

New World Monkeys

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New World monkeys are the living (nonhuman) primates of South and Central America.

Introduction

New World monkeys are distributed currently in wooded habitats from southern Mexico to northern Argentina and everywhere are threatened with extinction. Scientists recognize 16 different genera of living New World monkeys in the primate infraorder Platyrrhini, and more than two dozen extinct genera ranging back in time in South America to approximately 30 million years ago (**Figure 1**). New World monkeys have radiated into a wide variety of microhabitats and foraging niches in the neotropical forest ecosystem.

Basic Design

New World monkeys are anthropoid primates with very few anatomical characteristics that are derived within them from that basic starting point. The formal term for the group is Platyrrhini, which refers to the broad, flat shape of their external nose. They are distinct from other living monkeys in that they have three premolar teeth instead of two in each toothrow and their ear canal is not enclosed in a complete bony tube. These characteristics are thought to be primitive retentions in New World monkeys compared to the monkeys and apes of Africa and Asia.

New World monkeys range in body size from the 100 g pygmy marmoset to the 10 000 g of the largest species, the



Figure 1 A squirrel monkey, genus *Saimiri*, one of the 16 different genera of New World monkeys from the neotropics. Copyright by Noel Rowe, used by permission.

Introductory article

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woolly spider monkey. New World monkeys are the smallest anthropoid primates. They are almost exclusively arboreal and practise a wide variety of locomotor behaviours in order to move both horizontally and vertically within their forested milieu. The general anatomical features associated with arboreal quadrupedalism are accentuated in some radiations by adaptations for vertical clinging and leaping from support to support, and in other radiations by adaptations for suspension and brachiation beneath branches.

Within New World monkeys the marmosets and tamarins are characterized by reduced body size, loss of a molar on each side and the presence of derived claws on all digits except the big toe. The radiation of large-bodied New World monkeys, the atelines, is characterized by the ability to grasp branches with their tails. One genus, the owl monkey *Aotus*, is the only nocturnal anthropoid. These individual departures from a conservative anthropoid body plan reflect the various ways that New World monkeys have come to adapt to the habitats and food resources of the forests of Central and South America.

Diversity

Living New World monkeys are classified into 16 genera and approximately 75 species, although the latter figure probably overestimates their biodiversity. They can be grouped into four major subfamily radiations as indicated in **Table 1**. This subfamily classification is widely accepted with the exception of two genera, *Aotus* and *Callicebus*, for whom morphological and molecular signals of relatedness are not as clear.

Habitats and Abundance

New World monkeys live in arboreal habitats throughout the Amazonian ecosystem and the neotropics. They occupy a variety of niches by adapting to different food sources located at different vertical levels in the forest

Table 1 Genus level classification of living New World monkeys

Family	Subfamily	Genus	Common name	Number of species
Atelidae	Atelinae	<i>Ateles</i>	Spider monkey	4
		<i>Alouatta</i>	Howler monkey	6
		<i>Lagothrix</i>	Woolly monkey	2
		<i>Brachyteles</i>	Woolly spider monkey	1
	Pitheciinae	<i>Pithecia</i>	Saki	5
		<i>Chiropotes</i>	Bearded saki	2
		<i>Cacajao</i>	Uakari	2
		<i>Aotus</i>	Owl monkey	8
		<i>Callicebus</i>	Titi monkey	11
Cebidae	Cebinae	<i>Cebus</i>	Capuchin	4
		<i>Saimiri</i>	Squirrel monkey	2
	Callitrichinae	<i>Callithrix</i>	Marmoset	13
		<i>Saguinus</i>	Tamarin	12
		<i>Leontopithecus</i>	Lion tamarin	4
		<i>Callimico</i>	Goeldi's monkey	1
		<i>Cebuella</i>	Pygmy marmoset	1

canopy. In this way several species of monkeys may share the resources of a particular tropical forest without directly competing. For example, the atelines forage for leaves and fruits at the uppermost levels of the canopy, while the marmosets and tamarins cling and leap among the large calibre trunks and lianas of the lower canopy.

While New World monkeys are exclusively arboreal they are not limited geographically to the tropical forests of Amazonia. Howler monkeys, capuchins, squirrel monkeys and tamarins also inhabit subtropical woodlands to the north and south of Amazonia. Likewise, their habitats range in altitude from sea level along the Amazon delta to about 3000 metres above sea level in the Andean foothills of the high western Amazon.

No population of New World monkey is considered abundant, and several species face imminent extinction. The woolly spider monkey and the lion tamarin, both located only in the imperilled Atlantic Coastal Forest of eastern Brazil, are considered the most endangered. The survival of these and many other New World monkey species into the twenty-first century is directly related to the vitality of tropical and subtropical ecosystems that support them.

Habits and Life Histories

New World monkeys are typical primates in the sense that they eat a wide variety of things, they congregate in relatively large groups, have small litters (1–2) and long lactations, and they grow and develop with an emphasis on learned behaviour. Among the living genera are radiations that exploit particular food items to a greater degree: leaf-eating in the case of the howler monkeys, ripe fruit in the case of the spider monkeys, tree gum in the case of the marmosets, and hard-shelled fruits in the case of the saki and uakari monkeys. The other genera display a spectrum of food choice combinations that range from fruits to insects in the smaller genera and from fruits to leaves in the larger genera.

New World monkey social organization ranges from nearly solitary in the titi and owl monkeys to large and gregarious groups in the woolly, squirrel and capuchin monkeys. Mating strategies range from pair-bonded and monogamous in the owl, titi, and some callitrichine monkeys to mutual promiscuity in the woolly spider monkey. In contrast to some Old World monkeys, few New World monkeys display high degrees of sexual dimorphism as a result of intense male–male competition for mates.

