

Parks, reserves and Brazilian Amazonia

In 1979 there was only one national park in the forested Amazon region of Brazil. In that year Brazil adopted a conservation plan for the Amazonian region, proposed in 1976 as part of a system of conservation units for the whole country. Since then a further four national parks and a number of biological reserves and ecological stations have been established. The plan, which gives priority to ecosystem protection, takes the geographic diversity of plant species into consideration but not that of the fauna. The authors examine the effectiveness of the plan in protecting the primate families Callitrichidae, Callimiconidae and Cebidae and suggest how it could be adapted by recognising the importance of rivers, which limit the distributions of many primate species and subspecies as well as those of many other mammals, birds and plants.

The conservation plan for Brazilian Amazonia

In 1979, a document outlining the conservation priorities for Amazonia, most particularly regarding the siting of national parks and biological reserves (Wetterberg *et al.*, 1976), was incorporated as part of the proposed system for conservation units for Brazil, adopted by the government in that same year (MA-IBDF, 1979). The plan for the Amazonian region resulted from

studies completed as part of the Forest Development and Research Programme (PRODEPEF) of the Brazilian Forestry Development Institute (IBDF), the United Nations Development Programme (UNDP) and the Food and Agriculture Organisation (FAO). The proposals included the siting of national parks and biological reserves in 30 different areas. The choice of these areas was based on information regarding the distributions of certain taxa of birds (Haffer, 1969), butterflies (Brown, 1975, 1976), lizards (Vanzolini, 1970; Vanzolini and Williams, 1970) and plants (Prance, 1973). These authors identified areas of high species endemism, believed to have resulted from the retraction of the Amazon forests into isolated patches, separated by belts of non-forest vegetation, during the last major cold dry climate at the end of the Quaternary, approximately 21,000–13,000 years bp (Hammen, 1972). These formerly isolated areas are termed Pleistocene forest refuges for this reason, and speciation is believed to have occurred within them during their isolation. The rationale behind the choice of these areas is therefore the preservation of *species*, although the emphasis is placed on the preservation of Amazonian *ecosystems* (Thorington, 1974; Wetterberg *et al.*, 1976; Pires and Prance, 1977). For this reason the plan also takes into account the phytogeographic regions of Ducke and Black (1954) modified by Prance (1977), the vegetation types described by Pires (1974) and the vegetation surveys carried out during the government RADAM project (a survey of the Amazon basin using aerial radar photography and ground teams).

Efforts were made to avoid siting priority areas in those already earmarked for development

