

Conservation of white uacaries in Amazonian várzea

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Until two decades ago, the only reference to the white uacari of the upper Amazon, known locally as the 'English monkey', had been provided by the British naturalist Henry Walter Bates, who saw captured animals during his sojourn in Amazonia in the 1850s. A major Brazilian initiative led us to the first intensive field study of the species, which was carried out in 1983 and 1984 by one of the authors, J. M. Ayres, with the participation of a large number of Brazilian scientists and a few from overseas. The study illustrated the uniqueness of the várzea habitat in which the animals live and the threats it currently faces. It also captured the attention of both the Brazilian scientific community and the public. Possibilities for the creation of a reserve area within the várzea are now being implemented.

The eastern slopes of the Andean mountains receive more than 2500 mm of rain annually, with marked seasonality. The heavy runoff finds its way into the Solimões/Amazon river system, causing annual fluctuations in water level of up to 15 m and flooding valleys up to 100 km wide.

Seasonally inundated areas support a specialized vegetation with no equivalent anywhere in the world. Seen from the air, várzea in the low-water season looks rather like crazy-paving. Tall forest is restricted to narrow interlinked corridors (*restingas*) located on alluvial levées marking the deposition areas of old watercourses. This vegetation is flooded for less than six months each year. Separating the *restingas* are areas of low, dense scrub (*chavascals*), with some open grassy areas and many ribbon-like lakes. This low vegetation is flooded for more than half the year, usually being submerged completely. At peak flood only the canopies of the *restinga* trees appear above the water.

The landscape is formed by the entrapment of alluvia from the rapidly eroding Andes. Once established on the banks of watercourses, várzea trees grow impressive spreading buttresses, which slow down the passage of floodwater,

causing it to drop suspended material rich in plant nutrients. The longer the *restingas* are established, the more alluvia is trapped and the higher they rise, and the less *chavascal* remains. Ribbon lakes and channels are constantly changing their courses, however, as treefalls breach *restingas* or old watercourses silt up. The pattern of lakes, *restingas* and islands is highly dynamic.

Várzea floodplains extend from the lower reaches of the silt-laden white-water rivers, such as the Juruá and Japurá, along the length of the Solimões/Amazon to the tidal mangroves at its mouth. Much of this 55,000-sq-km area is contiguous with non-flooding *terra firme* forest and supports a subset of that species community. Islands in the intricate western várzeas do support some unique species, however: a small conebill *Conirostrum margaritae*, a diminutive piculet *Picumnus várzeae*, the spectacular Amazonian umbrellabird *Cephalopterus ornatus*; the newly discovered blackish squirrel monkey *Saimiri vanzolinii*, and the white uacari *Cacajao calvus calvus*. With the exception of the two primates, the habits and status of these species are virtually unknown.

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Aerial view of young *várzea* in the range of the white uacari; the water level is low, but still receding (R. Best).

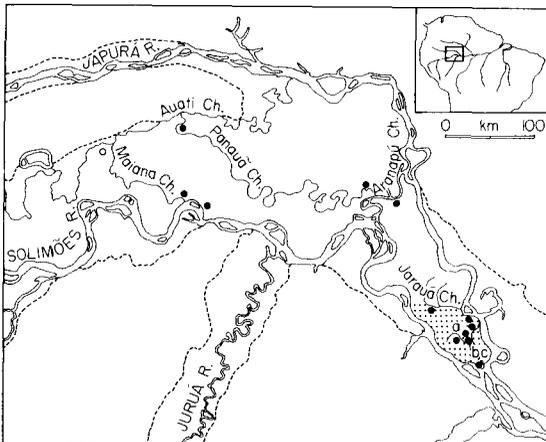


Figure 1. Geographical range of *Cacajao c. calvus*. Sites mentioned in the text are (a) Lake Teiú, (b) Vila São Pedro and (c) Lake Tracajá. Other areas where white uacaries have been observed are marked with closed circles. The open circle marks the easternmost record of *C. c. rubicundus*. The extent of *várzea* is indicated by the dashed line. The shaded area is the proposed Ecological Station.

