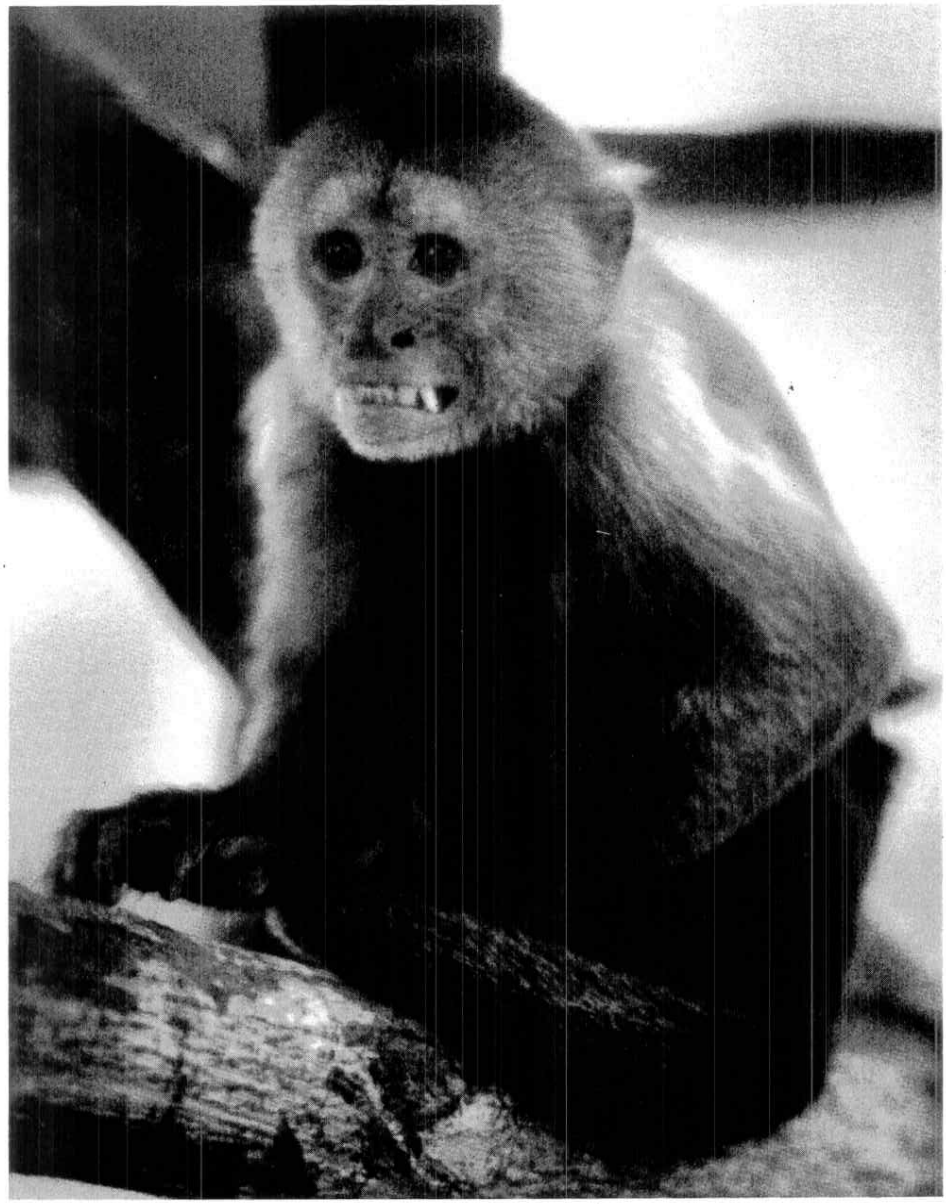
PRIMATE CONSERVATION

The Journal of the IUCN/SSC Primate Specialist Group

Numbers 12-13 1991-1992



Primate Conservation is produced and circulated courtesy of Conservation International and the Department of Anatomical Sciences of the State University of New York at Stony Brook.

CONSERVATION INTERNATIONAL

SPECIES SURVIVAL COMMISSION

IUCN

STONY BROOK

Front cover. Weeper capuchin (*Cebus nigrivittatus* = *olivaceus*) from Guyana, 1994. Photo by Russell A. Mittermeier.

A Word from the Editors

It gives me great pleasure to announce this issue, the first of three to bring *Primate Conservation* up to date and current for the first time in about six years. This number 12-13 covers 1991-1992, number 14-15 will cover 1993-1994, and number 16 covers 1995. Together with number 17 for 1996, already in preparation, we are now confident that we can produce the Journal on an annual basis.

For those of you who might not be aware of the history of the publication, it was launched in 1981, with the first four issues appearing under the title "The Newsletter of the IUCN/SSC Primate Specialist Group". In 1985 (number 5), it was given the title *Primate Conservation*, taking on the additional role of a journal. Its purpose was to link primate conservationists around the world, especially in habitat countries, and provide a global sense of community among those of us concerned with the long-term survival of these wonderful animals.

For the first ten issues, we included announcements of the various happenings in primate conservation: conferences, symposia, awards to members, etc. However, with the emergence of regional newsletters, beginning with *Asian Primates* in 1991, followed by *Neotropical Primates* and *Lemur News* in 1993, and finally *African Primates* to complete the set in 1995, there was no longer a need for an announcements section, and this was dropped as of number 11 (1990). The regional newsletters are now functioning very well, and the contact addresses for the five editors are provided on page 41. We believe that there continues to be a great need for rapid dissemination of newsworthy information on primates, and we feel that this combined format of regional newsletters 2-4 times per year plus a global yearbook of primate conservation is ideal, and will help to enhance communication among the world's primate conservationists still further. This combination of regional newsletters and a journal is also a first for an IUCN/SSC Specialist Group. Furthermore, we believe that it is important to produce these publications in a way that gives them a certain shelf-life, i. e., so that they are useful not just for a few months, but rather become permanent references in our field.

I am especially delighted to announce that, as of this issue, Dr. Anthony Rylands, Co-Vice Chair for the Neotropical Section of the PSG and co-editor of *Neotropical Primates*, has assumed responsibility for editing *Primate Conservation* as well. Anthony is an excellent editor and networker, and is far more responsible about meeting deadlines than your Chairman has ever been. Please give Anthony your full support and also your contributions to the Journal, so that we can make this publication of great use to all of us and something of which we can all be proud

Russell A. Mittermeier
Chairman, IUCN/SSC Primate Specialist Group

Anthony B. Rylands
Editor, *Primate Conservation*

Table of Contents

Neotropical Region

Asia

Primate Conservation 1991-1992 (12-13): 7-10

Patterns of Primate Mortality in a Drowning Forest: Lessons from the Tucuruí Dam, Brazilian Amazonia

Carlos A. Peres[1] and Andrew D. Johns[2]

[1] *Universidade de São Paulo, São Paulo, Brazil*
[2] *9 Garry Drive, Cambridge, England, UK*

With a gigantic fresh-water discharge system passing through 3.5 million km² of tropical forests, Brazil's grandiose plan to dam its Amazonian rivers and exploit their energetic potential have so far been impeded mainly by cash considerations. Should ELETROBRÁS, the Brazilian electricity company, ever put into practice its so-called "Plano 2010" - a regional development program which has pinpointed sites for 80 hydroelectric dams in the Amazon - a combined forest area of some 100,000 km² will eventually be flooded by man-made impoundments (Fearnside 1989). In 1985 ELETRONORTE, the northern subsidiary of ELETROBRÁS responsible for the Brazilian hydropower sector in the Amazon, did succeed in completing its first major dam in Amazonia, the Tucuruí Hydroelectric Dam on the Tocantins River, with the intention of generating 4000 MW, and at a cost of more than US$4 billion. This dam stopped short of being followed by seven other large and 20 smaller dams on this river and its tributaries, which would convert the Tocantins into an almost continuous chain of lakes, 1900 km long (Barham and Caufield 1984).

On 20th September 1984, the Tocantins river was dammed at Tucuruí, eastern Amazonia, creating a lake of some 2,430 km² at its top water level (Mascarenhas 1985), one of the few human constructions visible from space. Prior to the closure of the dam, ELETRONORTE commissioned a series of faunal inventories on both banks of the Tocantins river, in forest areas subsequently flooded. In addition, towards the final construction stages of this dam, ELETRONORTE mounted a large-scale, capital-intensive faunal "rescue" operation (named, "Operação Curupira"), targeted primarily at non-volant vertebrates which would be directly affected by the rapidly rising water level. The operation lasted seven months, involved some 470 people, and cost US$ 30 million. Data on the number of individuals of different species rescued by this operation have recently been made available by Mascarenhas and Puorto (1988). A total of 103,143 mammals, 3951 birds, and 100,822 reptiles were taken from a forest polygon currently occupied by the lake.

Animal densities in this area could be estimated prior to flooding for primates, but not for most other taxonomic groups. In this paper, we examine the effectiveness of efforts to rescue individuals of different primate species by combining population size estimates from line transect surveys that we conducted, and the actual numbers of animals rescued. We assume that much of the discrepancy between these two figures can be attributed to the differential mortality patterns of primates marooned in the canopy of thousands of effectively shrinking forest islands created by the gradually rising water level in this reservoir.

Methods and Assumptions

Between March and July 1984, we used line-transect censuses to survey primate communities in a number of undisturbed, non-flooded (*terra firme)* forest sites along what was then a section of the Tocantins river, upriver from Tucuruí, Pará (3°43' - 5°15'S, 49°00 - 50°00W). These surveys yielded relatively reliable primate population density estimates for five sites located between Marabá and Tucuruí (Johns 1986), where the hydroelectric reservoir currently stands (Fig.1).

We assume that the proportion of individuals of a given species successfully captured by small boats from large tree crowns in small forest islands (hereafter, rescue success) is (i) a direct function of the probability of animals being detected and subsequently captured; and (ii) an inverse function of the species-specific mortality induced by direct or indirect effects of the rising water-level. This is justified, given that capture effort by rescue teams deployed in aluminium boats powered by outboard engines remained constant across species: rescuers were instructed to capture all primates stranded in the islands without preferences to any given species. We also assume that these exclusively arboreal species were equally adept at climbing, and that they had comparable access to substrates above the water level during the filling of the lake, particularly the tallest treetops from which they were eventually rescued. The number of animals of different species rescued would thus approach a random sample of their residual abundance prior to and during the impoundment, provided that all species remained equally detectable to rescue teams. In addition, we assume that primate population sizes remained largely constant between the time the surveys were conducted and the time the dam was closed, a period of at most eight months. Indeed, it appears

that the negligible levels of forest disturbance and selective hunting during this relatively brief period did not noticeably change the total population size of primate species within the Tucuruí lake area.

Estimates of total population size took into account the vegetation composition of the reservoir area (detailed vegetation maps were provided by ELETRONORTE), and the habitat topography and vegetation types of each of the five forest sites surveyed (Johns 1986). Areas of open stands of babaçu palms (*Orbignya martiana* Barb. Rodr.), *campinas* (a low vegetation growing on leached white sands), and highly disturbed or cleared forest (which together accounted for 22.5% of the lake area) were excluded from the estimates because they were found to support few or no primates. Density estimates could not be calculated for dusky titis (*Callicebus moloch*) and night monkeys (*Aotus infulatus*) because these species were very rarely sighted: the extreme habitat specificity of the former, and the nocturnal habits of the latter, rendered them largely undetectable to or incompatible with our diurnal census routine. In order to strengthen our analysis, however, we arbitrarily assumed a mean crude density of one group per square kilometer for each of these two species, which appears to be a reasonable estimate, given approximate densities of these species in similar *terra firme* forest sites elsewhere in Amazonia (Peres 1993). In addition, we compiled data on the body size, ranging behavior, and intergroup spacing systems of all species. This is relevant because these variables can have a profound effect on each species' ability to survive the flooding period, which should ultimately affect its rescue probability. Mean adult body weights were taken from the published literature, or obtained from rescued animals in captivity. Since habituated groups were not followed systematically, we simply ranked the size of each species home ranges on the basis of well-studied conspecific populations in central-western Amazonia (e.g., Ayres 1981; Terborgh 1983; Peres 1993; E. Frazão pers. comm; W. Spironello pers. comm.). Spacing system here refers only to whether or not groups of a given species behave territorially. This has been well documented in the literature (see review in Mitani and Rodman 1979), and is clear for all species except for howler monkeys. Groups of this species consistently avoid one another (e.g., Whitehead 1987), but for the present purposes we consider them to be territorial because of their pronounced fidelity to space.