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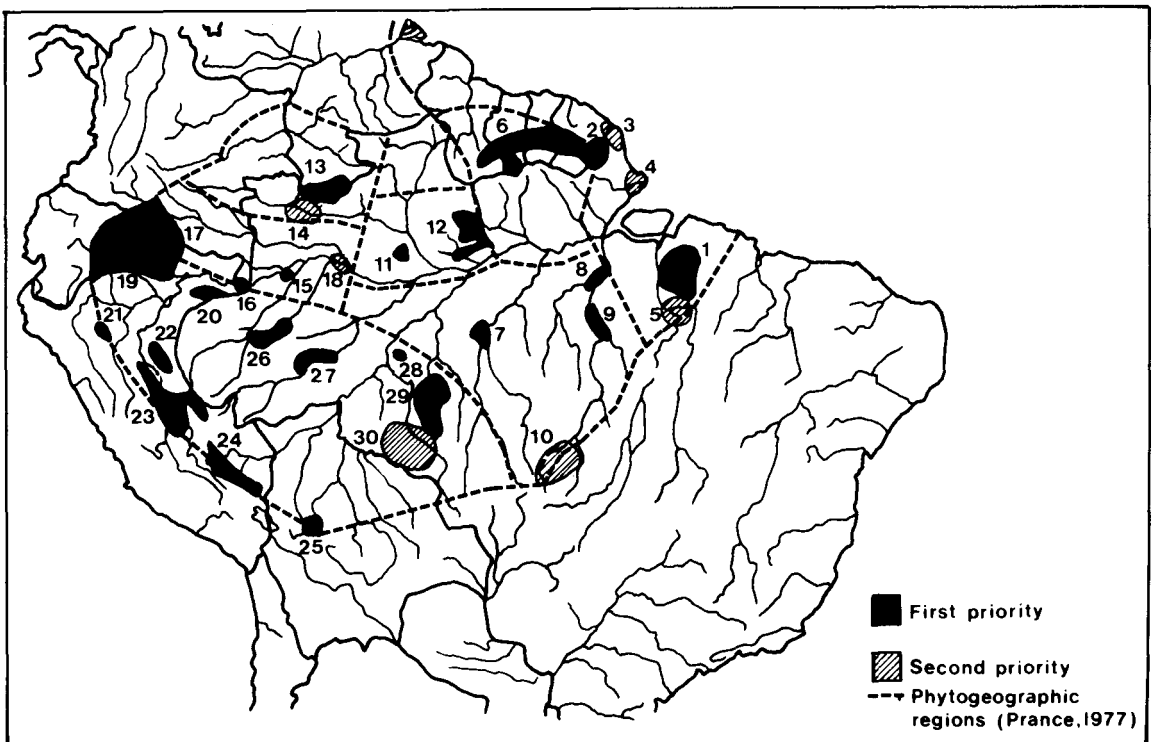
primate conservation in

Anthony Rylands and Russell Mittermeier

(Brazil, 1975) although these development areas do allow for the establishment of wildlife parks and reserves (Wetterberg *et al.*, 1976).

The plan gives first priority to 23 areas identified by two or more of the authors listed above and second priority to seven areas identified as

refuges by one of the above authors and/or considered important as a sample from one of the phytogeographic regions of Amazonia identified by Prance (1977). Third priority is given to areas recommended by other government agencies, voluntary organisations or scientists for reasons



The general areas recommended for preservation in Amazonia by Wetterberg *et al.* (1976). (1) Bacia do Capim. (2) Oiapoque. (3) Cabo Orange. (4) Cabo Norte. (5) Marabá. (6) Guiana. (7) Ponta do Flechal. (8) Altamira. (9) Caxinduba. (10) Alto Xingú. (11) Jaú. (12) Jatapú. (13) Pico da Neblina.

(14) Cuxiaua. (15) Cutuaia. (16) Loreto. (17) Napo Norte. (18) Panauá. (19) Napo do Sul. (20) Javari. (21) Huallaga. (22) Serra do Divisor. (23) Ucayali. (24) Inambari. (25) Yungas. (26) Eirunepé. (27) Puruá. (28) Marmelos. (29) Serra das Onças. (30) Parecis.

other than those outlined above. The proposed area for new parks and reserves in Amazonia, following this plan, is 17,500,000 ha in addition to 3,524,000 ha for the rest of Brazil (Wetterberg and Padua, 1978).

