

ECOLOGY AND BEHAVIOR OF TROPICAL PRIMATES

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Summary

The Primate Order includes lemurs, lorises, tarsiers, New World monkeys, Old World monkeys, apes, and humans. Non-human primates are an almost exclusively tropical radiation, and there are currently over 200 species of primates living in the tropics of Asia, Africa and the Americas. Adult primates can range in size from the mouse lemur, which fits in a human's hand, to the 170-kg male gorilla. Primate diet is affected by body size, and different primate species have developed a variety of strategies to ensure that they ingest sufficient calories and nutrients. For this reason, primates can be **folivorous**, **frugivorous**, **insectivorous**, faunivorous, **gramnivorous** or omnivorous. Social organization is also diverse among primates; **prosimians** are often solitary, while monkeys may live in large multi-male, multi-female social groups with over 100 associated individuals. When compared to other mammals of similar body size, primates are characterized by unusually slow rates of growth and reproduction, long interbirth intervals, reduced litter sizes (usually only one infant per birth), slow development, and extended life spans. It is likely that these features are related to the cost of growing and maintaining their relatively large brains. Large brain size, in turn, may be a combined result of adaptations towards greater visual acuity, spectacular acrobatic agility, increased fine-motor manual dexterity, increased social learning and behavioral flexibility, and increased memory storage. Primates' close genetic relationship to humans, as well as their complex behavioral repertoire, makes them of particular interest to humans. Unfortunately, due to increasing rates of deforestation in tropical areas, as well as increased hunting and logging pressures, many species of primates are now highly endangered. One important area of primate research is to understand how and under what circumstances primates are able to adapt behaviorally to survive in new and degraded habitats.

1. Introduction

Here we focus on the behavioral ecology of the Neotropical radiation of primates, the Platyrrhini. This group includes the small, squirrel-like marmosets and tamarins; the only nocturnal anthropoids, the owl monkeys; the tool-using capuchin monkeys; and the larger bodied, prehensile-tailed spider monkeys, howler monkeys, and muriquis. The Neotropical primates can all be grouped as **arboreal** tropical species; however, they are surprisingly diverse in terms of foraging ecology and social behavior.

1.1. Primate Phylogenetics and Distribution in Tropical Areas

Primates can be considered tropical specialists. Their present and past distribution has been primarily within the tropics, although some generalist primates, such as macaques and humans, have been able to successfully invade more temperate zones. There are six major extant radiations of primates: the lemurs, the lorises, the tarsiers, the New World or neotropical primates, the Old World monkeys, and the apes (including humans).

Lemurs are presently confined to Madagascar, and are the only native non-human primates on this island. In the absence of competition with other primates, lemurs have invaded **diurnal** and **nocturnal** niches, and have solitary to extremely social lifestyles. If recent fossil lemurs are taken into consideration, lemurs span from the smallest to

largest sized primates. The lorises are distributed across tropical Africa and Asia, with galagos in Africa and slow and slender lorises in Asia. All lorises are small-bodied, arboreal and nocturnal. Tarsiers are the sister group to Anthropoids (the monkeys and apes); there is only one **extant** genus of Tarsiers (*Tarsius*), distributed in tropical South East Asia.

All monkeys and apes share a common African ancestor at about 35 mya. Our current understanding of neotropical primates is that some small founder population rafted over to South America from Africa, and that all present day diversity in neotropical primates has evolved from this single founding group. The apes were widespread in Africa, Europe and Asia during the Miocene, but their populations and diversity dwindled as the Earth's climate became drier and habitats opened into grasslands and savannahs. In contrast, Old World monkeys flourished in these drier habitats, and we still see widespread populations of guenons, baboons and macaques throughout the African and Asian tropics today.

Primates have evolved surprising diversity in diet, locomotion, social organization, and daily activity patterns. For this reason, there can be many primate species in sympatry with one another. For example, in some Brazilian rainforests, there are 13 different monkey species living together in one habitat.