Survival Statistics

Primate communities within the Tucuruí reservoir area prior to the filling of the lake were dominated by howlers, squirrel monkeys, brown capuchins, and tamarins, whereas bearded sakis, night monkeys, and dusky titis were uncommon to rare (Table 1). However, this pattern was largely masked by the rescue operation: numbers of individuals of each species rescued were disparately different from those expected on the basis of calculated population sizes (x^2 = 2 6,657,6 df, $p<0.001$). In general, rescue success of large-bodied species was substantially greater than those of small species; mean adult body mass alone explained 86% of the variation in the number of animals rescued ($r = 0.93$, $p = 0.001$), and 78% of the variation in rescue success ($r = 0.88$, $p = 0.004$). The smallest species, squirrel monkeys and tamarins, showed the lowest rates of capture. Only howler monkeys showed greater than expected numbers captured, whereas dusky titis showed a number of captures not significantly different to that expected (Table 1).

The overwhelming effect of body size on the observed rescue success resulted from either the higher mortality of small-bodied primates during flooding, or the fact that these species were less detectable (and hence more difficult to capture) to rescue teams. Although the reservoir water was taken straight up to its maximum level of 72 m (at the dam site), the fill required more than six months to be completed. This gradual flooding inevitably resulted in a prolonged period of food stress to the arboreal fauna trapped in the several thousands of small canopy islands, which became smaller and more densely overcrowded each day. This was particularly the case for frugivores, which would have to move widely between fruiting trees, which in any case probably aborted their maturing fruit crops because of water-stressed conditions. Indeed, the only primate species which were not underrepresented in the rescue sample - howlers and titis - are partly folivores, and feed on a clearly more abundant resource, which was far less affected by the filling. Irrespective of dietary category, however, the physiological ability of large-bodied species to cope with long fasts is considerably greater (Lidstedt and Boyce 1985), which would suggest a longer survival time in isolated treetops, even if levels of famine remained high across most other species.

We further tested whether a species' ranging behaviour affects its survival during flooding in a predictable manner. It should be expected that wide-ranging species are subject to lower mortality rates because they are less prone to isolation in treetop islands because of their greater ability to move away from flooding valleys into hills and ridges. Should this be the case, our rank of home range size would correlate positively with rescue success. In contrast, however, we found a negative, but not significant, correlation between these two variables ($r_s = 0.64$, $n = 7$, $p = 0.12$). We

Table 1. Population size, rescue success, and species characteristics of primates in the Tucuruí Hydroelectric Reservoir area.

Primates Species[a]	Body Mass Kg	Diet[b]	Population Size No	%	No of animals Rescued Obs.	%	Exp.	Rescue Success	Range size Rank	Territorial
Saguinus midas niger	0.5	In, Fr	13842	15.0	1073	4.0	4041	7.8[c]	4	+
Saimiri sciureus	0.8	Fr, In	20603	22.3	1747	6.5	6015	8.5[c]	6	-
Aotus infulatus	0.9	Fr, In	4708	4.1	627	3.5	1100	13.3[c]	3	+
Callicebus moloch	0.4	Fr, Fo	3767	5.1	941	2 3	1374	25.0	1	+
Chiropotes satanas utahicki	2.5	Fr, Ys	7439	8.0	543	2.0	2172	7.3[c]	7	-
Cebus apella	2.6	Fr, In	16234	17.5	2580	9.6	4739	15.9[c]	5	-
Alouatta belzebul ululata	6.5	Fo, Fr	25914	28.0	19496	72.2	7566	5.2[c]	2	+
Total	-	-	92507	100.0	27007	100.0	27007	100.0	-	-

[a] Taxonomy follows Hershkovitz (1984, 1985, 1990).

[b] Diet: Fr = ripe fruits; Fo = foliage; Ys = young seeds; In = insects.

[c] Significant post-hoc contributions to overall chi-square value (Brown 1974).

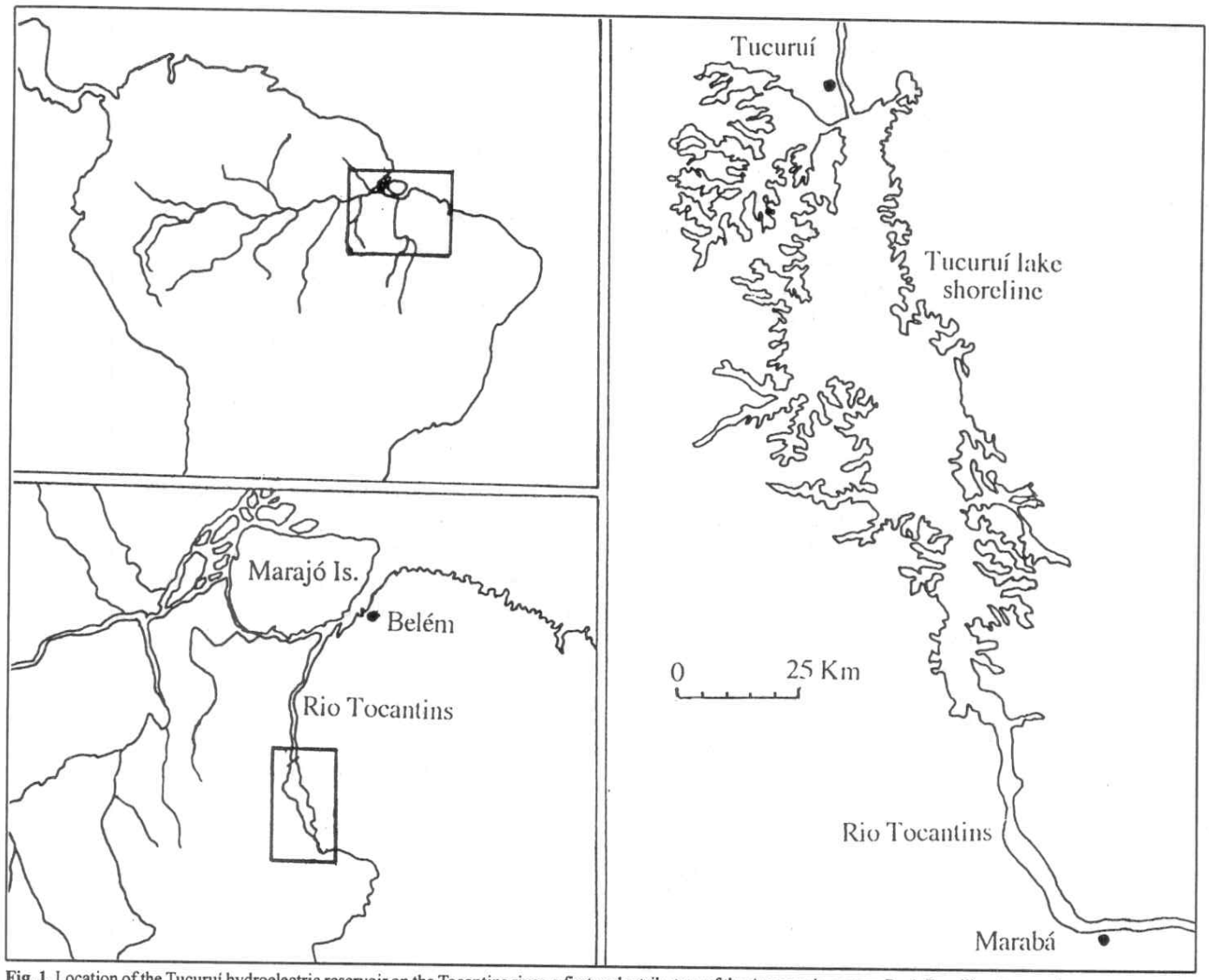


Fig. 1. Location of the Tucuruí hydroelectric reservoir on the Tocantins river, a first-order tributary of the Amazon in eastern Pará, Brazilian Amazonia.

thus dismiss the possibility that wide-ranging movement patterns *per se* enhance a primate species' rescue probability. The same can be applied to territorial behavior; intergroup territoriality may discourage groups from escaping flooding on their own accord, even if they used peripheral areas of the reservoir, because of their reluctance to move into areas already occupied by other groups. We found, however, that the rescue success of territorial species was no different to that of non-territorial species (if howler monkeys are considered territorial, $z = 1.06$, $p = 0.29$; if non-territorial, $z = 0$, $p = 1.0$; Mann-Whitney U tests).

We conclude that the most important factor influencing the frequency of captures of primates is a species' ability to survive for long periods while stranded in isolated treetops, which can be largely predicted from body size. This, in turn, is probably an effect of a corollary ability of large vertebrates to endure prolonged fasts, and resort to alternative food sources during periods of pronounced food stress. It seems less likely that the greater detectability of larger primates can alone account for their remarkably greater representation in the rescue sample. For instance, species' mean group size (which clearly affects detectability) had no affect on rescue success ($r = 0.11$, $p = 0.80$). Body size alone largely affects the ability of Amazonian primates to coexist with other forms of human disturbance, such as selective logging, subsistence/shifting agriculture (Johns and Skorupa 1987) and selective hunting (Peres 1990). Further work would help to clarify the relationship between the allometric effects of body size and a species' tolerance to human disturbance.

In the aftermath of Tucuruí, ELETRONORTE has made a greater effort to improve its faunal management policies as directed at two recent dams in Amazonia (Balbina, in the state of Amazonas: Fearnside 1989; Samuel, in the state of Rondônia: Lemos de Sá 1992). The real conservation value of rescue operations, however, remains highly controversial, calling into question the fate of forest wildlife displaced by such pharaonic development projects (Johns 1986). In the case of Tucuruí, ELETRONORTE commissioned no preliminary studies aimed at defining appropriate sites for translocations of captured animals, which in the end were in fact released on the nearest piece of dry land (Johns 1986). Although no follow-up studies attempted to determine the fate of these animals, post-release mortality in already overcrowded lake fringe areas was probably extremely high, eventually resulting in a local population no greater than that of the original resident one through a process of resource-dependent density relaxation. The moral dilemma remains in that few would

Until 1987, transect censuses in the Pando had produced just one sighting of Goeldi's monkey, and the belief that it was to be found there in considerable numbers was supported largely by evidence from word of mouth. On the basis of the single sighting and reports from local people, Pook and Pook (1979) indicated the population density of Goeldi's monkey to be in the order of 0.25 groups/km². From eight sightings, of at least four groups made during the 1987 survey, the population density was estimated to be 1.6 groups/km². The imprecision of the census technique means that the true figure probably lies somehow between these two estimates, but our estimate, coming as it does from a far greater amount of censusing, provides strong evidence that reasonable numbers are present (Cameron *et al.* 1989).