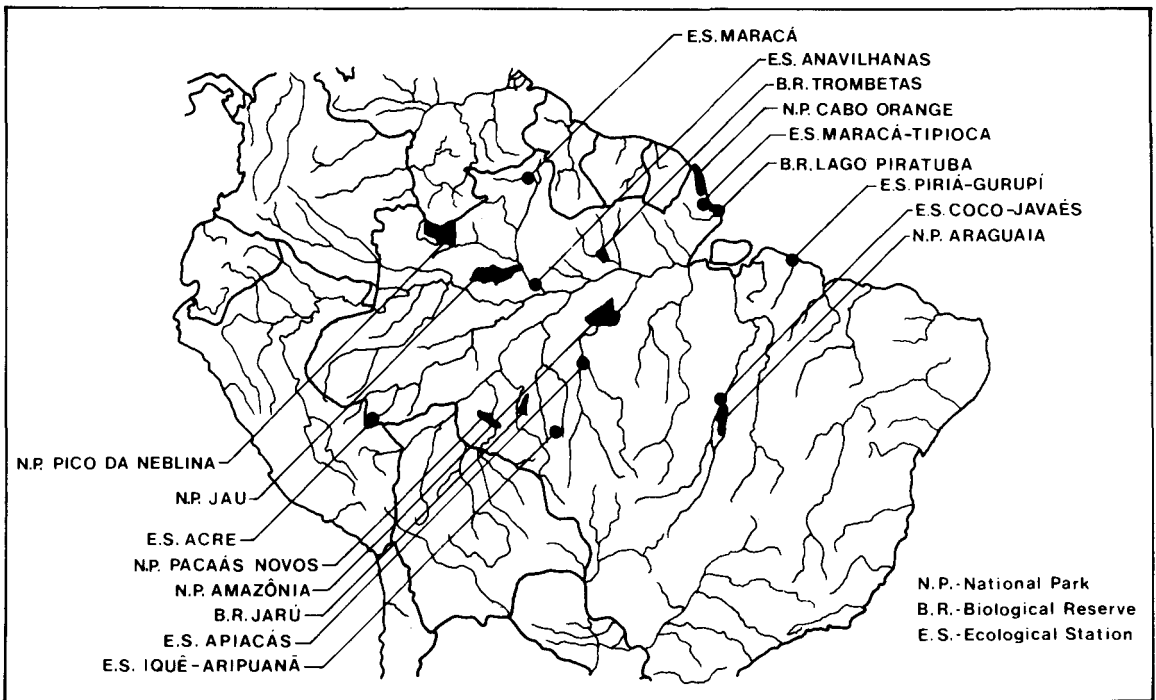
Parks and reserves in Brazilian Amazonia

The area known as Legal Amazonia in Brazil covers 4,975,527 sq km (Tardin *et al.*, 1979), 58-45 per cent of the country. Over 68 per cent is forest, mainly dense tropical forest, but including inundated forests, white sand forests, and liana and bamboo forests (Pires, 1974; Prance, 1978; Braga, 1979). Non-forest formations include seasonally flooded and dry savannahs and campinas (low vegetation on white sand) (Prance, 1978).

Proposals for conserving Brazilian Amazonian ecosystems include the establishment of national parks, biological reserves and ecological stations. National parks are usually large and managed to

allow for educational, recreational and scientific activities (Padua, 1977); biological reserves protect threatened ecosystems or species and interference is kept to a minimum (Padua, 1977). These are established and administered by the Parks Department of the Brazilian Forestry Development Institute (IBDF) of the Ministry of Agriculture. Ecological stations are established by the Special Environmental Agency (SEMA) of the Ministry of the Interior to protect representative samples of the chief Brazilian ecosystems for ecological studies (Nogueira-Neto and Carvalho, 1979).

Until 1979, the only national park within forested Amazonia was the Amazonia National Park, where some management studies and faunal and floral surveys have been carried out (Wetterberg and Padua, 1978; Barrett, 1978; Branch, 1979; Ayres and Milton, 1981). SEMA has established 17 ecological stations in Brazil since 1976, eight of these are in Legal Amazonia, although only five include dense tropical forest. During 1979/80, a



The national parks, biological reserves and ecological stations in Brazilian Amazonia (MA-IBDF, 1980; Padua, 1977; Nogueira-Neto and Carvalho, 1979; Carvalho, 1981).

further four national parks and three biological reserves were created in Brazilian Amazonia bringing the total area protected to 10,143,263 ha, 2.04 per cent of Legal Amazonia. Except for two, they lie within the priority areas identified in the conservation plan. The exceptions are the Pacaás Novos National Park, just to the north-west of the Parecis refuge but within a refuge identified by Brown (1976) and the Trombetas Biological Reserve which was established primarily to protect turtle nesting beaches.

