AVAILABILITY OF RESOURCES TO PRIMATES AND HUMANS IN A FOREST FRAGMENT OF SIERRA DE SANTA MARTHA, MEXICO

Theories of island biogeography and minimum viable populations are used to predict consequences of large versus small protected areas and usually conclude that large reserves protect species, ecosystems, and biodiversity with greater certainty than smaller ones (Soulé & Simberloff, 1986, in Ayres *et al.*, 1991). From our perspective, such a statement implies that efforts to preserve large tracts of forest should never be abandoned. However, in the face of the rapid changes that are transforming the tropical rain forest landscape (e.g., Rylands & Keuroghlian, 1988), our ability to propose conservation measures on behalf of primates may depend on our study of the processes allowing specific taxa to persist in fragmented habitats (Schwarzkopf & Rylands, 1989). This is particularly evident in tropical countries, where protecting a series of forest fragments may represent the only chance to ensure the survival of native primates in a given part of their range.

It may be argued that forest fragments are a poor option to preserve primates in the long run. Nevertheless, if our conservation measures take into account the potential for improvement in the rural inhabitants' quality of life, people may become an integral component of the conservation effort and, with their support, our perception of a fragmented forest may switch from what it is to what it might be. In the meantime, we believe that studies on what a fragment has to offer to primates as well as humans, for example in the form of ecological services and products, are of key importance to examine the ecological and socio-economic values forest remnants may have in a severely transformed landscape. In this paper we present an evaluation of the food resources available to primates in a forest fragment of Sierra de Santa Martha, Veracruz, Mexico, and compare it to the potential forest products available to locals.

In Santa Martha, the expansion of the agricultural frontier, the small scale extraction of wood and wild plants for various uses, along with stochastic events such as forest fires, have transformed large expanses of forest into small, disconnected fragments which remain in the public land lots (*ejidos*) of the south and southeastern slopes (Silva-López & García, 1984). Symptoms more than causes of a situation with deep socio-economic roots, these problems have transformed the landscape in multiple scales and dimensions. The problems are not only threatening the survival of wild species inhabiting the fragments, but also life conditions of the local zoque-popoluca inhabitants, as well as their traditional methods of appropriation, management, and use of natural resources.

What resources remain in a forest fragment which are of use to primates and humans? To answer this question, we re-examined the results of a detailed vegetation study, conducted in one of 23 forest fragments of 2-20 ha surveyed by Silva-López (1987; Silva-López *et al.*, 1988). The fragment is approximately circular, and with 10 ha is a little above the 8.37 ha mean recorded in the area. It is inhabited by a group of howlers (*Alouatta palliata*, n=10) and a group of spider monkeys (*Ateles geoffroyi vellerosus*, n=16). The habitat characteristics and feeding habits of both groups were studied by Jiménez-Huerta (1992).

Trees with a DBH equal to or greater than 20 cm and trees with crowns forming part of a continuum in the canopy were the main focus of attention in our original study. We labelled and mapped 1167 trees, 74% of which were identified (38 families and 78 species). The Leguminosae and Moraceae families were the richest in species (with 9 each). *Pseudolmedia oxyphyllaria*, *Guarea glabra*, *Cymbopetalum penduliflorum*, *Inga* sp., and *Sapium lateriflorum* were among the most abundant species in the fragment. The Shannon-Wiener index (H') was 1.59. Species richness and biological diversity in the vegetation remnant are within the ranges reported for other larger tracts of forest in nearby areas (e.g., Jiménez-Huerta, 1992).

In general, forest fragments are left in the campesinos' lots as sources of wood, medicine, food, and firewood (Silva-López and Garcia, 1984; Jiménez-Huerta *et al.*, 1992). However, the fate of the primates is linked not only to the humans' dependence on forest fragments, but also the resources available to them. The mere fact that the howling monkeys and spider monkeys have been inhabiting the fragments for the past 10-15 years (Silva-López *et al.*, 1988) suggests that they are meeting their key nutritional and other requirements. In evaluating the fragment, our

Table 1. Plant species used by *Ateles geoffroyi vellerosus* (AGV), *Alouatta palliata* (AP), and by humans in a 10 ha forest fragment at Sierra de Santa Martha, Veracruz, México. MED = medicine; Fr = fruit; Fl = flower; Frwd = firewood; Const = construction material).