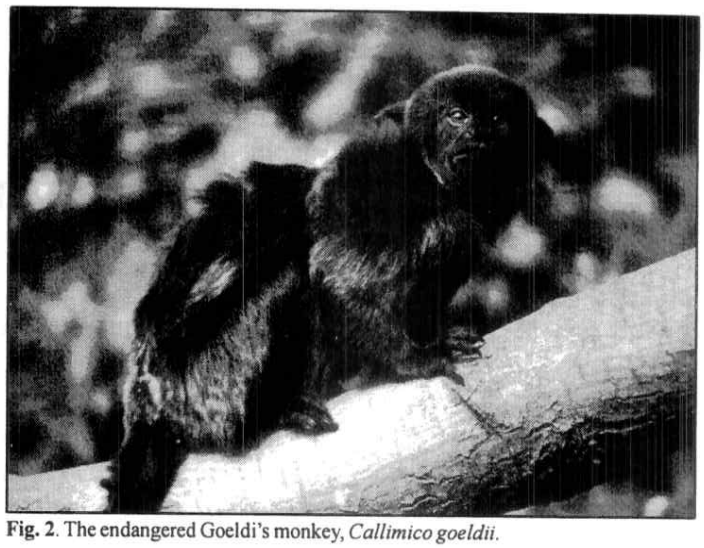


Fig. 2. The endangered Goeldi's monkey, *Callimico goeldii*.

Human Population

The forests of the area have been inhabited by people of European descent since the end of the eighteenth century. Over most of the area, the population density is of the order of 0.4 individuals/km². The majority live in single family units in small clearings, each separated by a few kilometers.

Most families own little livestock, and depend on the forest fauna for animal protein. What essentials cannot be grown or obtained from the forest are traded with rubber latex and Brazil nuts. Both the rubber trees, *Hevea* sp. and Brazil nut trees (*Bertholletia excelsa*) occur naturally throughout the forest. The susceptibility of rubber trees to disease epidemics makes plantations in the area unviable. For their exploitation it may be essential that they are separated by a variety of forest species. The livelihood of all of the forest people depend upon continued demand for rubber.

Subsistence Hunting

Some of the native fauna have suffered greatly at the hands of hunters (Pook and Pook 1979), but the major part of their decline may have been confined to the early part of the century during the height of the rubber trade, when the human population density was considerably higher than it is now. Population density estimates calculated from the results of transect censuses in 1975, 1979 and 1987 (Heltne *et al.* 1975; Pook and Pook 1979; Cameron *et al.* 1989) show no clear reduction in the population densities of any of the primates commonly favored as food species (see Table 1).

Table 1. Population density estimates. 1 = Cameron *et al.* 1989, 2 = Pook and Pook, 1979, 3 = Heltne *et al.*, 1975.

Scientific name	Groups (km²)		
	1	2	3
	1987	1979	1975
Saguinus fuscicollis weddelli	4.2	5.5	4.6
Saguinus labiatus labiatus	2.8	3.6	4.6
Callimico goeldii	1.6	0.25	-
Saimiri boliviensis boliviensis	0.2	0.7	0.6
Callicebus brunneus	2.4	2.1	4.9
Pithecia irrorata	1.0	0.3	1.1
Cebus apella apella	0.6	1.0	0.7
Cebus albifrons	0.2	-	-
Alouatta seniculus	0.4	0.3	-
Aotus nigriceps	-	-	-

There remains a variety of alternative food species, and the frequency with which each family shoots primates, as opposed to other animals, is more a matter of personal preference than of availability. All of the species, except the pygmy marmoset, are favored as food by some and not by others, and since each area is in general hunted by only one family, there may remain areas where species are under little or no hunting pressure. For these reasons we do not consider the current level of subsistence hunting a short term threat to the area's primate populations and do not discount the possibility that it is sustainable. In addition, there appears little reason to believe that the human population is growing. Thus a significant increase in hunting pressure seems unlikely.

Habitat Alteration

Disturbance of the forest vegetation is limited to the inhabited clearings, areas of shifting cultivation, "chacos", and the establishment of narrow rubber trails and paths. Every year most families clear an area of between one and 3 ha for cultivation. The soil remains fertile for only two or three years, after which it is left to regenerate. The areas are normally re-used for cultivation after about 10 years. As a result, the amount of forest disturbed for this purpose remains confined to a small ring of land around each house.

Eight of the primate species observed during the 1987 survey were seen in secondary forest adjacent to inhabited clearings, and its alteration may actually have enhanced the habitat for some of them. Goeldi's monkey inhabits scrub forest, with well developed undergrowth, with or without stands of bamboo. By increasing the amount of this type of vegetation, human activity may encourage higher numbers of the species.

Commercial Trapping

Transect census estimates of the population density of the red-bellied tamarin, *Saguinus labiatus*, show clear reductions between

Fig. 3. Forest clearance for "chacos".

1975, 1979 and 1987. The species is little favored as food and, in areas where it was not trapped for export, it is considered to occur at densities higher than the 1987 estimates (Buchanan-Smith 1990). Between 1974 and 1981, an estimated 1,500 were removed from the area each year. Thus its decline is almost certainly due to commercial trapping. Large scale export of the saddle-back tamarin, *Saguinus fuscicollis weddelli*, is reported to have begun around 1977 and its estimated population density shows a clear reduction between 1979 and 1987. In addition, the populations of both Goeldi's monkey and the emperor tamarin are believed by local people to have been reduced through trapping and exportation.

Reports of local people and individuals involved with the primate trade suggest that commercial trapping in the Pando ceased in 1981 or 1982, and there followed a total ban on the capture for export of all Bolivian primates. The ban expired in 1989, and the current situation is not known to the authors.

Development and Deforestation

In 1979, Pook and Pook reported the threat of deforestation from government development schemes, road construction and resettlement plans. West of the Department's capital, Cobija, the extent of habitat destruction has been largely confined to within 10-15 km of the town. But the threats outlined, in addition to that of cattle ranching, remain. To the east and south of Cobija, large areas have been cleared for cattle ranching and, because of the lack of capital to clear land, the cattle are kept at stocking rates usually double those which would be sustainable.

Political Importance

Throughout its history, Bolivia's national boundaries have been eroded by the surrounding countries. The political importance of the north-west Pando, at the junction of three countries, should not be underestimated. Even now its population is largely Brazilian, and government action to establish its Bolivian identity would not be surprising.

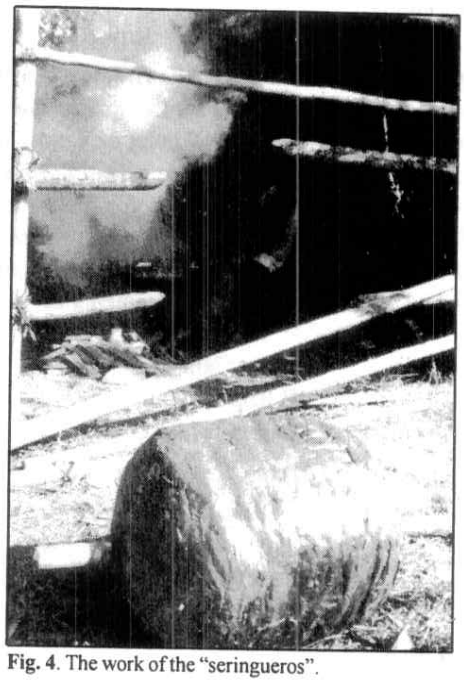


Fig. 4. The work of the "seringueros".

The Seringueros

In the light of the threats to the forest, unions of rubber tappers, "seringueros", have collectively expressed their interest that the forest should remain, so that their way of life may continue. Within the forest, seringuero unions represent an overwhelming local consensus in favor of forest conservation, and in the adjacent area of Brazil have made considerable advances in promoting plans of rational forest exploitation. Should the demand for rubber cease, the consensus may be removed. There would be no choice for many but to turn to agriculture, requiring large scale forest clearance.

Current rubber plantation development in São Paulo, Brazil, provides a significant threat to conservation in the Pando. Should it be successful, rubber from the Pando may become less competitive and livelihoods other than latex collection may become more lucrative.

Outlook

The human population of the forest depends on its environment for a multiplicity of resources, including animal protein, areas of cultivation, rubber latex and Brazil nuts. Use of all of these appear sustainable. Together they provide strong grounds for optimism. However, long term plans for conservation in the area seem impractical, for they would be entirely subordinate to the vagaries of its political importance and the demands of the rubber trade.

The ban on the capture for export of all Bolivian primates expired in 1989 and prospects for the country's primate fauna as a whole, depend on the legislation to follow this ban. A Presidential decree recognizes the need for population data so that levels for sustainable export may be set. Bolivia's primate fauna constitutes a sizable resource which, if properly managed, could provide the country with a valuable and continued supply of much needed foreign revenue.

Acknowledgments

Foremost we are grateful to Chris Wiltshire, Charles Foley, Nigel Dougherty, Luis Rea and Ximena Aramayo for their participation in the Bolivia'87 survey. Thanks are also due to Reginald Hardy (Prodena Bolivia) for logistical help; the Centro de Desarollo Forestal, for permission to carry out the research; Max Nicholson, Jonathan Kingdon and Mario Baudoin, for their encouragement and official support of the Bolivia'87 survey; Jeorge Franco, Galindo Franco and Edilio Nascimiento for their help in the field; and Dr. Hilary Box and Dr. Tim Jordan for comments on a draft of this article.

Robert Cameron
2B Roman Way
London N7 8XG, UK.

and

Hannah M. Buchanan-Smith
Department of Psychology
University of Stirling
Stirling FK9 4LA, UK.

Literature Cited

Buchanan-Smith, H. M. 1990. Polyspecific association of two tamarin species, *Saguinus labiatus* and *Saguinus fuscicollis* in Bolivia. *Am. J. Primatol.* 22: 205-214.

Cameron, R., C. Wiltshire, C. Foley, N. Dougherty, X. Aramayo and L. Rea. 1989. Goeldi's monkey and other primates in northern Bolivia. *Primate Conservation* (10):, 62-70.

Freese, C. H. 1975. A census of non-human primates in Peru. In: *Primate Censusing Studies in Peru and Colombia*, pp. 17-41, Pan American Health Organisation, Washington, D.C.

Heltne, P.G., C. H. Freese and G. Whitesides. 1975. A field survey of non human primate populations in Bolivia. Final Report. Pan American Health Organization, Washington, D. C.

IUCN. 1982. *The IUCN Mammal Red Data Book. Part 1. Threatened Mammalian Taxa of the Americas and the Australasian Zoogeographic Region (excluding Cetacea).* J. Thornback and M. Jenkins (compilers). The World Conservation Union (IUCN), Gland.

Izawa, K. 1979. Studies on the peculiar distribution pattern of *Callimico. Kyoto University Primate Research Institute, Reports of New World Monkeys* (1979): 23-41.

Pook A. G. and G. Pook. 1979. A field study on the status and socio-ecology of the Goeldi's monkey (*Callimico goeldii*) and other primates in northern Bolivia. Unpubl. Report. New York Zoological Society, New York.

Southwick, C. H. and F. C. Cadigan. 1972. Population studies of Malaysian primates. *Primates* 13: 1-18.

Soulé, M. E. 1980. Thresholds for survival: maintaining fitness and evolutionary potential. In: *Conservation Biology*, M. E. Soulé and B. Wilcox (eds.), pp.151-169. Sinauer Associates, Inc., Sunderland.