Uacaries and várzea

Shades of uacari

The uacari monkeys comprise the black uacari *Cacajao melanocephalus*, and two subspecies of *C. calvus*, the red uacari *C. c. rubicundus* and the white uacari *C. c. calvus* (Hershkovitz, 1972). The last taxon is the most threatened and, unlike the others, is restricted to *várzea*, occupying a small area between the Japurá and Solimões rivers (Figure 1). Skins collected by a ranch owner in the north-west of this area (the southern side of the Auati Channel near its junction with the Maiana Channel) indicate that red and white uacaries may overlap in part of this area.

Odd one out

In the northern part of their range, where the *várzea* may be more than 100,000 years old and is contiguous with *terra firme* forest, uacaries are sympatric with seven other primates. In much of their range, however, the *várzea* is more recent



Adult male white uacari (*L. C. Marigo*).

(less than 20,000 years old) and only three other primates exist: the red howler *Alouatta seniculus*, the black-capped capuchin *Cebus apella*, and a squirrel monkey, either *Saimiri vanzolinii* or *S. sciureus*. All are generalists, feeding on a wide variety of foods. White uacaries are specialist frugivores feeding mainly on the seeds of unripe fruit, although they also eat mesocarps and arils of ripe fruit, nectar and a few insects. They are able to live in young *várzeas*, despite their specialized feeding habits, because of particular botanical characteristics of the *restingas*. Trees of the Brazil nut family (Lecythidaceae) and lianas of the family Hippocrateaceae appear very quickly and are abundant in *restingas*; both have large-seeded fruits, which form a major component of the uacaries' diet, and only they are able to open the tough seed cases. Fallen fruits and seeds are another important food source, and entire troops can sometimes be seen foraging on the ground (Ayres, 1987). In non-flooding

forest this food is eaten by peccaries, *Tayassu* spp., and large rodents such as agoutis and pacas, *Dasyprocta* spp. and *Agouti paca*, but these animals cannot live in *várzea*.

Although their troops can contain 50 individuals, uacaries usually forage in much smaller units. This is an efficient way of finding scattered food trees, some of which provide only a few fruits. Because of the ribbon-like nature of the *restingas*, the individual monkeys can easily relocate each other, and usually come together to sleep. They need to travel long distances each day in search of food, however, and the troop as a whole may have a range of up to 6 sq km.

The timber industry

The principal threat to populations of the white uacari arises from the growth of the timber industry: felling for industrial hardwood, and potentially for pulp production. Selective logging for hardwoods has been carried out in their geographical range for more than 30 years, firstly for only a few rare species, such as red cedar *Cedrela* spp., but lately for a considerable number of others. Almost all the timber marketed in western Amazonia comes from *várzea*, which is being cut over more and more intensively as each year the removal of more species becomes commercially viable.

The trees are felled during the low-water season, and floated out as the water rises. Some timber species are heavy and these have to be buoyed up by attaching logs of floating species to each side. Generally, however, removal of trees causes little damage at present when compared with logging in *terra firme* forests, where heavy machinery has to be used and logging roads, loading areas and storage yards constructed. Current average extraction levels of four to five trees/hectare have caused a total loss of only about 5 per cent of standing trees in *restingas*. In nearby *terra firme* forest, removal of the same number of timber trees causes a total loss of 60 per cent.

The most important influence of logging will be the extent to which cut timber trees are also the food trees used by the uacaries. At present, few of the timber trees are exploited as food sources, but there are some important exceptions (Table

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High *restinga* at Lake Teiú; note sparseness of the understory (L.C. Marigo).

1). One tree, *Piranhea trifoliata*, provides a vital food source at times of overall fruit shortage in the form of swarms of caterpillars of a species of noctuid moth. Loss of these trees would introduce a periodic critical food shortage, not only for uacaries but also for insectivorous birds, which also feed on the caterpillars, and for the frugivorous fishes, which eat the floating seeds of the tree (Goulding, 1980). It is a very common tree of *várzea* at present, but all large specimens of a tree can be removed very quickly (as shown by the almost complete eradication of *Ceiba pentandra* in one year, 1984, when it suddenly became commercially valuable).