1.2. Conservation Status of Primates

1.2.1. Endangered Species and Factors with Influence in their Conservation

Recent evaluations have suggested that approximately 48% of the 634 primate species and subspecies are threatened with the risk of extinction; most of these are located in tropical regions. Deforestation, commercial bushmeat hunting, and the illegal animal trade are considered the primary threats to primate conservation. A failure to respond to these threats may provoke the first primate extinctions in over a century. In fact, a subspecies of red colobus monkey, Miss Waldron's colobus (*Procolobus badius waldroni*), was pronounced extinct in the last decade, and has not been observed in the wild since 1993 despite several intensive surveys of its known range.

Several intrinsic and external factors strongly influence primate conservation. Intrinsic aspects affecting primate conservation include primates' low reproductive potential, because most primates produce only one offspring per litter with long interbirth intervals. This low reproductive rate can mean that stochastic or rare events have large impacts on population size and viability. Primates live at low population densities, so to save a large population it is often necessary to have a large area of preserved habitat. Most primate species are restricted to the tropics, and particularly the tropics of the southern hemisphere. Primates living in poor, developing nations may be affected by economics and human population growth, with increasing extraction of resources from the forest as well as modification or destruction of primates' natural habitat.

External factors affecting primate conservation include: hunting for food (spider monkeys in Central and South America), hunting for trophies or ornaments (apes, colobus monkeys), and hunting of pest species (macaques, baboons, capuchin

monkeys). Primates are also 'harvested' through live capture, especially for biomedical research. Primates are considered to be good models for medical research because of their close genetic relationship to humans. Primates are also brought into captivity for the pet trade. In the Neotropics, for example, capuchin monkeys are popular pets, as are spider, howler and squirrel monkeys.

The other most important threat to primate conservation is habitat destruction. Habitat destruction has high potential impact not just on primates but on local biodiversity as a whole. Habitat destruction can occur through differential wood extraction or complete deforestation.

Small-scale logging usually involves cutting trees by hand, with timber often used for the construction of houses or for firewood by local people. Most of the world's population still uses wood for heat and cooking, and as a population grows, there is increasing need for wood. With population growth, increasing amounts of forest are also cleared for agriculture. For slash-and-burn agriculture, individuals will clear an entire area of forest, burn it off, and plant crops that yield only one to two years of good harvest. Unfortunately, the soil then becomes depleted, crops fail, and the farmers will move on to slash-and-burn new areas.

Large-scale logging and deforestation is usually commercial, and results in the clearing of entire forests. Many forests are cut to make paper in paper mills. In Asia, for instance, deforestation is driven by the demand to supply paper mills, and oil refineries are located where rainforests once occurred. In Central and South America cattle ranching is one of the major causes for deforestation. While small-scale logging occurs at a local scale because local people need firewood or food, multinational corporations are often involved in the higher-impact, large-scale logging and deforestation.

1.2.2. Primate Status around the Tropical World

The “World's 25 Most Endangered Primates, 2006-2008” list, compiled in 2006 at the 21th Congress of the International Primatological Society in Entebbe, Uganda includes as critically endangered 11 species from Asia, seven from Africa, four from Madagascar, and three from South America, showing that threats to primates exist wherever they live. All 25 primates on the 2006-2008 lists are found in the world's biodiversity hotspots. These include 34 regions identified by Conservation International that cover just 2.3% of the Earth's land surface but harbor well over 75% of all threatened terrestrial plant and animal life. Eight of the hotspots are considered the highest priorities for the survival of the most endangered primates: Indo-Burma, Madagascar and the Indian Ocean Islands, Sundaland, Eastern Afromontane, Coastal Forests of Eastern Africa, Guinean Forests of West Africa, the Atlantic Forest of Brazil, and Western Ghats-Sri Lanka.

Comparing by region,, Asia has the highest number of taxa(species and subspecies) currently categorized by the IUCN as threatened, followed in descending order by the Neotropics, Africa and Madagascar (Table 1).

Region	Primate genera by region (and	Primate species and subspecies by
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	number of genera that include threatened taxa)	region (and number of taxa threatened)
Asia	16 (16 gen = 100 % threatened)	169 (120 taxa = 71 % threatened)
Neotropics	19 (18 gen = 94.7 % threatened)	199 (79 taxa = 40 % threatened)
Africa	23 (14 gen = 60.8 % threatened)	170 (63 taxa = 37 % threatened)
Madagascar	15 (10 gen = 66.6% threatened)	96 (41 taxa = 43 % threatened)

(**) Rylands (2008). *Pers Comm.*

Table 1. Threatened primate species by region.