Received for publication: February 1990
Revised: September 1994

Primate Conservation 1991-1992 (12-13): 15-23

Distribution and Status of the Golden-Headed Lion Tamarin, *Leontopithecus chrysomelas*, in the Atlantic Forest of Southern Bahia, Brazil

Anthony B. Rylands[1], Ilmar B. Santos[2] and Russell A. Mittermeier[3]

[1] *Departamento de Zoologia, Universidade Federal de Minas Gerais, Belo Horizonte, Minas Gerais, Brazil*
[2] *Fundação Biodiversitas, Belo Horizonte, Minas Gerais, Brazil*
[3] *Conservation International, Washington D. C., USA*

Introduction

Although the destruction of their natural habitats in the Atlantic coastal forest and the Rio Paraná basin, Brazil, makes it difficult to identify their original distributions, even in historic times, the fact remains that, today, wild populations of the lion tamarins, *Leontopithecus rosalia*, *L. chrysomelas*, *L. chrysopygus*, and *L. caissara*, are isolated from each other by distances of 600-1000 km. Coimbra-Filho (1970) and Coimbra-Filho and Mittermeier (1972) indicated that the center of distribution for the genus was the coastal forest region of the state of Rio de Janeiro. From there the ancestral form spread north to at least southern Bahia, and perhaps the Rio São Francisco, and west to the Rio Paraná in the state of São Paulo, and, on the basis of pelage color patterns, they argued that the present-day forms represent remnants of a once-continuous clinal variation. The disjunct distributions seen today have resulted from climatic changes during the Pleistocene and late Tertiary, which eliminated lowland forests (for example, in the state of Espírito Santo), leaving isolated populations in so-called "forest refuges" (Kinzey 1982), and in historic times through forest destruction by man. The lowland coastal range of *L. caissara*, in the extreme north of the state of Paraná, and neighboring São Paulo, is separated from that of *L. chrysopygus* by the Serra do Mar (Lorini and Persson 1990). Today, forest destruction is not merely a contributing factor to the isolation of *Leontopithecus* but threatens their very survival.

Until the 1980's, the only information available on the distribution, habitat preference, and ecology of the northernmost form, *L. chrysomelas*, was provided by Coimbra-Filho and Mittermeier (Coimbra-Filho 1970; Coimbra-Filho and Mittermeier 1972, 1973, 1977; see also Hershkovitz 1977). Further information was later obtained by Mittermeier and co-workers during a major study of the distributions of all of the eastern Brazilian primates in 1979-1980 (Mittermeier *et al.* 1981, 1982), and also by William Oliver and Ilmar Santos and their co-workers during similar studies in 1983 and 1986-1987 (Santos *et al.* 1987; Oliver and Santos 1991). Some distribution data were also obtained by Rylands during an ecological study of the species at Una, southern Bahia, in 1980 (Rylands 1982, 1983, 1984, 1989).

Ballou (1989) detailed the situation regarding the captive population of golden-headed lion tamarins (see also Mallinson 1989; Mace 1990), and in this paper we review the current knowledge of the distribution of *Leontopithecus chrysomelas*, and discuss its status in the wild.

Distribution and habitat

Coimbra-Filho and Mittermeier (1973, 1977) described the range of *L. chrysomelas* as the south of the state of Bahia, between the Rio de Contas (14°S) in the north and the Rio Pardo (15° 05'S) in the south, limited inland to the coastal forest, which Coimbra-Filho and Mittermeier (1977) indicated as approximately 50 km wide. The occurrence of *L. chrysomelas* to the south of the Rio Pardo, just south of the Rio Mucurí on the border between the states of Bahia and Espírito Santo, reported by Ruschi (in Coimbra-Filho and Mittermeier 1973), proved erroneous (Coimbra-Filho and Mittermeier 1973; see also Oliver and Santos, 1991). Hershkovitz (1977) also concluded that the Rio de Contas marked the northern limit to its range, although his southern limit is somewhat confused due to his placing the Rio Pardo as a northern affluent of the Rio Jequitinhonha (= Rio Belmonte), a mistake repeated in the distribution map of Forman *et al.* (1986) and Rylands (1989). Hershkovitz (1977), therefore placed the Rio Belmonte and Rio Pardo as the southern limit.

Coimbra-Filho (1970) suggested that the distribution of *L. chrysomelas* may extend to the municipalities of Camamú and Maraú, north of the Rio de Contas. Despite the fact that respectable stretches of forest still exist in these areas, there is no evidence that *L. chrysomelas* ever occurred there (Coimbra-Filho in litt. to Hershkovitz, 1977; Oliver and Santos 1991; Santos unpubl. data).

The surveys of Santos and co-workers provided evidence that the distribution of the golden-headed lion tamarin is rather larger

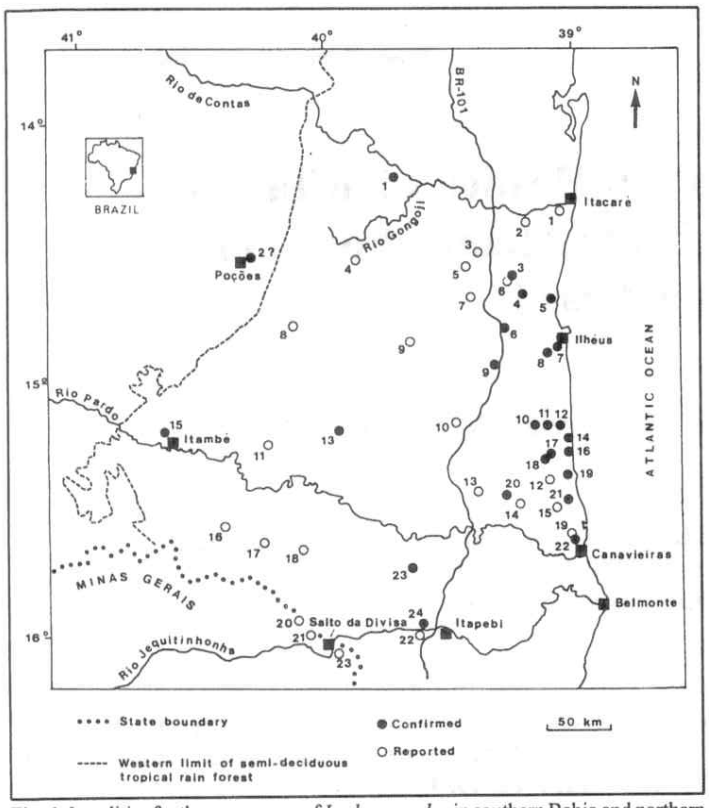


Fig. 1. Localities for the occurrence of *L. chrysomelas* in southern Bahia and northern Minas Gerais, Brazil.

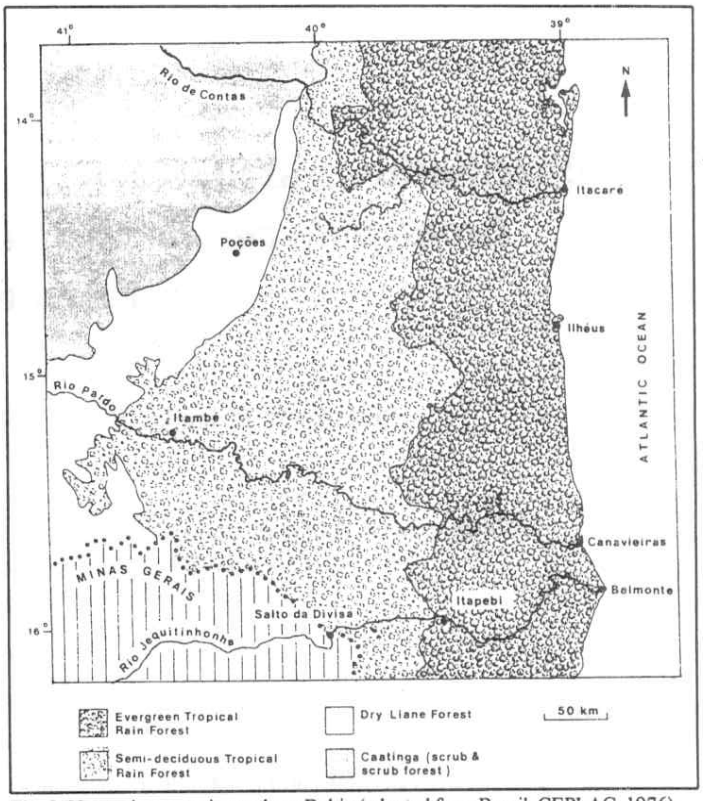


Fig. 2. Vegetation types in southern Bahia (adapted from Brazil, CEPLAC, 1976).

than previously thought (Santos *et al.* 1987; Oliver and Santos 1991). Near to the coast, the northern limit is marked by the Rio de Contas, although there is no evidence for its presence south of the upper and middle reaches of the river. The northernmost locality is that of O. Pinto on the Rio Gongojí in 1932 (Fig. 1, confirmed locality No. 1, see Appendix). However, in 1983 Santos found that local hunters did not recognize *L. chrysomelas* north of the Rio Gongojí, indicating that it is now either extremely scarce or extinct in this region. The northernmost records in recent times are those of R. A. Mittermeier (reported not seen in 1980) just south of the lower Rio de Contas (reported Nos. 1 and 2). Further south, the westernmost record is that of Wied-Neuwied in 1815/1817 for Barra da Vereda, upper Rio Pardo (confirmed, No. 15), although recent surveys have also failed to confirm its continued existence there. Inland, we suggest that the range of *L. chrysomelas* is restricted to the western limit of the remnant fragments of semi-deciduous forest (Fig. 2, and see below). Only the record for Poções (confirmed No. 2) lies outside the distribution of this forest type, and it would seem probable that this refers to the municipality of Poções, which extends into the semi-deciduous forest to the east.

Napier (1976) gave the type locality as including the Rio Belmonte (= Rio Jequitinhonha), south of the Rio Pardo (see Appendix 1), and Oliver and Santos (1991) confirmed its presence there, observing lion tamarins just to the north of the river in the municipality of Itapebí (confirmed, No. 24) in Bahia. Curiously, although Santos and G. A. B. da Fonseca observed *L. chrysomelas* between the Rios Pardo and Jequitinhonha in the Fazenda Santa Inês, municipality of Itapebí, in 1986-1987 (confirmed, No. 23), Oliver and Santos (1991) were unable to obtain any evidence that it had ever occurred east of this locality, between the lower reaches of these rivers. Interviews with local hunters strongly indicated that *L. chrysomelas* occurs north of the Rio Jequitinhonha, to the west of Itapebí, in the state of Minas Gerais in the municipality of Salto de Divisa (reported, Nos. 20-23) and possibly also Jordânia. Upriver from there, however, the forest has been almost completely destroyed, and the middle section of the Rio Jequitinhonha (west from approximately 41° 15'W) is today characterized by desert scrub (*caatinga*). The only localities where *L. chrysomelas* has been recorded south of the Rio Jequitinhonha are just south of the town of Salto de Divisa in the state of Minas Gerais (reported, No. 23), and just west of the BR-101 highway in the municipality of Itapebí (reported, No. 22). These records south of the Rio Pardo could have resulted from introductions, or alternatively, as strongly argued by Coimbra-Filho (pers. comm.), are most probably a recent range extension due to the extreme silting-up of the Rios Pardo and Jequitinhonha due to a long history of mining, and the destruction of the forests in the region, pushing the animals south. This argument is reinforced by the fact that Prince Maximilian zu Wied-Neuwied, a meticulous observer, recorded the species only to the north of Rio Pardo (Wied-Neuwied 1940).