Surveys of unlogged and logged *várzeas* during 1984 and 1985 indicate that moderate levels of logging do not result in population reduction amongst uacaries (Table 2). All primates are patchily distributed in *várzeas*, uacaries most of all, and this can contribute more to differences reported from survey data than do habitat parameters. Species of the genera *Saimiri* and *Cebus*, Uacaries and *várzea*

for example, are usually tolerant of habitat disturbance and often occur at higher densities in logged than in unlogged *terra firme* forest (Johns, 1985, 1986). Nevertheless, it is clear that the logged *restinga* complex at Vila São Pedro still supports its resident uacaries, and observations made at that site suggest that breeding has not been reduced.

Only one of the nine sites surveyed by J. M. Ayres showed a severe reduction in group size: Tracajá Lake, close to the mouth of the Japurá. This site was between two settled old *restingas*, and logging levels appeared to be unusually high, although no quantitative data are available. There would seem to be a level of tree loss, less than is typical for logging operations in *terra firme* forest, beyond which uacari populations are affected.

It is thus clear that although current logging levels over most of the *várzea* have probably not affected the density of uacaries, there are no

Table 1. Trees cut in *várzea* by one community (Vila Alencar: 13 families, 5 engaged in logging) during 1984, and their importance as food trees for white uacaries

Tree species	Number of trees removed	Price: 1984 US\$ per cu m	Use	Importance in uacari diet/part eaten
<i>Licania amara</i>	234	8.6	Hardwood, canoes	Nil
<i>Apeiba cf. burchelli</i>	200	?	Floats	C/ripe pulp
<i>Ceiba pentandra</i>	200	5.8	Plywood	Nil
<i>Virola surinamensis</i>	87	2.4	Floating houses	Arils probably eaten
<i>Couratari</i> sp.	77	2.4	Plywood	Nil
<i>Hura crepitans</i>	73	2.4	Floating houses	C/seeds
<i>Calophyllum brasiliense</i>	68	7.6	Hardwood, canoes	Nil
<i>Piranhea trifoliata</i>	60	0.8 per m of bole	Beams	D/caterpillars
'Muiratinga' (Moraceae)	53	5.8	Plywood	Nil
<i>Hevea spruceana</i>	47	?	Plywood	C/seeds
'Mulateiro' (Leguminosae)	34	7.6	Hardwood	Nil
<i>Nectandra</i> sp.	26	6.7	Hardwood, canoes	Nil
<i>Schizolobium amazonicum</i>	16	2.4	Plywood	A/base of petioles
'Copaiba' (Leguminosae)	14	2.4	Plywood	Nil
'Cedro da várzea' (Leguminosae)	8	7.1	Hardwood	Nil
<i>Macrolobium</i> sp.	3	2.4	Plywood	B/seeds
Cut irregularly for canoes:				
<i>Guarea subsessiliflora</i>				C/seeds
<i>Xylopia frutescens</i>				D/ripe pulp and aril
<i>Mesilaurus</i> sp.				Nil
<i>Ocotea</i> sp.				Nil
<i>Parkia</i> sp.				Nil

Importance to uacari diet: A, eaten but not important; B, not in top 20 foods; C, important; D, very important.

NB: the large number of trees cut reflects the use of already heavily logged *várzea*: in more remote areas only a few species may be removed (e.g. at Fazenda Biussu on the Auati Channel only two species were being cut in 1984: *Ceiba pentandra* and *Couropita* sp.).

grounds for complacency. As the commercial properties of Amazon trees become better documented, especially amongst international traders, so more species become marketable and logging levels will increase.

An even more alarming trend is the ascendancy of the pulp industry. Pulp production has not been profitable in the lower Amazon *várzeas* because up to 60 per cent of trees are palms. In the young *várzeas* around the Solimões, however, the proportion of palms is less than 1 per cent and the pulp potential of the remaining trees is high. Cardboard-producing industries are becoming very profitable and are well established around Manaus. This has probably not escaped the attention of Japanese industries, which have almost exhausted the accessible forests of Indonesia and which already have to import pulp and paper from Brazil. Because of its interlinked lakes and channels, *várzea* is very accessible to floating paper mills.

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Pulping effectively eradicates the forest of the *restingas*. Even intensive timber logging would create large gaps and alter local conditions of water flow and sediment deposition. Both may well disrupt the dynamics of *várzea*, and areas so affected may never regenerate the natural balance of *restingas* and *chavascas*. An area lacking *restingas* will, of course, support no primates and very few other animals (including most fishes, which rely on *restingas* both for food and for spawning: Goulding, 1980).