	FRAGMENT	PRIMATES/ FOOD			SPECIES USED BY LOCALS	
SPECIES	No. Ind.	AGV	AP	FOOD	MED	OTHER
Alchornea latifolia	6	X				
Aspidosperma megalocarpon	2				Expectorant	
Belotia mexicana	2	X	X			
Brosimum alicastrum	16	X	X	Fr	Lactogenic	
Bursera simaruba	7		X		Analgesic	Frwd
Calophyllum brasiliense	14					Const
Cecropia obtusifolia	12	X	X	Fr, Fl	Urinary system	
Coccoloba sp.	2	X				
Cordia gerascanthus	3	X	?		Skin	
Cupania dentata	4	X			Anti-inflamatory	
Cymbopetalum penduliflorum	51	X				
Dendropanax arboreus	63	X				
Dialium guianense	8	X	X	Fr		Const
Ficus insipida	4	X	X			
Ficus sp.	19	X	X			
Ficus tecolutensis	1	X				
Gliricidia sepium	1					Frwd
Guarea glabra	66	X				
Inga sapindioides	41			Fr		
Inga sp.	1	X			Diarrhea	
Liquidambar macrophylla	1					Frwd
Manilkara sapota	14	X	X	Fr		Frwd/Const
Miconia argentea	9			Fr	Ofthalmic	
Myrcia sp.	4	X				
Nectandra ambigens	22	X	X			
Piper amalago	3				Anti-crotalic	
Pithecellobium arboreum	2	X	?			
Poulsenia armata	5		X	Fr		
Pouteria campechiana	10	X	X	Fr	Skin	Frwd/Const
Pseudolmedia oxyphyllaria	68	X	X	Fr		
Psychotria chiapensis	4				Gangrene	
Pterocarpus rohrii	4	X	X			
Rheedia edulis	23			Fr		Const
Rollinia jimenezi	5			Fr		
Spondias mombin	12	X	X	Fr	Diarrhea	
Tapirira aff. macrophylla	29	X		Fr		
Terminalia amazonia	25		X			Const
Trichilia havanensis	2				Skin	
Trophis racemosa	9	X	X	Fr		
Vatairea lundellii	1				Anti-crotalic	

estimations and percentages were based entirely on the figures of 78 species and 835 individuals identified. Twenty-eight tree species form part of the monkeys' diet (Jiménez-Huerta, 1992), including some of the most abundant, for example, *G.glabra*, *P.oxyphyllaria*, *C.penduliflorum*, and *D.arboreus*, as well as three fig species (*Ficus* sp., *F.insipida*, and *F.tecolutensis*). The 28 species account for more than 35% of the species' total and almost 60% of the individuals (see Table 1). This large number of potential food sources may help to understand the almost 15-year span in which the monkeys have been inhabiting such a small forest fragment.

A zoque-popoluca family use a broad variety of the resources available in a forest fragment. Based on the studies of Silva-López (1987), Santos-Rodríguez (1988), and González-Rivera (1989), we found that these people may use up to 14 tree

species (25.5.% of the total) for food, 14 species (14.5%) as a source of medicine, and at least 10 species (15.2%) for other purposes such as construction materials, ornaments, and firewood. If we take into account the species that are used for more than one purpose (see Table 1), the data show that the fragment provides at least 27 different tree species (34.6% of the species total), and 329 individuals (38% of the total) of use for the family.

These figures are very conservative if we consider the biological form, DBH, and canopy continuum criteria selected. Table 1, for example, does not include the four *Chamaedorea* palm species used as ornaments by locals, nor the climber, *Vitis popenoi*, and three unidentified Leguminosae tree species consumed by *Ateles*. However, the figures do give us an indication of the large amount of resources that must be protected and managed in these fragments.

To conclude, we provide the following suggestions.

1) A study of the political decisions and socio-economic factors that may alter the people's desire to protect forest fragments is a crucial next step (see SMBC, 1992). Agroecological and socio-economic diagnoses will help us to contextualize what is happening in fragmented areas. It is important to remember that on a large scale, one area of fragmented forests may look the same as another, but the origin and maintenance of the fragmentation processes may be very different between micro-regions. The delimitation of landscape units, including biological, ecological, agroecological, and socio-economic aspects, may be very helpful to promote general actions on a regional level, as well as specific actions at lower levels.