The distribution of *L. chrysomelas* coincides with that of the evergreen and semideciduous tropical forest, as plotted by CEPLAC (1976) (Fig. 2). The former is a tall humid forest with a high diversity of tree species, a closed canopy at heights reaching 30-40 m, and extremely abundant in epiphytes (Orchidaceae, Bromeliaceae). Rainfall in this area is not seasonal, and averages rather more than 2000 mm per year. *L. chrysomelas* has also been found in the *restinga* (coastal forest on sand, accompanying the coastline) (confirmed, No. 23, Fig. 1). The semi-deciduous forest is similar in appearance but with fewer large trees, a higher tree

density, and an undergrowth characterized by Ciperaceae and Bromeliaceae. The climate is drier (annual rainfall of approximately 1000 mm) with marked wet and dry seasons. The dry liana forest (*floresta de cipó*) is undoubtedly a barrier to *L. chrysomelas*. As the name suggests, lianas are abundant and trees are generally slender-trunked, deciduous, and dense. The annual rainfall is approximately 800 mm. The vegetation west of this region and along the middle Rio Jequitinhonha is a xerophytic thorn scrub (*caatinga*) with few remnants of deciduous scrub forest (*caatinga arbórea*). Seasonality of rainfall exists, although the rains are unpredictable.

Ecology and Status in the Wild

Ecology

L. chrysomelas is syntopic with the marmoset, *Callithrix kuhli*. Although group sizes of both are similar (mean 6.6, s.d. = 1.3, range 5-9, n = 8 groups for *C. kuhli*; mean 6.7, s.d. = 1.5, range 5-8, n = 3 groups for *L. chrysomelas*; Rylands 1982, 1983, 1989), densities of *C. kuhli* are much higher. Population surveys (repeat transect method, see NRC 1981) in the Lemos Maia Experimental Station at Una, provided estimates of 8.7-9.1 groups or 50-68 individuals/km² for *C. kuhli*, whereas densities of *L. chrysomelas* ranged from 0.9 to 3 groups or 5 to 17 individuals/km² (Rylands 1982, 1989).

The reason for this difference lies in the larger home ranges used by the *L. chrysomelas* groups; approximately 40 ha compared to 10-12 ha for *C. kuhli*. The difference in home range size is correlated with differences in their feeding behavior and animal prey foraging techniques (Rylands 1989). The plant part of the diet of *C. kuhli* is rather more diverse in terms of the number of species used; and plant exudates, obtained by gouging, are also important. *L. chrysomelas* is unable to exploit plant exudates, except when they are readily available, but, with its larger home range, is able to benefit from a larger number of individuals of a particular fruiting species; increasing availability in terms of both space and time. Whereas *C. kuhli* forages for animal prey using a foliage gleaning strategy in the lower canopy and middle strata of the forest, *L. chrysomelas* is considerably more manipulative, exploiting larger prey in specific and more widely dispersed sites such as rotten bark, litter and humus piles, and especially tank bromeliads, in the upper levels of the forest (Coimbra-Filho 1970, 1978; Coimbra-Filho and Mittermeier 1973; Rylands 1982, 1983, 1984, 1989).

Whereas *C. kuhli* is able to survive, and even thrives, in secondary forest and degraded mature forest, it appears that *L. chrysomelas* is dependent on tall mature lowland forests (Coimbra-Filho 1970; Coimbra-Filho and Mittermeier 1973, 1977; Rylands 1982, 1989). Reasons for this are still unclear but are undoubtedly related to its foraging behavior, especially its use of epiphytic bromeliads, and also its use of holes in tree trunks as sleeping sites (*C. kuhli* uses patches of dense vegetation) (Coimbra-Filho 1977; Rylands 1989). Both of these resources are absent from secondary forests. In addition, an analysis of the ranging patterns of *L. chrysomelas* demonstrated a preference for forests on slopes and most especially stream valley bottoms (Rylands 1982, 1989). This has also been observed for *L. rosalia* by Peres (1984, 1989) and may also be true for *L. chrysopygus* (C. Valladares-Padua pers. comm.). The exact reason for this preference is unknown, although probably related to key food resources, but indicates that *Leontopithecus* is a habitat specialist even within mature forest, and may be dependent on the distribution of a limited number of key species, especially during times of fruit shortage, when nectar, for example, is important. An important species providing nectar for both *L. rosalia* and *L. chrysomelas* is *Symphonia globulifera*, a tree restricted to stream valley bottoms (Peres 1984, 1989; Rylands 1982, 1989).

Status and Threats

As indicated above, in comparison to the sympatric marmoset *C. kuhli*, *L. chrysomelas* is naturally more scarce and, unlike *C. kuhli*, is dependent on tall mature forest; features which render it more susceptible to hunting and forest destruction. For these reasons, despite the fact that populations of these two species are confronting the same depredations to their habitats, *C. kuhli* may at best be considered vulnerable, whereas the status of *L. chrysomelas* has long been recognized as endangered (Coimbra-Filho 1970; 1984; Mittermeier *et al.* 1981, 1982). *L. chrysomelas* is completely protected by Brazilian Law, being included on the Official List of Brazilian Fauna Threatened with Extinction (Edict No. 1522/19 December 1989, see Bernardes *et al.* 1990). It is categorized as endangered by the International Union for the Conservation of Nature (IUCN, 1982), and is also on Appendix I of the Washington Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), which was signed by Brazil in 1975 (see Inskipp and Wells 1979; Mack and Mittermeier 1984).

The strip of evergreen humid forest within the range of *L. chrysomelas* (Fig. 2) is the principal cocoa growing region of Brazil. A number of other perennial crops are also of increasing importance, including rubber, cloves, pepper, coconuts, African palm oil, and coffee. Extractivism is limited mainly to the fibers of the *piaçava* palm, *Attalea funifera*, used for thatching and floor brushes, and common in the coastal forest and *restinga*. The second most important activity, especially in areas where soils are unsuitable for cocoa plantations, and inland in the semi-deciduous forests, is cattle-ranching. All these activities involve forest clearance, although one method of cocoa cultivation is that called *cabruca*, predominant in some regions, although little practiced today, where some of the larger trees are left standing to provide the necessary shade for the cocoa trees (Alves 1990). Lion tamarins have been observed in *cabruca*, although in all cases in close proximity to intact forest (Coimbra-Filho and Mittermeier 1973; Rylands 1983; Alves 1988, 1990; Santos unpubl. data).

In the past, forest clearance in southern Bahia was largely restricted to that necessary for agriculture. Timber exploitation was limited to selective logging for a few species, such as jacarandá (*Dalbergia nigra*) and pau brasil (*Caesalpinia echinata*), stocks of which have long since been largely exhausted (see Rizzini and Mattos Filho 1986). Magnanini (1978) estimated that by 1975 the state of Bahia maintained only 5% of its original forest cover. Considering only the cocoa-growing region of southern Bahia, Vinha *et al.* (in Brazil, CEPLAC 1976) estimated that, by 1975, 82.5% of the evergreen rain forest, and 93.3% of the semi-deciduous for-

est had been destroyed. However, in the last two decades, the timber industry has increased its presence dramatically, in part because of the almost total depletion of the forests in the neighboring state of Espírito Santo. A. F. Coimbra-Filho, visiting southern Bahia in 1969, recognized the importance of the area of intact primary forest in the municipality of Una as presenting the only significant possibility for the establishment of a reserve for *L. chrysomelas*, although even then some parts were already being destroyed (Coimbra-Filho 1970). In 1980, the small town of Una had seven sawmills. By 1986 this number had increased to 18, and by 1989 to 23. Another factor contributing to the increase in forest cutting in recent times is the Agrarian Reform Policy of the Brazilian Government. Farmers are cutting remaining tracts of forest under threat of the appropriation of unused farmland for the establishment of small-scale farming and settlement schemes. In addition, a recent increase in the incidence of Witch's broom disease, an incurable fungus infection of cocoa, along with poor cocoa prices on international markets (resulting from the expansion of cocoa plantations in the Far East), indicate the threat of large areas of cocoa plantations being abandoned, and converted into coconut or African oil palm plantations and cattle pasture. An increase in these activities will undoubtedly result in further forest destruction concomitant with a change in the socioeconomic scenario of the region (M. de Menezes, CEPLAC, pers. comm., 1991).

Although a recent decree prohibited all cutting of the Atlantic forest (Decree No. 99.547/25 December 1990), the Brazilian Government authorities lack personnel and finance necessary to carry out any effective fiscalization of the continuing and now illegal destruction of the Bahian forests.

Besides forest destruction, a second and significant factor endangering wild populations of *L. chrysomelas* is illegal hunting and capture for the pet trade. Mallinson (1984) alerted that illegal export, via Bolivia, Guyana and French Guiana, increased dramatically in the early 1980's with at least 50 individuals appearing in France, Belgium, Japan and Hong-Kong in 1983 alone. However, illegal trade within Brazil is undoubtedly even more substantial and injurious than the international trade. Golden-headed lion tamarins, along with other callitrichids, are commonly sold in the markets of such tourist resorts as Belém, Recife, São Luiz, Ilhéus, Salvador and Rio de Janeiro. Although no official records or data are available to illustrate the problem, in 1983 Santos (unpubl. data) registered nine *L. chrysomelas* for sale in various localities in the area between Ilhéus and Canavieiras in just one month. Also in 1983, 19 *L. chrysomelas* were offered illegally by an animal dealer to the Sorocaba Zoo in the state of São Paulo (eventually placed in the São Paulo Zoo). There is no doubt that active and lucrative trading continues unabated.

Protected Areas

The only reserve protecting golden-headed lion tamarins in the wild is to the north of the town of Una: the Biological Reserve of Una, administered by the Brazilian Institute for the Environment and Renewable Natural Resources (Ibama) (Fig. 1, confirmed locality No. 11). Coimbra-Filho (1984) estimated that in 1976 there was approximately 15,000 ha of continuous forest in this region. As a result, the government acquired 5,250 ha, although the Reserve was decreed in December 1980 with 11,400 ha (Decree No. 85463/10 December 1980). As pointed out by Coimbra-Filho (1984), however, the Reserve has always suffered severe problems regarding human encroachment. In 1980, one of the two park guards estimated that approximately 200 families were cutting the forest for charcoal and small-scale agriculture in the northwest of the Reserve. Until 1982, it remained without any administration or management for its protection (Brazil, MA-IBDF-FBCN 1982). In 1985, 82 families were registered occupying 2,300 ha of forest of the reserve, 24 of which were removed by 1987. The problem currently facing the Reserve Director is the lack of sufficient funds for indemnities, although a solution under consideration is the transfer of all the squatters to one part of the Reserve (the north-west block, which has already suffered extensive deforestation), and excluding that part and buying adjacent intact forest to compensate. By February 1991, only 20 families were still residing within the Reserve boundaries, all within the north-west (Piedade) block (S. Neto de Sousa, Reserve Director, pers. comm.), and in March 1991, the Reserve area (land owned by Ibama) was increased by 659 ha, importantly widening the corridor which connected the two blocks of forest already under Ibama jurisdiction (see Mallinson 1989). It is unlikely, however, that the reserve will ever attain its decreed size of 11,400 ha. The acquisition of land and other areas of intact forest within the decreed area to the north, and the redefinition of the Reserve limits to exclude the totally destroyed areas in the northwestern Piedade block are important steps to consolidate the Una Biological Reserve.

Approximately three to four groups are, at least temporarily, protected in about 200 ha of forest in the 495 ha Lemos Maia Experimental Station at Una (Fig. 1, confirmed locality No. 17), maintained by the Regional Cocoa Growing Authority (CEPLAC) for agricultural research purposes. In 1987, I. B. Santos and W. Oliver (Jersey Wildlife Preservation Trust) proposed to Ibama that efforts be made to secure the remaining forest which connects Lemos Maia with the Una Biological Reserve (see Oliver and Santos 1991).

A possibility for a third protected area was discovered during the surveys by Oliver and Santos (1991) in 1987. The 500 ha Canavieiras Experimental Station (ESCAN) (Fig. 1) reported locality, No. 12), also belonging to CEPLAC, just south-west of Una, remains almost totally forested, and is potentially important for the protection not only of *L. chrysomelas*, but also for other threatened and endangered primates such as *Cebus xanthosternos* and *Callicebus personatus melanochir*. Authorities in CEPLAC are negotiating the transfer of the land to Ibama for permanent protection as an Ecological Station.