Primates and the conservation plan for Amazonia

Family Callitrichidae

Of the 49 callitrichid species and subspecies listed by Mittermeier and Coimbra-Filho (1981), 41 occur in Brazil. Thirty-one of these are mainly or wholly Amazonian in their distributions, and ten are restricted to central and eastern Brazil. Twenty-four (and possibly as many as 29) callitrichid species and subspecies are endemic to

Brazil and 14 (and possibly as many as 19) to Brazilian Amazonia. Peru has the second highest diversity of this family with 13 (and possibly as many as 15) species and subspecies, three of which are endemic.

Most of the members of this family have restricted distributions. Although at present the Amazonian Callitrichidae are not in serious danger, it is only a matter of time before many with very restricted distributions in areas proposed for development will be endangered, in a situation similar to that of the lion tamarins, *Leontopithecus* and the marmosets *Callithrix aurita* and *C. flaveiceps* in south-east Brazil (Mittermeier *et al.*, 1980).

Of the nine Amazonian Callitrichidae in the *Red Data Book* (IUCN, 1982), eight are restricted to Brazilian Amazonia. The ninth, the emperor tamarin *Saguinus imperator*, of indeterminate status, occurs in Brazil, south-east Peru and north-west Bolivia. Although protected in Peru, in the 1,532,800 ha Manu National Park, the Brazilian range of *S.i. imperator* does not include

	Location	Date of decree	Area (ha)	Vegetation types
<i>National park</i>				
Araguaia	Goiás	12/59	562,312	Transition dense tropical forest/cerrado, gallery forest, flooded plains
Amazonia	Pará	02/74	1258,000	Dense tropical forest, inundated forest
Pico da Neblina	Amazonas	06/79	2200,000	Dense tropical forest, white sand forest
Pacaás Novos	Rondônia	09/79	764,801	Transition dense tropical forest/cerrado
Cabo Orange	Amapá	07/80	619,000	Mangrove swamps, flooded savannahs
Jaú	Amazonas	09/80	2272,000	Dense tropical forest, white sand forest
<i>Biological reserve</i>				
Jarú	Rondônia	07/79	268,150	Dense tropical forest
Rio Trombetas	Pará	09/79	385,000	Dense tropical forest, turtle nesting beaches
Lago Piratuba	Amapá	07/80	395,000	Dense tropical forest, coastal forest
<i>Ecological station</i>				
Maracá	Roraima		92,000	An island. Dense tropical forest, flooded forest
Anavilhanas	Amazonas		350,000	Archipelago. Dense tropical forest, permanently and seasonally flooded forest
Iquê-Aripuanã	Mato Grosso		266,000	Transition dense tropical forest/cerrado
Apiacás	Mato Grosso		500,000	Transition dense tropical forest/cerrado
Maracá-Tipioca	Amapá		70,000	Two islands. Mangrove swamps, flooded savannahs, small forest patches
Piriá-Gurupí	Pará		31,000	Estuary. Mangrove swamps, mud-flats
Coco-Javaés	Goiás		37,000	Seasonally flooded forest, savannahs
Acre	Acre		77,500	Dense tropical forest, bamboo forest