Among the New World monkeys are the only anthropoid primates that routinely give birth to twin offspring. Except for one species, callitrichine New World monkeys display the most prodigious reproductive potential of any anthropoid primate. They may give birth to two offspring in each of two litters per year. These smallest of anthropoids display some of the most derived reproductive features in the primate order. The life history characteristics of most other genera have not been studied in sufficient detail. The squirrel monkey and the capuchin monkey are known to have the largest relative brain sizes of the New World monkeys, but it has been shown that they arrive at this state through opposite prenatal and postnatal growth patterns. The squirrel monkey has an extended gestation length for its body size and gives birth to an extremely precocial newborn. By contrast, at least half of the neural growth in capuchins takes place after birth, after a gestation of normal length.

Fossil History

The fossil record of New World monkeys samples their adaptive radiation in only the barest detail. At the present time approximately two dozen different extinct genera are recognized, but they span almost 30 million years of time and have been found in only five different geographic areas. The diversity of fossils from approximately 15 million years ago at one locality in Colombia also indicates that New World monkeys have been a prominent part of mammalian evolution in South America.

The fossil record as it is known today includes discoveries in Bolivia, Argentina, Chile, Colombia, Brazil and the Caribbean islands. Since four of these five regions are along the periphery of where New World monkeys live today, the past biodiversity of New World monkeys almost certainly exceeded that of the living genera. The fossil genera and their approximate age ranges are listed in **Table 2**.

Table 2 Chronology, geography, and taxonomy of the platyrrhine fossil record

Geological age	Locality	Taxon	Key specimens	?Affinities?
Late Oligocene \cong 26 Ma	Salla, Bolivia	<i>Branisella boliviana</i>	Jaw fragments	??
		<i>Szalatavus attricuspis</i>	Jaw fragments	??
Early Miocene \cong 19 Ma	Central Argentina	<i>Dolichocebus gaimanensis</i>	Cranium	Squirrel monkeys
	Central Argentina	<i>Tremacebus harringtoni</i>	Cranium	Owl monkeys
	Central Chile	<i>Chilecebus carrascoensis</i>	Dentition	Cebines
Middle Miocene \cong 17 Ma	Patagonia	<i>Soriacebus</i> spp.	Dentition	Pitheciines
	Patagonia	<i>Carlocebus</i> spp.	Dentition	Pitheciines
	Patagonia	<i>Homunculus patagonicus</i>	Partial skeleton	Pitheciines
Middle Miocene \cong 15 Ma	Central Argentina	<i>Propithecina neuquensis</i>	Dentition	Pitheciines
Middle Miocene \cong 9–14 Ma	La Venta, Colombia	<i>Stirtonia</i> spp.	Dentition	Howler monkeys
		<i>Neosaimiri fieldsi</i>	Dentition	Squirrel monkeys
		<i>Laventiana annectens</i>	Dentition	Cebines
		<i>Cebupithecina sarmientoi</i>	Partial skeleton	Pitheciines
		<i>Nuciruptor rubricae</i>	Dentition	Pitheciines
		<i>Mohanamico hershkovitzi</i>	Dentition	Callitrichines
		<i>Aotus dindensis</i>	Dentition	Owl monkeys
		<i>Lagonimico conclutatus</i>	Crushed skull	Pitheciines (?)
		<i>Patasola magdalena</i>	Dentition	Callitrichines
		<i>Micodon kiotensis</i>	Isolated teeth	Callitrichines
Pleistocene < 500 000 BP	Bahia, Brazil	<i>Protopithecus brasiliensis</i>	Complete skeleton	Howler monkeys
		<i>Caipora bambuorum</i>	Complete skeleton	Spider monkeys
	Caribbean Islands	<i>Xenothrix mcgregori</i>	Cranium, mandible	Pitheciines
		<i>Antillothrix bernensis</i>	Dentition	??
		<i>Paralouatta varonai</i>	Cranium, mandible	Howler monkeys

One remarkable aspect of the New World monkey fossil record is that almost all of the extinct taxa bear close resemblance to a radiation of living species. As far back as the early Miocene are fossils that share anatomical traits with living New World monkeys, and the middle Miocene site of La Venta in Colombia has yielded at least four genera that are reasonable direct ancestors to living species. However, recent discoveries in Brazil have also demonstrated that platyrrhines once ranged in body size up to twice as large as any living species. Two complete skeletons recovered from Brazilian caves are evidence of extinct ateline species that weighed as much as 25 kg.

Phylogeny

Recently the results of morphologists and molecular biologists have begun to converge. Some long-suspected close relationships have been supported through numerous studies of both anatomy and genetics, while some long-debated relationships continue to be ambiguous across all databases. In general, the close affinities of genera within the Atelinae, Pitheciinae and Callitrichinae are supported strongly by molecular and morphological studies. The unity of Cebinae, and their close affinity with callitrichines, tends to be supported also. The same studies fail to 'confirm' a clear picture of the evolutionary position of *Aotus* and *Callicebus*.

In the broad sense of evolutionary history, the key driving force in the adaptive radiation of the living New World monkey genera may have been the diverse exploitation of key feeding niches. What most distinguishes the subfamily groups from one another is their adaptations to foraging styles and feeding niches. The focus of atelines on upper canopy leaves and fruits, for

example, starkly contrasts with the focus of callitrichines on lower canopy tree gums, botanica and invertebrate fauna. To the extent that the evolution of feeding niches is the story of New World monkey phylogeny, a basic bifurcation between frugivore-faunivores on the one hand (Cebinae and Callitrichinae) and frugivore-folivores (Atelinae, Pitheciinae, Aotinae) on the other may represent the earliest phylogenetic split among the living forms. Diversification within these adaptive radiations almost certainly has resulted in the monophyletic atelines, pitheciines and callitrichines.

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