In June 1990, a workshop on the conservation status of the four lion tamarin species resulted in population viability analyses for these three protected areas (Seal *et al.* 1990). Due to the lack of any population studies on *L. chrysomelas*, the population viability analysis of Seal *et al.* (1990) used parameters regarding reproduction, (breeding only once a year), survival, age distribution and inbreeding depression which were based on information from the studies of *L. rosalia* at the Poço das Antas Biological Reserve, Rio de Janeiro. Population sizes of *L. chrysomelas* were estimated using two methods based on data from Rylands (1982, 1989). The first was based on an average group size of 6.6 individuals and a home range size (no overlap) of 42 ha., and the

second on the range of population density estimates obtained from repeat transect censusing in the Lemos Maia Experimental Station; 0.05 to 0.17 individuals per hectare. The results are as follows: Una Biological Reserve (then 5,250 ha) - 412 animals (first method) or 131-892 animals (second method), assuming that 50% of the Reserve contained suitable habitat; Lemos Maia Experimental Station (200 ha) - 31 animals (first method) or 10-34 animals (second method); and the Canavieiras Experimental Station (600 ha) - 94 animals (first method) or 30-102 animals (second method). It should be noted that figures are highly speculative because differences in habitats (floristic composition) in the three areas might well result in very different group sizes, range sizes and densities. However, these densities indicated that the population in the Una Biological Reserve is relatively secure, but that those in the Lemos Maia and Canavieiras Experimental Stations have a high chance (inbreeding depression, epidemics, and environmental variation) of becoming extinct.

Conservation Measures

According to Mallinson (1984, 1986), very few golden-headed lion tamarins were known to be held in captivity until 1972: London Zoo in 1869, Rio de Janeiro Zoo in 1961, one in Rio Zoo in July 1971, and since 1971 at the Tijuca Biological Bank (as of 1979 transferred to the Rio de Janeiro Primate Center - CPRJ, of the Fundação Estadual de Engenharia do Meio Ambiente - FEEMA, Rio de Janeiro). However, during 1983/1984 some 50-60 *L. chrysomelas* appeared in Belgium, France, Japan and Hong-Kong (Mallinson 1984; Konstant 1986). This epidemic of contraband lion tamarins resulted in the establishment, in 1985, of the International Recovery and Management Committee (IRMC) for the species (Mallinson 1989). The principal aims were to organize the return of the animals to Brazil, and set up an international management plan and studbook for all captive populations. The signatories to the captive breeding program agreed that all founder stock and progeny belong to Brazil. As a result, in 1985, 16 of the 26 animals in Belgium (29 were imported of which three died) were returned to Brazil (a further eight were placed in the Antwerp Zoo - presumably the remaining two also died). Through collaboration with the local WWF-TRAFFIC office, Japan returned 13 *L. chrysomelas* to Brazil in 1986.

In August 1987, a preliminary studbook documented 181 animals, with an extant captive population of 157 (78.66.13) in 11 institutions (Mallinson 1987). By August 1988, the total captive population had risen to approximately 222 (104.98.20), held in 19 different localities (Mace 1988), by August 1989 to 285 (1312.117.37) in 22 institutions (Mace, 1989), and by August 1990 to 334 (151.126.5) in 30 institutions in South America, North America, Europe and Asia (Mace 1990). Mallinson (1984, 1986, 1989), Konstant (1986), Ballou (1989) and Seal *et al.* (1990) provide further details of the history of the captive populations and the activities and successes of the IRMC.

Due to the efforts of the Committee, it is evident that the captive breeding program is achieving success in an extraordinarily short time, and in the near future, it will be necessary to restrict captive breeding, as is already the case for *L. rosalia*. However, there are two problems. The first is that the number of institutions with a budget, expertise, and infrastructure sufficient to participate in the breeding program is limited in Brazil, where the possibilities have already been largely exhausted. The São Paulo Zoo, for example, despite the recent construction of new cages, has already reached its capacity. Approximately 25 golden-headed lion tamarins maintained in captivity in the Una Biological Reserve, the result of confiscation and donation of contraband animals (an indication of the success of the environmental education program initiated in 1990; see Konstant 1990), were released in a 300 ha forest patch outside the Reserve, with a minimal follow-up, in July 1991 (B. Beck and J. Dietz pers. comm.). The removal of these animals was necessary because of the potentially dangerous contact (disease epidemic) with the wild population in the Reserve, and because no institution was identified which could immediately house them.

The second problem pertains to the ultimate aim of the breeding program. Reintroduction methods are still at the stage of expensive experimentation, and the Golden Lion Tamarin Conservation Program of the Smithsonian Institution is alone in research efforts of this kind for Neotropical primates. The prerequisite for a reintroduction program is the existence of a protected forest where they can be introduced (Kleiman 1989). This does not exist for *L. chrysomelas*, and it remains to be seen whether it ever will. A detailed survey of the geographic distribution of the species is required, which will also examine the possibilities for reintroduction sites and the establishment of new protected areas.

A noteworthy development regarding the conservation of *L. chrysomelas* is the official recognition of the of the International Recovery and Management Committee by the Brazilian Institute for the Environment - Ibama (Edict No.1.204/18 July 1990). As from the date of the edict, the Committee, previously concerned only with the establishment and control of the captive population, is charged with recommending, supervising, and carrying out measures concerning research and protection of the species in the wild, specifically those included in the population viability analysis for the genus (Seal *et al.* 1990; Mallinson 1989; Mace 1990).

Recent research and conservation efforts for the golden-headed lion tamarin include an environmental education program concerning the protection of the remaining forest of southern Bahia, but using *L. chrysomelas* as a "flagship species", begun in 1990 by Cristina Alves (pers. comm.; see also Konstant 1990; Seal *et al.* 1990), along with CEPLAC, and students from the local University of Santa Cruz, Itabuna. In addition, in 1991, Luiz Paulo de Souza Pinto of the Federal University of Minas Gerais, initiated a year-long population survey to examine more closely the size and location of remaining populations throughout its distribution.

In conclusion, the findings of Oliver and Santos (1991; Santos *et al.* 1987) and their co-workers that the distribution is rather larger than previously estimated, the confirmation of the survival of populations in at least 14 localities, along with reports of its existence in a further 23, the environmental education and research program initiated in 1990/1991, and the evaluation of the Population Viability Analysis Workshop (Seal *et al.* 1990) offset somewhat the extremely pessimistic appraisals of Coimbra-Filho (1970, 1984), Coimbra-Filho and Mittermeier (1973, 1977) and Mittermeier *et al.* (1981, 1982), and we would judge that the numbers of wild *L. chrysomelas* are the largest of the four lion tamarins. Oliver and Santos (1991) obtained positive reports of its

survival in 28 of 30 localities visited and in other areas where larger primates had already been eliminated.

It should be remembered, however, that populations are mostly very small, isolated and extremely vulnerable (see Ralls *et al.* 1986). The situation is critical because of the rapid and accelerating pace of forest destruction which threatens all of southern Bahia's endemic species (Oliver and Santos 1991). Urgent measures are still required to provide adequate protection for the Una Biological Reserve, to establish further protected areas, and instigate an effective management of the remaining forest patches in the region (Mittermeier *et al.* 1981, 1982; Rylands 1983; Oliver and Santos 1991). This will require a considerable investment in research, to obtain the necessary ecological, demographic and genetic data to provide an understanding of the viability of the small populations remaining. Genetic uniformity and inbreeding of the lion tamarins are problems not only of captive populations but also already of those in the wild (Valladares-Padua 1987; Randolph *et al.* 1981; Ballou 1989; F. Simon pers. comm.; Seal *et al.* 1990). As Wilcox (1986) points out, extinction is a process not an event. In the wild, the golden-headed lion tamarin is undergoing this process and it remains to be seen whether it can be halted or reversed. A first step will be a more profound commitment on the part of the Brazilian Environment Institute (Ibama) regarding solutions to the serious problems of the Una Biological Reserve, in controlling illegal trading, and in the enforcement of laws prohibiting forest destruction in the region. With regard to the wild populations, there is little room for optimism, although the safeguard strategy of the establishment of a healthy captive population is already showing signs of success.

Acknowledgments

Aline T. Bernardes, Adelmar F. Coimbra-Filho, Isabel D. Constable, Gustavo A. B. da Fonseca, Mendelson Lima, Liliana Lodi, Ricardo B. Machado, William Oliver, Carlos Alberto M. Pinto, Wilson R. Spironelo, and Célio M. C. Valle, participated in the field surveys of RAM and IBS, which were financed by the World Wildlife Fund - US (WWF), the Jersey Wildlife Preservation Trust (JWPT), Wildlife Preservation Trust International (WPTI), and the Program for Studies in Tropical Conservation (PSTC), University of Florida, Gainesville. The study of ABR was supported by the Brazil Science Council (CNPq), the World Wildlife Fund - US (WWF), the Fauna and Flora Preservation Society (FFPS), and the Conder Conservation Trust. The Comissão Executiva do Plano da Lavoura Cacaueira (CEPLAC), Itabuna, provided considerable logistic support for both ABR and IBS, as well as permission for ABR to work in the Lemos Maia Experimental Station. Finally our thanks to the Regional Office of the Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis (Ibama), Itabuna, Bahia.

Anthony B. Rylands
Departamento de Zoologia
Universidade Federal de Minas Gerais
31270-901 Belo Horizonte
Minas Gerais, Brazil

Ilmar B. Santos
Fundação Biodiversitas
Avenida do Contorno 9155
30110-130 Belo Horizonte
Minas Gerais, Brazil

and

Russell A. Mittermeier
Conservation International
1015 Eighteenth Street, N. W.
Washington D. C. 20036, USA

Literature Cited

Alves, M. C. 1988. Tamarins and cocoa don't mix ... or do they? *On the Edge* (36): 3-4, 12.

Alves, M. C. 1990. The role of cacao plantations in the conservation of the Atlantic forest of southern Bahia, Brazil. Unpubl. Master's thesis, University of Florida, Gainesville. 166pp.

Ballou, J. D. 1989. Emergence of the captive population of golden-headed lion tamarins *Leontopithecus chrysomelas*. *Dodo, J. Jersey Wildl. Preserv. Trust* 26: 70-77.

Bernardes, A.T., A. B. M. Machado and A. B. Rylands. 1990. *Fauna Brasileira Ameaçada de Extinção.* Fundação Biodiversitas, Belo Horizonte.

Brazil, CEPLAC. 1976. *Diagnóstico Socioeconômico da Região Cacuaeira, 7, Recursos Florestais*. Comissão Executiva do Plano da Lavoura Cacaueira (CEPLAC), and Instituto Interamericano de Ciências Agrícolas (IICA), Ilhéus, Bahia.

Brazil, MA-IBDF-FBCN. 1982. *Plano do Sistema de Unidades de Conservação do Brasil. II Etapa.* Ministério da Agricultura (MA), Insitituto Brasileiro de Desenvolvimento Florestal (IBDF) and Fundação Brasileira para a Conservação da Natureza (FBCN), Brasília.

Coimbra-Filho, A. F. 1970. Considerações gerais e situação atual dos micos-leões escuros, *Leontideus chrysomelas* (Kuhl, 1820) e *Leontideus chrysopygus* (Mikan, 1823) (Callithricidae, Primates). *Rev. Brasil. Biol.* 30:249-268.

Coimbra-Filho, A. F. 1978. Natural shelters of *Leontopithecus rosalia* and some ecological implications (Callitrichidae, Primates). In: *The Biology and Conservation of the Callitrichidae*, D. G. Kleiman (ed.), pp. 79-98. Smithsonian Institution Press, Washington, D. C.