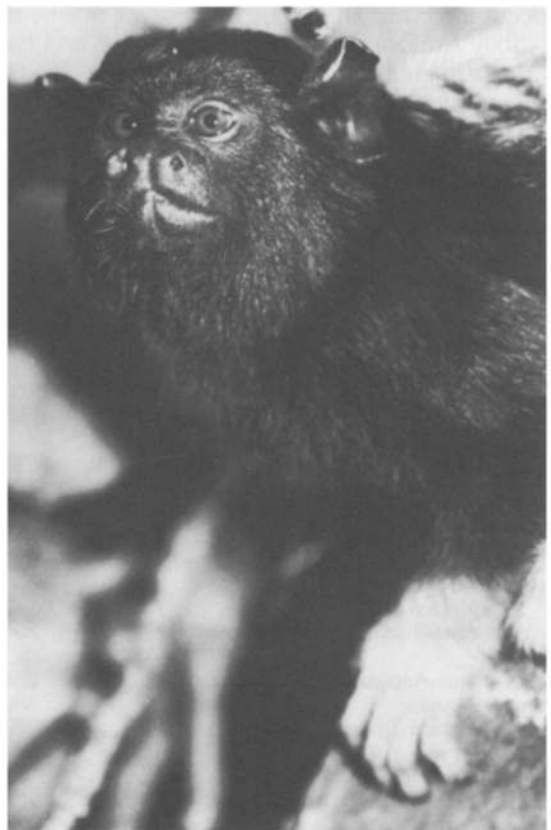
The national parks, biological reserves and ecological stations in Brazilian Amazonia. Information obtained from MA-IBDF (1980), Padua (1977), Nogueira-Neto and Carvalho (1979), Carvalho (1981) and Padua and Carvalho (1979).

any established reserves although it would be included in the proposed Juruá National Park (of third priority in the plan) (Carvalho, 1981). The subspecies *S.i.subgrisescens* is protected in the newly established Rio Acre Ecological Station. The tiny range of the golden-white bare-eared marmoset *Callithrix argentata leucippe*, considered vulnerable in the *Red Data Book*, is covered by extensive plans for development along the Cuiabá-Santarém highway. Although protected in part of the Amazonia National Park, east of the Rio Tapajós, the creation of the third priority Cupari Biological Reserve would be of great importance for its future protection as would captive-breeding.

Of the three tassel-eared marmosets, *C. humeralifer*, classified as vulnerable in the *Red Data Book*, the nominate subspecies is protected in the Amazonia National Park, west of the Rio Tapajós, but the subspecies *chrysoleuca* and *intermedius* remain without any existing or proposed protection. The subspecies of the bare-face tamarin *S. bicolor*, classified as indeterminate in the *Red Data Book*, all have very restricted distributions, especially the nominate subspecies occurring around the city of Manaus, the capital of the state of Amazonas. Although surviving in degraded forests and secondary growth in suburbs, the future of the small and usually isolated populations is precarious. *S.b. bicolor* is protected in the 10,000-ha Adolfo Ducke Forest Reserve and the Walter Egler Forest Reserve of 5000 ha of the National Institute for Amazon Research, to the north-east of Manaus, but there is an urgent need for reserves to protect all three subspecies (Ayres *et al.*, 1981). None of the Amazonian callitrichids in the *Red Data Book* occur within the priority refuge areas in Brazil proposed in the conservation plan (Wetterberg *et al.*, 1976).

Callitrichids attain their highest diversity in the upper Amazon basin (Mittermeier *et al.*, 1978). This is due to sympatry between the black-mantle tamarins *Saguinus nigricollis*, the saddleback tamarins *S. fuscicollis*, and the moustached tamarins *S. mystax*, *S. labiatus* and *S. imperator*, many subspecies of which have very restricted distributions, limited by both large and small rivers. There is only one established Brazilian reserve in this region (Rio Acre Ecological

Station) and only two small refuge areas (Eirunepé and Purús) included in the conservation plan. At present, only eight of the 11 Amazonian callitrichid species and only 10 (and possibly 12) of the 31 taxa, found in Brazilian Amazonia are protected in national parks, biological reserves and ecological stations. Furthermore, only four (and possibly six) of the 14 (and possibly as many as 19) taxa endemic to Brazilian Amazonia are protected in these areas. A number of reserves in the Eirunepé and Purús refuge areas might protect a further three *S. fuscicollis* subspecies, the three *S. mystax* subspecies and the red-bellied tamarin *S. labiatus* as well as the pygmy marmoset *Cebuella pygmaea*. Overall, however, it must be concluded that more needs to be done to ensure adequate protection for all Amazonian callitrichids, and that the conserv-



The golden-handed tamarin *Saguinus midas midas* is the best protected of the Amazonian tamarins, occurring in at least five reserves. (Russell A. Mittermeier)

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ation plan (Wetterberg *et al.*, 1976) does not provide them with sufficient protection.

