower risk.

Name	Threat Status	+	Endemicity	
Macaca fascicularis umbrosa	CR (N) (1)	+	Asia (3)	4
Trachypithecus geei	CR (N) (1)	+	South Asia (2)	3
Hylobates hoolock	EN (N) (2)	+	South Asia (2)	4
Macaca silenus	EN (2)	+	India (1)	3
Trachypithecus phayrei	EN (N) (2)	+	Asia (3)	5
Trachypithecus johnii	VU (3)	+	India (1)	4
Loris tardigradus	LRnt (N) (4)	+	South Asia (2)	6
Macaca arctoides	LRnt (N) (4)	+	Asia (3)	7
Macaca assamensis	LRnt (N) (4)	+	Asia (3)	7
Nycticebus coucang	LRnt (N) (4)	+	Asia (3)	7
Trachypithecus pileatus	LRnt (N) (4)	+	South Asia (2)	6
Macaca mulatta	LRIc (N) (5)	+	Asia (3)	8
Macaca radiata	LRIc (5)	+	India (1)	6
Semnopithecus entellus	LRIc (N) (5)	+	South Asia (2)	7
Macaca nemestrina	DD (N) (3)	+	Asia (3)	6

Table 4. Illustrating Inverse Relationship between Number of Animals in Captivity & Requirement for Captive Breeding according to Endemicity and Degree of Threat

Species	Number of Animals of Each Species in Indian Zoos M F U	Total	Number of Zoos Holding	Priority Ranking for Captive pgm
Macaca mulatta	204.176.83	463	76	
Macaca radiata	152.94.186	432	44	
Semnopithecus entellus	78.56.19	153	36	
Macaca silenus	34.34.06	74	22	
Macaca assamensis	44.24.06	74	17	
Macaca arctoides	23.18.00	41	14	
Trachypithecus pileatus	12.04.00	26	15	
Nycticebus coucang	12.10.03	25	10	
Trachypithecus johnii	03.09.04	25	9	
Macaca nemestrina	08.08.00	18	9	
Macaca fascicularis umbrosa	10.07.00	17	1	
Trachypithecus geei	09.08.00	17	10	
Loris tardigradus	01.05.03	09	3	
Hylobates hoolock	05.04.09	09	9	
Trachypithecus phayrei	02.02.00	04	1	

Table 5. Taxonomic and Nomenclature Changes in Indian Primates

Name: CAZ Database	**Changes in Taxonomy and Nomenclature according to Groves, Colin (2001)** ***Primates Taxonomy*****, Smithsonian Institution, 348 pp.**
Macaca fascicularis umbrosa	No changes
Trachypithecus geei	No changes
Hylobates hoolock	Name change: ***Hylobates (?Bunopithecus) hoolock hoolock*** (Harlan, 1834)
Macaca silenus	No change
Trachypithecus phayrei	Name change: ***Trachypithecus phayrei phayrei***
Trachypithecus johnii	No change
Loris tardigradus	Taxonomic changes—subspecies added: ***Loris lydekkerianus lydekkerianus*** (Cabrere, 1908) Mysore Slender Loris ***Loris lydekkerianus malabaricus*** (Wroughton, 1917), Malabar Slender Loris
Macaca arctoides	Name change: ***Macaca speciosa*** ***Macaca arctoides*** now refers to Burmese subspecies
Macaca assamensis	Taxonomic changes—subspecies added: ***Macaca arctoides*** (I. Geoffroy, 1831) Stump-tailed/Bear Macaque India: Northeastern—South of Brahmaputra; Burma: Northern ***Macaca assamensis assamensis*** (McClelland, 1839) Assam Macaque p. 234. India: North along Dihang (= middle Brahmaputra) ***Macaca assamensis pelops*** (Hodgson, 1840) Assam Macaque p. 234. India: Sikkim, northernmost West Bengal, Sundarbans; Nepal: Central; Bhutan: Central
Nycticebus coucang	Name change: ***Nycticebus bengalensis*** (Lacépède, 1800) Bengal Slow Loris
Trachypithecus pileatus	Taxonomic changes—subspecies added: ***Trachypithecus pileatus pileatus*** (Blyth, 1843) Capped Langur ***Trachypithecus pileatus brahma*** (Wroughton, 1916) Capped Langur ***Trachypithecus pileatus durga*** (Wroughton, 1916) Capped Langur ***Trachypithecus pileatus tenebricus*** (Hinton, 1923) Capped Langur
Macaca mulatta	No change
Macaca radiata	Taxonomic changes—subspecies: ***Macaca radiata radiata*** (E. Geoffroy, 1812) Bonnet Macaque ***Macaca radiata diluta*** (Pocock, 1931) Bonnet Macaque
Semnopithecus entellus	Taxonomic changes: ***Semnopithecus entellus*** (Common Hanuman langur) is now seven species instead of one: ***Semnopithecus entellus entellus*** (Dufresne, 1797) Northern Plains Gray Langur ***Semnopithecus entellus*** Subspecies ***Semnopithecus ajax*** (Pocock, 1928) Kashmir Gray Langur ***Semnopithecus dussumieri*** (I. Geoffroy, 1843) Southern Plains Gray Langur ***Semnopithecus hector*** (Pocock, 1928) Tarai Gray Langur ***Semnopithecus hypoleucos*** (Blyth, 1841) Black-footed Gray Langur ***Semnopithecus priam*** (Blyth, 1844) Tufted Gray Langur ***Semnopithecus schistaceus*** (Hodgson, 1840) Nepal Gray Langur
Macaca nemestrina	Name change: now named ***Macaca leonina*** (Blyth, 1863)