Coimbra-Filho, A. F. and R. A. Mittermeier. 1972. Taxonomy of the genus *Leontopithecus* Lesson 1840. In: *Saving the Lion Marmoset*, D. Bridgewater (ed.), pp. 7-22. Wild Animal Propagation Trust, Wheeling, West Virginia.

Coimbra-Filho, A. F. and R. A. Mittermeier. 1973. Distribution and ecology of the genus *Leontopithecus* Lesson, 1840 in Brazil. *Primates* 14: 47-66.

Coimbra-Filho, A. F. and R. A. Mittermeier. 1977. Conservation of the Brazilian lion tamarins (*Leontopithecus rosalia*). In: *Primate Conservation*, H. S. H. Prince Rainier III of Monaco and G. H. Bourne (eds.), pp.59-94. Academic Press, New York.

Coimbra-Filho, A. F. 1984. Situação atual dos calitriquídeos que ocorrem no Brasil (Callitrichidae-Primates). In: *A Primatologia no Brasil*, M. T. de Mello (ed.), pp.15-33. Sociedade Brasileira de Primatologia, Brasilia.

Forman, L., D. G. Kleiman, R. M. Bush, L. G. Phillips, A. F. Coimbra-Filho and S. J. O'Brien. 1986. Genetic variation within and among lion tamarins. *Am. J. Phys. Anthropol.* 71: 1-11.

Hershkovitz, P. 1977. *Living New World Monkeys (Platyrrhini) with an Introduction to Primates, Vol. 1.* Chicago University Press, Chicago.

Inskipp. T. and S. Wells. 1979. *International Trade in Wildlife.* Earthscan Publications, London.

IUCN. 1982. *The IUCN Mammal Red Data Book, Part 1: Threatened Mammalian Taxa of the Americas and Australasian Zoogeographic Regions (excluding Cetacea).* J. Thornback and M. Jenkins (compilers). International Union for Conservation of Nature (IUCN), Gland.

Kinzey, W. G. 1982. Distribution of primates and forest refuges. In: *Biological Diversification in the Tropics*, G. T. Prance (ed.), pp.455-482. Columbia University Press, New York.

Kleiman, D. G, B. B. Beck, J. M. Dietz, L. A. Dietz, J. D. Ballou and A. F. Coimbra-Filho. 1986. Conservation program for the golden lion tamarin: captive research and management: ecological studies, educational strategies, and reintroduction. In: *Primates: The Road to Self-Sustaining Populations*, K. Benirschke (ed.), pp. 959-979. Springer Verlag, New York.

Kleiman, D. G. 1989. Reintroduction of captive mammals for conservation. *BioScience* 39:152-161.

Konstant, W. R. 1986. Illegal trade in golden-headed lion tamarins. *Primate Conservation* (7):29-30.

Konstant, W. R. 1990. Project Mico-Leão Baiano. *On the Edge*, Wildlife Preservation International (41): 1-5.

Laemmert Jr., H. W., L. de C. Ferreira and R. M. Taylor. 1946. An epidemiological study of jungle yellow fever in an endemic area in Brazil. Part II - Investigations of vertebrate hosts and arthropod vectors. *Am. J. Trop. Med.* 26: 23-60.

Lorini, V. G. and M. L. Persson. 1990. Uma nova espécie de *Leontopithecus* Lesson, 1840, do sul do Brasil (Primates, Callitrichidae). *Bol. Mus. Nacional, Rio de Janeiro, nova sér. Zoologia*, 338:1-14.

Mace. G. M.. 1988. *International Studbook Golden-Headed Lion Tamarin* Leontopithecus chrysomelas. *Number 1*. Jersey Wildlife Preservation Trust, Jersey.

Mace, G. M. 1989. *International Studbook Golden-Headed Lion Tamarin* Leontopithecus chrysomelas. *Number 2*. Jersey Wildlife Preservation Trust, Jersey.

Mace, G. M. 1990. *International Studbook Golden-Headed Lion Tamarin* Leontopithecus chrysomelas. *Number 3*. Jersey Wildlife Preservation Trust, Jersey.

Mack, R. D. and R. A. Mittermeier. 1984. *The International Primate Trade, 1, Legislation, Trade and Captive Breeding.* TRAFFIC (U. S. A.), World Wildlife Fund - U. S. Primate Program and IUCN/SSC Primate Specialist Group, Washington, D. C.

Magnanini, A. 1978. Progress in the development of Poço das Antas Biological Reserve for *Leontopithecus rosalia rosalia* in Brazil. In: *The Biology and Conservation of the Callitrichidae,* D. G. Kleiman (ed.), pp.131-136. Smithsonian Institution Press, Washington, D. C.

Mallinson, J. J. C. 1984. Golden-headed lion tamarin contraband a major conservation problem. *IUCN/SSC Primate Specialist Group Newsletter* (4):23-25.

Mallinson, J. J. C. 1986. The Wildlife Preservation Trusts' (J.W.P.T./W.P.T.I.) support for the conservation of the genus *Leontopithecus. Dodo, J. Jersey Wildl. Preserv. Trust* 23:6-18.

Mallinson, J. J. C. (compiler). 1987a. *A Preliminary International Studbook Golden-Headed Lion Tamarin,* Leontopithecus chrysomelas. Jersey Wildlife Preservation Trust, Jersey. 10pp.

Mallinson, J. J. C. 1987b. International efforts to secure a viable population of the golden-headed lion tamarin. *Primate Conservation* (8):124-125.

Mallinson, J. J. C. 1989. A summary of the work of the International Recovery and Management Committee for Golden-Headed Tamarin *Leontopithecus chrysomelas* 1985-1990. *Dodo, J. Jersey Wildl. Preserv. Trust* 26:77-86.

Mittermeier, R. A, I. D. Constable, A. F. Coimbra-Filho. 1981. Conservation of eastern Brazilian primates. Unpubl. Report, Project 1614, Primate Program of the World Wildlife Fund - US, Period 1979/80, Washington, D. C.

Mittermeier, R. A., A. F. Coimbra-Filho, I. D. Constable, A. B. Rylands and C. Valle. 1982. Conservation of primates in the Atlantic forest region of eastern Brazil. *Int. Zoo Yb.*, 22:2-17.

Napier, P. H. 1976. *Catalogue of the Primates in the British Museum (Natural History). Part 1: Families Callitrichidae and Cebidae.* British Museum (Natural History), London.

NRC. 1981. *Techniques for the Study of Primate Population Ecology.* National Research Council (NRC), National Academy Press, Washington, D. C.

Oliver, W. L. R. and I. B. Santos. 1991. Threatened endemic mammals of the Atlantic forest region of south-east Brazil. *Wildl. Preserv. Trust, Special Scientific Report* (4):1-125.

Peres, C. A. 1986. Golden Lion Tamarin Project II. Ranging patterns and habitat selection in golden lion tamarins, *Leontopithecus rosalia* (Linnaeus, 1766) (Callitrichidae, Primates). In: *A Primatologia no Brasil - 2*, M. T. de Mello (ed.), Sociedade Brasileira de Primatologia, Brasília.

Ralls, K., P. H. Harvey and A. M. Lyles. 1986. Inbreeding in natural populations of birds and mammals. In: *Conservation Biology: The Science of Scarcity and Diversity*, M. E. Soulé (ed.), pp. 35-56. Sinauer, Associates, Sunderland, M. A.

Randolph, J., M. Bush, M. Abramowitz, D. G. Kleiman and R. J. Montali. 1981. Surgical correction of familial diaphragmatic hernia of Morgagni in the golden lion tamarin. *J. Pediatr. Surg.*, 16: 396-401.

Rizzini, C. T. and A. de Mattos Filho. 1986. Espécies vegetais em extinção. *Boletim FBCN*, Rio de Janeiro 21: 99-104.

Rylands, A. B. 1982. The Behaviour and Ecology of Three Species of Marmosets and Tamarins (Callitrichidae, Primates) in Brazil. Unpubl. Ph.D. Thesis, University of Cambridge, Cambridge.

Rylands, A. B. 1983. The Behavioural Ecology of the Golden-

Headed Lion Tamarin, *Leontopithecus chrysomelas*, and the marmoset, *Callithrix kuhli* (Callitrichidae, Primates). Report to the World Wildlife Fund-US, the Fauna and Flora Preservation Society, and the Conder Conservation Trust. December 1983. 47pp.

Rylands, A. B. 1984. Ecologia do mico-leão, *Leontopithecus chrysomelas*, e o sagüi, *Callithrix kuhlii*, na Bahia. In: *Resumos. VI Congresso Brasileiro de Zoologia*, Belém, Pará, 12-17 February 1984. (Abstract).

Rylands, A. B. 1989. Sympatric Brazilian callitrichids: the black-tufted-ear marmoset, *Callithrix kuhli*, and the golden-headed lion tamarin, *Leontopithecus chrysomelas*. *J. Hum. Evol.* 18(7):679-695.

Rylands, A. B., W. R. Spironelo, V. L. Tornisielo, R. M. Lemos de Sá, M. C. Kierulff and I. B. Santos. 1988. Primates of the Rio Jequitinhonha valley, Minas Gerais, Brazil. *Primate Conservation* (9):100-109.

Santos, I. B., R. A. Mittermeier, A. B. Rylands and C. M. C. Valle. 1987. The distribution and conservation status of primates in southern Bahia, Brazil. *Primate Conservation* (8):126-142.

Seal, U. S., J. D. Ballou and C. Valladares-Padua (eds.). 1990. Leontopithecus: *Population Viability Analysis Workshop Report*. IUCN/SSC Captive Breeding Specialist Group (CBSG), Apple Valley, Minnesota.

Valladares-Padua, C. 1993. The Ecology, Behavior and Conservation of the Black Lion Tamarin. Unpublished Ph.D. dissertation. University of Florida, Gainesville.

Vieira, C. C. 1955. Lista remissiva dos mamíferos do Brasil. *Arq. Zool., São Paulo*, 8: 341-474.

Wied-Neuwied, Prince Maximilian zu. 1940. *Viagem ao Brasil*. Translation by E. S. Mendonça and F. P. de Figueiredo. Annotated by O. M. O. Pinto. Cia. Editora Nacional, São Paulo.

Wilcox, B. A. 1986. Extinction models and conservation. *Trends Ecol. Evol.* 1: 46-48.

Received for publication: November 1991
Revised: July 1993

APPENDIX I

Localities for *Leontopithecus chrysomelas*. Sightings and museum specimens. The localities, all in the state of Bahia, Brazil, are shown in Figure 1.

SEPSFA: Serviço de Estudos e Pesquisa sobre a Febre Amarela (see Laemmert *et al.* 1964).
CPRJ: Centro de Primatologia do Rio de Janeiro, Rio de Janeiro
MNRJ: Museu Nacional, Rio de Janeiro.
FMNH: Field Museum of Natural History, Chicago.
RMNH: Rijksmuseum van Natuurlijke Historie, Leiden.

Type locality: Forests of the Rios Ilhéos, Pardo and Belmonte; restricted by Elliot (1913) to the forests of the Rio Ilhéus. See Napier (1976).

Type locality: Ribeirão das Minhocas (locality 302), left bank upper Rio dos Ilhéos (locality 299), southern Bahia, Brazil (Wied-Neuwied 1821, p. 137). See Hershkovitz (1977, p. 836).

1. Rio Gongojí. 14°12'S, 39°38'W. O. M. O. Pinto, 1932. Cited in Vieira (1955), Coimbra-Filho (1970), Hershkovitz (1977: locality 297c, p. 386), Kinzey (1982: locality 16). Note: this locality was given by Pinto in a footnote in Wied (1940) (see Coimbra-Filho 1970, p. 257). The coordinates place the locality nearer to the Rio de Contas than the Rio Gongoji.