Protecting small populations of callitrichids may not require reserves larger than 10,000 ha as long as they are managed appropriately (Thorington, 1978). Thus, without denying the importance of the plan for a system of reserves in refuge areas, the restricted distributions of the Callitrichidae and their need for only relatively small reserves would plead a subsidiary programme for their protection.

Family Callimiconidae

Goeldi's monkey *Callimico goeldii* is listed as rare in the *Red Data Book*. It has a disjunct distribution and is limited probably more by its specialised habitat requirements than by rivers; even single groups may be isolated (Izawa, 1979; Pook and Pook, 1979). The rareness of this monkey necessitates large reserves to maintain viable populations that are not subject to genetic change or random extinction due to their isolation. Reserves in all the refuges where it may occur (those in Peru) are of potential importance for its protection. It is probably protected in the Rio Acre Ecological Station but there are no other reserves proposed within the conservation plan within its known range in Brazil.

Family Cebidae

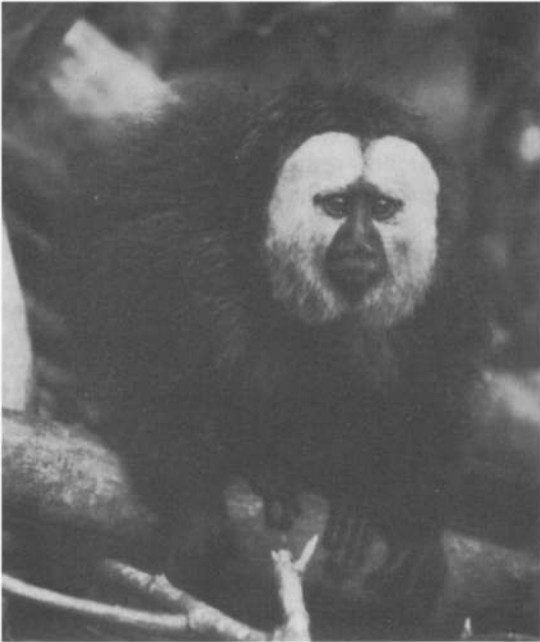
There are approximately 21 Amazonian cebid species, 20 of which occur in the Brazilian Amazon and three of which are endemic: the white-nosed saki *Chiropotes albinasus*, the black-and-white saki *Pithecia albicans*, and the red-handed howler monkey *Alouatta belzebul*. All the Brazilian Amazonian Cebid species occur in at least two existing Brazilian reserves except for the uakari *Cacajao calvus*, and the saki monkeys, *P. albicans* and *P. monachus*. All species except for those mentioned above and the weeper capuchin *Cebus nigrivittatus*, which also occurs in several Surinam reserves, are currently protected in at least one Brazilian national park. The wide ranging cebids, such as the tufted capuchin *Cebus apella*, the squirrel monkey *Saimiri sciureus*, the night monkey *Aotus trivirgatus* and the red howler monkey *Alouatta seniculus*, are already protected in a number of reserves and will obtain

more protection with reserves created in the conservation plan. Of more concern are those species and subspecies listed in the *Red Data Book* (IUCN, 1982) or with restricted ranges.