In Asia critically endangered primates include the Tonkin snub-nosed monkey (*Rhinopithecus avunculus*) of Vietnam, the Sumatran orangutan (*Pongo abelii*), and several species of gibbons (for example, *Nomascus hainanus* of China and *Hoolock hoolock* in Bangladesh, India and Myanmar). One critically endangered Neotropical primate is the Northern muriqui (*Brachyteles hypoxanthus*) from the Atlantic rainforest of eastern Brazil, where only about 1-5% of the original rainforest still exists. Close relatives to muriquis, but found on the opposite side of South America, the brown-headed spider monkey (*Ateles fusciceps*) from Ecuador and Colombia, and the Peruvian yellow-tailed woolly monkey (*Oreonax flavicauda*) are also critically endangered. In Africa, one of the most well known critically endangered species is the mountain gorilla (*Gorilla beringei beringei*) from Congo, Rwanda and Uganda, but the Cross River gorilla (*Gorilla gorilla diehli*) from the Cameroon-Nigeria border is also critically endangered, with only 200-300 individuals remaining. The kipunji (*Rungwecebus kipunji*) is a new genus of mangabey-like monkeys, discovered in 2003 and limited to two small regions in Tanzania. Madagascar is very important despite its small size because its species do not occur anywhere else in the world. In fact, approximately 14 lemur species have already gone extinct after human colonization of the island.

Why should humans conserve primates? The question is of particular interest because of the similarity of primates to humans. As "Flagship Species" and our closest living relatives, nonhuman primates are important to the health of their surrounding ecosystems. Through seed dispersal and other interactions with their environments, primates help support a wide range of plant and animal life that make up the Earth's forests.

As large bodied, mobile, fruit eaters, many species of primates are important seed dispersers, and thus contribute to a vital part of the maintenance of diverse tropical forests. However, not all primate species are key seed dispersers and seeds may be broken down during mastication or digestion. Some species are also useful indicators of diversity and can play the role of "key species". Most primates live in tropical forest, so primates and tropical forest are inextricably linked. Nonhuman primates are special because they are genetically and behaviorally similar to humans. We might desire to preserve them simply because they are our nearest genetic relatives, or because of their value in biomedical research.

Whatever the ethical reasons behind conservation, the practical aspects involve long-term support and some difficult decisions. We have evidence that success of conservation efforts to protect rainforests is contingent upon strong public support,

effective law enforcement, low human population densities and substantial support from international donors. This means that, despite the ecological importance of primates, their role as indicators and flagships for conservation, and the ethical reasons for focusing on primate conservation, there will be conflicts between the needs of local people and conservation interests. Long-term commitment, trust and reliable sources of funding are vital to sustain conservation efforts over time.

1.2.3. Primate Conservation Strategies

Currently, primate exploitation is limited by **CITES**, an international agreement that was introduced in the 1970s and signed by most countries to strictly limit international trade in endangered species. It has been effective in limiting both the pet trade and biomedical research. Since the introduction of CITES, wild capture has been significantly reduced. Rehabilitation and re-introduction centers have also been established, especially for apes like the orangutan and chimpanzee. Several zoological parks have established rehabilitation programs to release animals back in their natural habitat (particularly managed reserves), although in general about 50% of these re-introductions have failed. Habitat destruction remains the most difficult conservation problem. A crucial part of the solution is education, especially of young people but also of adults.

National parks and reserves are one way to officially designate protected areas for animals. However, even when reserves are created by the government the infrastructure may not function well enough to protect the animals. In many cases parks exist on paper but there is no money for hiring people to protect the areas, so it is common to see people living within reserve boundaries, and clearing land for crops. Some of the most encouraging success stories about national parks are those where strategies combined the needs of primates and people, for instance ecotourism in national parks has worked well in some areas for gorilla conservation.

The benefits of conservation are international but the costs are borne by the countries where the primates are found. Twenty-nine out of the 36 world's poorest countries are in Sub-Saharan Africa. Nine out of ten Africans live in poverty. It is imperative that developed countries make significant contributions if conservation efforts are to be successful.

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Biographical Sketches

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