The human population

Human population density is very low in *várzea*, although many fishermen and loggers come in from *terra firme* forest areas at certain times of the year. Residents clear small areas for subsistence crops such as manioc and maize, but commercial rice and jute production have proven unsuccessful. Villages and crop fields are established on the highest ground available, old *restingas*, where

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Logging camp in *várzea* close to Lake Teiú (J.M. Ayres).

the soil is better aerated and where the flooded period is short.

The *várzeas* of the Solimões region have only limited areas of natural grassland, unlike upper Amazon *várzeas*, and are not conducive to cattle ranching. A few ranches have been established around the Auati Channel, but do not represent a

major threat to even the older *várzeas* at the present time.

Hunting in the *várzea* is largely limited to the high-water season, when fishing is less productive and when there is an influx of loggers, but it is rarely intensive. Uacaries are rarely shot; most residents never eat them, considering them

Table 2. Primate densities in *várzea*

Species	Mean group size	Groups/sq km	
		Lake Teiú (< 0.1 trees cut/ha)	Vila São Pedro (4.6 trees cut/ha)
<i>Saimiri vanzolinii</i>	50	1.4 \pm 0.4	0.7 \pm 0.4
<i>Cebus apella</i>	6.0	1.1 \pm 0.3	0.6 \pm 0.3
<i>Cacajao c. calvus</i>	40	0.4 \pm 0.1	0.6 \pm 0.3
<i>Alouatta seniculus</i>	5.0	3.2 \pm 0.9	10.7 \pm 4.5
Distance surveyed (km)		67.6	63.1

All surveys were carried out during the low-water season (September to December). Density estimates and 95 per cent confidence limits are derived by Fourier series analysis (Burnham *et al.*, 1980). Around 60 per cent of *várzea* in the two sites is *chavascal*, not used by primates: surveys avoided this habitat, but presented figures are corrected for *várzea* as a whole.

Uacaries and várzea

to be much too ugly or, alternatively, much too human. Hunting is unlikely to become a problem while the *restingas* and the fish stocks remain.

The future

The creation of a reserve for white uacaries (and other *várzea* species) is important in view of the real possibilities of intensification of logging levels and of the initiation of pulp production within their small geographical range. A proposal for an Ecological Station (an area open only for approved scientific research) was submitted to the Brazilian Special Secretariat of the Environment (SEMA: a governmental organization) in late 1984.

The proposed Ecological Station is a 950-sq-km area at the eastern limit of the range of the white uacari, between the Japurá and Solimões rivers and the Jarauá Channel. It would preserve an estimated 3000–5000 uacaries, in addition to the blackish squirrel monkey *Saimiri vanzolinii*, which occurs only there (Ayres, 1985).

The recent surveys indicate that the fact that most has been logged is of marginal importance at present. Continuation of logging will be deleterious, however; single treefalls or cut logs can change the course of waterways and drown or dry out large areas of established vegetation, and the extent of alteration of natural dynamics will increase with the degree of disturbance. The reserve will need to be established as rapidly as possible.

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Postscript

During 1986 a series of inventories was carried out within the area proposed as an Ecological Station. Work was undertaken by three Brazilian institutions, with some financial support from WWF: SEMA, FBCN (Brazilian Nature Conservation Foundation) and ITERAM (Institute of Lands and Colonization, Amazonas State). Surveys were aimed principally at investigating the extent of land tenure within the area, and the feasibility of decreeing it totally protected. The area surveyed was much greater than that originally proposed, extending north to the Aranapú Channel, and now contains approximately 210 families comprising 1600 individuals (H. B. Figueiredo/SEMA, *in litt.*). At the end of 1986, SEMA was still studying land tenure and the possibilities of compensation for families moved away from the reserve. The implementation of the area as an Ecological Station is due during 1987.

At the end of 1986 Museu Goeldi (Belém) built a floating house/office at Mamirauá Lake, close to the uacari study site at Teiú Lake. Construction costs were donated by WIF (Wildlife International Foundation, France). Tree platforms have also been built at Lake Teiú, principally for filming purposes. Research is continuing, aided by these new facilities.

Dedication

We dedicate this article to the memory of our friend and colleague Robin C. Best, who died in December 1986.