Of the 14 Amazonian Cebidae in the *Red Data Book*, four are restricted to Brazil. The white uakari *C.c.calvus*, which is classified as vulnerable but which should be considered endangered, is sometimes shot for food, and has a tiny range. An urgent need exists for the creation of the Auati-Paraná National Park, proposed by Mittermeier (1973) in the Panauá refuge of the conservation plan. This would cover its entire known range. The black saki *Chiropotes satanas satanas* is classified as endangered. It suffers from hunting and is restricted to one of the most populated parts of the Brazilian Amazon (Ayres, 1977). In the future the situation will worsen with the building of the Tucuruí dam on the Rio Tocantins and extensive mining operations in the Carajás mountains in the south of its range. The white-nosed saki *C. albinasus*, listed as vulnerable, has a relatively wide distribution and occurs in the Amazonia National Park, as well as the Jarú Biological Reserve. More reserves in the Serra das Onças, Marmelos and Ponta do Flechal refuges will play an important part in its protection. The fourth Cebid in the *Red Data Book* which is restricted to the Brazilian Amazon is the white-whiskered spider monkey *Ateles belzebuth marginatus*. To date it is protected only in the Amazonia National Park, east of the Rio Tapajós. Reserves in the Altamira and Caxinduba refuges are important for the protection of this monkey as well as for the southern bearded (or black) saki.

The black and the red uakaris, *C. melanocephalus* and *C.c.rubicundus*, have wider distributions than the white uakari, occurring in Brazil, Venezuela, Colombia and Peru, but both are heavily hunted. Although *C. melanocephalus* is protected in two large national parks in Brazil, Pico da Neblina and Jaú, it is threatened in Colombia. The red uakari *C.c.rubicundus* is severely threatened both in Brazil and most especially in Peru but remains unprotected and without any provision for its protection in the conservation plan.

The black-and-white saki monkey *P. albicans* is not included in the *Red Data Book*, but it is restricted to a small area in Brazil which is covered



The white-faced saki *P. pithecia* occurs in a number of Brazilian reserves north of the Rio Amazonas, but it is always uncommon and its habits are unknown.

(Russell A. Mittermeier)

by extensive plans for future development. This species does not occur in any existing or proposed conservation areas.

All the woolly monkeys *Lagothrix lagothricha* are classified as vulnerable in the *Red Data Book*. They occur mainly in the upper Amazon, the part least adequately covered in the conservation plan. Hunting, both for food and pets, and habitat destruction are serious threats to the survival of the four recognised subspecies, three of which occur in Brazil. The subspecies *cana* is probably protected in the Pacaás Novos National Park and the Rio Acre Ecological Station, but it is believed to be absent from the Amazonia National Park, at least in parts so far surveyed (Branch, 1979; Ayres and Milton, 1981). The two subspecies *poepigii* and *lagothricha* are unprotected in Brazil and more reserves in their ranges are urgently needed. Reserves in areas on the upper Rios Japurá and Javari near the Colombian and Peruvian borders are needed for their protection in addition to reserves proposed in the Cutuaia and Eirunepé refuges.

The Amazonian spider monkeys, *Ateles belzebuth* and *A. paniscus*, with four Amazonian subspecies, are considered vulnerable in the *Red*

Data Book. The white-bellied spider monkey *A.b.belzebuth* occurs in the Pico de Neblina National Park, the black spider monkey *A.p.paniscus* occurs in the Trombetas Biological Reserve, as well as in reserves in Surinam, and *A.p.chamek* occurs in the Pacaás Novos National Park, the Jarú Biological Reserve and the Rio Acre Ecological Station.

Although the spider and woolly monkeys occur in a number of reserves proposed in the conservation plan, *Lagothrix* and *Ateles* are unquestionably the most endangered of the Amazonian primates. Although certain species or subspecies may be in worse trouble, these two large, slow-breeding, heavily hunted genera are in worse shape than any other genus. Their protection should be considered one of the highest Amazonian primate conservation priorities

The subspecies of the red-handed howler monkey *Alouatta belzebul* are restricted to the south of the lower Amazon in Brazil. The subspecies *discolor* and *nigerrima* are protected in the Amazonia National Park, but the nominate subspecies, particularly, occurs in a heavily populated part of Amazonia in the State of Pará, in which there is continuous and extensive habitat destruction.