2) It is necessary to emphasize the role forest products may play in the family's domestic economy in the area. Natural resources have been used by rural people such as the zoque-popolucas for a long time. However, they have been rarely included as an integral part of regional development plans. Studies are urgently required which examine the role forest products may play in domestic economies, and to promote them whenever possible.

3) We must always keep in mind the possibility of incorporating the management of forest fragments in our contributions to development plans, but this will not be achieved if our proposals are argued from a purely biological perspective. Besides emphasizing biological diversity, the establishment of vegetation corridors to connect the fragments, for example, should be based on their role in protecting cultivations, and to enable local people to extract useful products of native species in a sustainable way.

4) Research alone is insufficient to propose realistic conservation measures; community work is also very important. In most cases, primatologists working in a given area may be the only people having a friendly relationship with local authorities and other people whose opinion may influence the decision-making process in a rural settlement. Even on a very small scale, our support and ideas may be of great help for locals to cross from "the potential for natural resource management" to "the management of natural resources in a sustainable way".

Most of these ideas have been expressed before by several authors. Nevertheless, it is in the light of studies such as the one reported here, that they may have a meaning to primatologists facing fieldwork for the first time, to whom these suggestions are primarily intended.

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New Field Records of Night Monkeys, Genus *Aotus*, in Northern Brazil

According to Hershkovitz (1983), the night monkeys, *Aotus*, are comprised of nine allopatric species, of two natural groups distinguishable by karyotype, phenotype and geographic distribution. The first group includes the gray-neck species: *A.lemurinus* (*A.l.lemurinus* and *A.l.griseimembra*), *A.trivirgatus*, *A.vociferans*, and *A.brumbacki*. The second group, the derived red-neck species, includes: *A.azarae* (*A.a.azarae* and *A.a.boliviensis*). *A.miconax*, *A.nigriceps*, *A.infulatus*, and *A.nancymai*. In Brazil, night

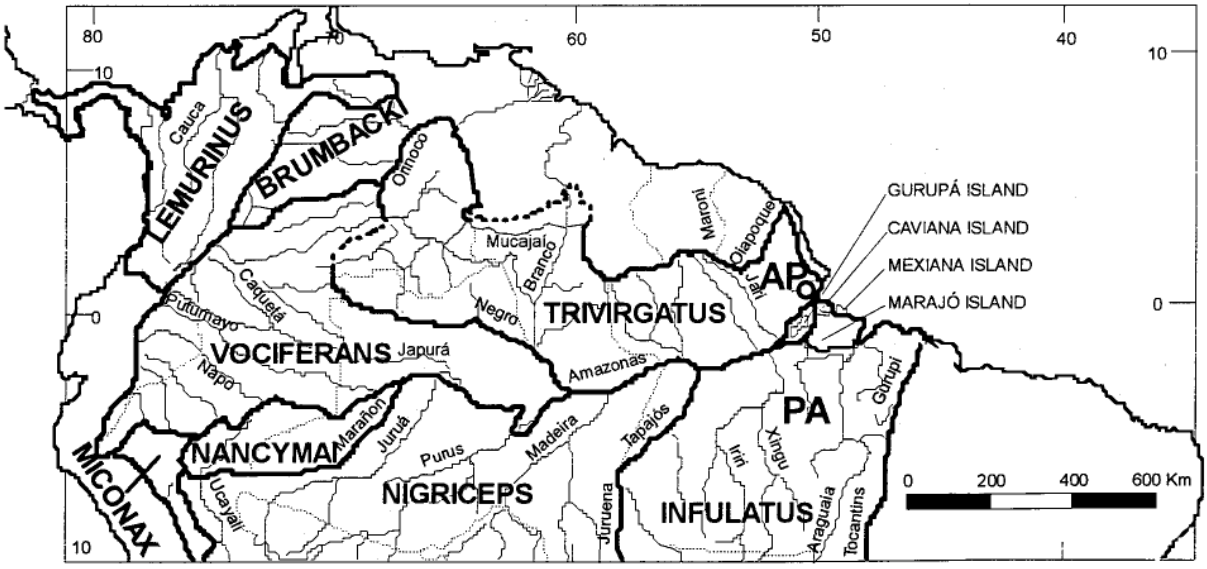

Figure 1. Map showing part of the distribution of the genus *Aotus* according to Hershkovitz (1983). O = Carmo do Macacoari. AP = state of Amapá and PA = state of Pará.