Although the Cebidae in general have larger distributions than the Callitrichidae and therefore receive more adequate protection within the conservation plan, many species and subspecies, particularly those mentioned above will need additional protection in new parks and reserves. Cebid groups have larger home ranges than those of the callitrichids and they require large and well-protected reserves to maintain viable populations.

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This woolly monkey subspecies, *Lagothrix lagotricha cana*, is classified as vulnerable but is protected in the Pacaás Novos National Park and the Rio Acre Ecological Station.

(Russell A. Mittermeier)

The refuge theory and Amazonian conservation

The theory of Pleistocene forest refuges and their effects on diversity and distribution patterns of South American fauna is still the subject of controversy (Prance, 1982). That the so-called refuges are centres of endemism is, however, undisputed and, in itself, a reason for their protection (Oren, 1982; Lovejoy, 1982). However, Brown (1976) points out that the peripheral zones of refuges contain marginalised forms and that inter-refugial zones contain a higher diversity of butterflies due to the mixing of gene pools from the refuge areas. It may be as important to protect these areas as it is to protect the refuges. The application of the refuge model for conservation in Amazonia would create irreversible geographical isolation and it ignores geographic variation (Ayres and Best, 1979) as well as aquatic ecosystems (Junk, 1979).

With regard to primates, Kinzey and Gentry (1979) and Kinzey (1982) account for the distributions and subspeciation patterns of Amazonian Callitrichidae and titi monkeys, *Callicebus*, by their isolation in forest refuges identified by Brown (1975) for butterflies. Thorington (1978) also believes that the Pleistocene forest refuges were significant for present-day distribution patterns of Amazonian primates and that protection of these areas would result in the preservation of the essential genetic diversity within the different species. Hershkovitz (1963, 1977) explains present-day distributions of Callitrichidae and titi monkeys by dispersal centres on the periphery of the basin, with speciation and subspeciation resulting from isolation by rivers. These peripheral dispersal centres may or may not have been forest refuge areas.

Historical explanations for the distributions and speciation patterns of primates can only be speculative. Undisputed, however, is the importance of rivers as barriers to their dispersal and in marking the limits to the present distributions of many of the Amazonian species and subspecies (Wallace, 1853; Avila Pires, 1974; Hershkovitz, 1977). Several authors have proposed parks and reserves in Brazilian Amazonia based on regions separated by rivers (Junk, 1979; Ayres and Best, 1979). Rylands (1980) analysed the occurrence

of Amazonian primates in the 30 priority refuges of the conservation plan and also in 19 regions separated by rivers and international frontiers. Although the regions are too large to be homogeneous with regard to the primates occurring in them, superimposing them on the refuge areas sorts the refuges into groups regarding the species and subspecies being protected and also orientates the siting of parks and reserves within them. For example refuges spanning rivers should have reserves on both sides. Modifying the refuge model in this way would produce at least one reserve in each region. Although still inadequate, this would increase considerably the diversity of fauna protected. Such a plan would protect all but the most restricted Cebidae in a number of reserves, but effective protection for all Callitrichidae would still require many additional reserves.

It should be noted that the refuge area model, although providing a wide, if uneven, coverage for Brazil and Peru, is not adequate for other Amazonian countries.

While recognising that the conservation of Amazonian ecosystems is more important than the protection of individual species and subspecies, it should be remembered that there is still an immense lack of knowledge regarding Amazonian ecology, and classifications of terrestrial and aquatic ecosystems are still at a gross and almost entirely qualitative level. A crude list of ecosystems to be preserved and the simple neatness of the plan for Amazonian parks and reserves in the 30 priority refuge areas should not prevent conservation proposals and measures which are based on more detailed or subtle differences between grossly similar ecosystems and a better understanding of the taxonomy and distributions of the fauna and flora. In the rush to protect a sample of permanently inundated forest, for example, it must not be ignored that by doing so in the region of the Auatí-Paraná, between the Rios Solimões and Japurá, rather than elsewhere, protection could be given to the entire wild population of the white uakari, *Cacajao calvus calvus*.

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