2. Bahia, Poções. 14°31'S, 40°21'W. Virgílio de Oliveira 1944, Skin in MNRJ. Cited in Coimbra-Filho (1970), Hershkovitz (1977: locality No. 301), Kinzey (1982: locality No. 15). Note: It is our opinion that this probably does not refer to the town of Poções which is in a region of dry liana forest, where annual rainfall is approximately 800 mm, in the south Bahian plateau (average altitude 800 m) (see Brazil, CEPLAC 1976, and Fig. 2). We conclude that the skin was collected in an area of semi-deciduous forest within the municipality of Poções to the east (see Fig. 2).

3. Uruçuca. 14°35'S, 39°16'W. A. F. Coimbra-Filho (in Coimbra-Filho 1970). Cited in Hershkovitz (1977: locality No. 299), Kinzey (1982: locality No. 18). Note: The original affirmation of Coimbra-Filho (1970) was simply that he believed that *L. chrysomelas* could still be found in the municipality of Uruçuca. We conclude that Hershkovitz (1977) provided the coordinates.

4. Fazenda Almada, Rio Almada. 14°38'S, 39°12'W. SEPSFA, 1944/45. Cited in Hershkovitz (1977: locality No. 299), Kinzey (1982: locality No. 18).

5. Bahia, Ilhéus, Rio do Braço, Fazenda São José, Pontal. 14°39'S, 39°01'W. SEPSFA, 1944/45. Specimens in MNRJ. Cited in Coimbra-Filho (1970), Hershkovitz (1977: locality No. 299), Kinzey (1982: locality No. 18). Note: The coordinates (cited in Hershkovitz, 1977) place the Fazenda in the Atlantic Ocean. Although we were unable to locate the Fazenda São José, we have used the following coordinates: 14°39'S, 39°07'W.

5. Bahia, Ilhéus, Rio do Braço, Fazenda São Luiz, roça de Cacau. SEPSFA, 1945. Specimen in MNRJ. Cited in Coimbra-Filho (1970).

5. Urucutuca. 14°39'S, 39°03'W. SEPSFA, undated. Cited by Hershkovitz (1977: locality No. 299) and Kinzey (1982: locality No. 18). Note: The cooordinates cited in Hershkovitz (1977) place Urucutuca in the Atlantic Ocean. We have used the coordinates of the town of Urucutuca, 14°39'S, 39°07'W.

6. Fazenda Borrachudo, Itabuna. 14°48'S, 39°16'W. SEPSFA, 1945. Specimen in FMNH. Cited in Hershkovitz (1977: locality No. 300).

6. Itabuna, Rio Ilhéus (= Cachoeira). 14°48'S, 39°16'W. Wied, 1815-17 (see Wied 1940, p. 356). Cited by Coimbra-Filho (1970), Hershkovitz (1977: locality No. 300), and Kinzey (1982: locality No. 17). Note: Hershkovitz (1977) cites Coimbra-Filho as author of this locality. Coimbra-Filho (1970, p. 257) merely cites Wied's localities: the vicinities of the small rivers, Cajaseira, Minhocas and Issara, affluents of the left bank of the headwaters of the Rio Ilhéus.

7. Ilhéus. 14°49'S, 39°02'W, sea level. Wied-Neuwied, 1815-17. Cited in Coimbra-Filho (1970), Hershkovitz (1977, locale 299), Kinzey (1982: locality No. 18). Note: Coimbra-Filho (1970) cites three specimens labeled "Bahia, Ilhéus" in the National Museum, Rio de Janeiro and indicates that populations probably still exist in the municipality of Ilhéus.

7. Sertam (= Sertão) d'Ilhéus. 14°49'S, 39°02'W. SEPSFA, 1944. Cited in Hershkovitz (1977: locality No. 299).

8. Fazenda Pirataquisse. 14°50'S, 39°05'W. SEPSFA, 1944. Cited in Hershkovitz (1977: locality No. 299), Kinzey (1982: locality No. 18).

9. Bahia, Buerarema, Ribeirão da Fortuna, Estação da Mata do Cacau. 14°57'S, 39°19'W. SEPSFA, 1944. Specimen in MNRJ. Cited in Coimbra-Filho (1970), Hershkovitz (1977: locality No. 299), Kinzey (1982: locality No. 18). Note: On the highway BA-251.

9. Fazenda Fortuna, Buerarema, Estação da Mata do Cacau. 14°57'S, 39°19'W. SEPSFA, 1944/45. Cited in Hershkovitz (1977: locality No. 299).

10. Fazenda Piedade, north of São José-Una road. 15°11'S, 39°12'W. A. B. Rylands, 1980. Adult male captured during logging operation; sent to CPRJ. Cited in Rylands (1983). Note: The original coordinates (15°10'S, 39°15'W) given in Rylands (1983) are incorrect.

11. Reserva Biológica de Una (IBAMA), municipality of Una. 15°11'S, 39°06'W. A. F. Coimbra-Filho, 1969. Cited in Coimbra-Filho (1970). Note: Coordinates not given by Coimbra-Filho (1977).

12. Barro Vermelho, Rio Maruím. 15°10'S, 39°03'W. I. B. Santos, 1983. Observation.

12. Reserva Biológica de Una (Ibama) (Rio Maruím). 15°11'S, 39°03'W. I. B. Santos, 1983. Observation.

13. Ribeirão das Minhocas, Rio Ilhéus. 15°12'S, 39 57'W. Wied-Neuwied, 1815-17. Cited in Coimbra-Filho (1970), Hershkovitz (1977: locality No. 302), Kinzey (1982, locality No. 19). Note: The type locality according to Hershkovitz (1977).

14. Lagoa da Mabaca, near Rio Maruím, 01 km from the BA-001 road. 15°12'S, 39°01'W. I. B. Santos, 1983. Observation.

15. Barra da Vereda, Rio Pardo. 15°15'S, 40 39'W. Wied-Neuwied, 1815-17. Cited in Hershkovitz (1977: locality No. 305), Kinzey (1982, locality No. 20).

16. Road Una-Ilhéus, BA-001, in *restinga/piaçava*, white-sand forest interface. 15°15'S, 39°01'W. A. B. Rylands, 1980. Observation. Cited in Rylands (1983).

17. Road Una- Ribeirão da Serra (to Una Biological Reserve - Ibama). 15°16'S, 39°06'W. I. B. Santos, 1983. Observation.

17. Road Una - Ribeirão da Serra (to Una Biological Reserve - Ibama). 15°16'S, 39°05'W. A. B. Rylands, 1979. Observation

17. Lemos Maia Experimental Station (CEPLAC), Una. 15°17'S, 39°05'W. A. B. Rylands, 1980. Observation. Cited in Rylands (1982, 1983).

17. Road Una - Colônia de Una, municipality of Una. 15°17'S, 39°06'W. I. B. Santos, 1986. Observation.

18. Una. 15°18'S, 39°06'W. Cited by Hershkovitz (1977, locale 303), Kinzey (1982, locale 22).

19. Road Outeiro - Una, 2 km from the road (Canavieiras - Una). 15°21'S, 39°02'W. A. B. Rylands, 1980. Observation. Note: The original coordinates (15°21'S, 39°03'W) given in Rylands (1983) are incorrect.

20. Road Canavieiras - Santa Luzia, between Ponta Nova and Nova Betânia. 15°28'S, 39°15'W. I. B. Santos, 1983. Observation.

21. Riacho Ribeira, Poxim do Sul. 15°28'S, 39°01'W. I. B. Santos, 1983. Observation.

22. Rio Pardo. 15°39'S, 38°57'W. Wied-Neuwied, 1815-17. Cited in Hershkovitz (1977: locality No. 304), Kinzey (1982: locality No. 23).

23. Fazenda Santa Inês, marble quarry, municipality of Itapebí. 15°46'S, 39°40'W. I. B. Santos and G. A. B. da Fonseca, 1983. Observation.

24. Fazenda Palmeira, municipality of Itapebí. 15°57'S, 39°38'W. I. B. Santos, 1983. Observation.

APPENDIX II

Localities for *Leontopithecus chrysomelas*. Unconfirmed. Listed below are the localities where interviews with local hunters and farm owners provided clear descriptions of *L. chrysomelas* and convincing affirmations that populations still survive in the region. The localities are shown in Figure 1.

1. Taboquinhas - Itacaré road, km 25, municipality of Itacaré. 14 19'S, 39°01'W. R. A. Mittermeier, 1980.

2. Taboquinhas - BR 101 road, km 25, municipality of Itacaré. 14 21'S, 39°12'W. R. A. Mittermeier, 1980.

3. Vicinity of Banco Central, BA - 656 road, municipality of Aurelino Leal. 14°30'S, 39 23'W. A. B. Rylands, 1980.

4. Vicinity of Ibituba, municipality of Almadina. 14°32'S, 39°39'W. I. B. Santos, 1983.

5. Vicinity of Pimenteira, municipality of Ilhéus. 14°34'S, 39 26'W. A. B. Rylands, 1980. Note: The coordinates cited in Rylands (1983), 14°33'S, 39°30'W, are incorrect.

6. Vicinity of Uruçuca, municipality of Uruçuca. 14°36'S, 39°17'W. I. B. Santos, 1983.

7. Vicinity of Barra, municipality of Ilhéus. 14°40'S, 39 25'W'. A. B. Rylands, 1980.

8. Vicinity of Nova Canaá, municipality of Nova Canaá. 14°48'S, 40°09'W. I. B. Santos, 1983.

9. Vicinity of Floresta Azul, municipality of Floresta Azul. 14°52'S, 39°39'W. I. B. Santos, 1983.

10. Vicinity of Jussari, municipality of Itabuna. 15°11'S, 39°30'W. I. B. Santos, 1983.

11. Vicinity of Itapetinga, municipality of Itapetinga. 15°15'S, 40°15'W. I. B. Santos, 1983.

12. Estação Experimental de Canavieiras (ESCAN/CEPLAC), municipality of Canavieiras. 15°23'S, 39°12'W. I. B. Santos and W. L. R. Oliver, 1987 (Oliver and Santos, 1991).

13. Road from BR-101 highway to Canavieiras, km 11, municipality of Canavieiras. 15°25'S, 39 22'W. R. A. Mittermeier, 1980.

14. Road from BR-101 highway to Canavieiras, municipality of Canavieiras. 15°30'S, 39°02'W. A. B. Rylands, 1980.

15. Road between Una and Canavieiras, municipality of Canavieiras. 15°30'S, 39°02'W. A. B. Rylands, 1980.

16. Vicinity of Macarani, municipality of Macarani. 15°34'S, 40°26'W. I. B. Santos and W. L. R. Oliver, 1987 (Oliver and Santos 1991).

17. Vicinity of Maiquinique, municipality of Maiquinique. 15°38'S, 40°15'W. I. B. Santos and W. L. R. Oliver, 1987 (Oliver and Santos 1991).

18. On the Maiquinique - Itarantim road, municipality of Itarantim. 15°38'S, 40°04'W. I. B. Santos and W. L. R. Oliver, 1987.

19. Vicinity of Canavieiras, 5 km, municipality of Canavieiras. 15°38'S, 38°59'W. R. A. Mittermeier, 1980.

20. Fazenda Morro Grande, left bank of the Rio Jequitinhonha, municipality of Salto da Divisa, State of Minas Gerais. 15°52'S, 40°05'W. I. B. Santos and W. R. Spironelo, 1987.

20. Fazenda Boa Vista, left bank of the Rio Jequitinhonha, municipality of Salto da Divisa, State of Minas Gerais. 15°52'S, 40°05'W. I. B. Santos and W. R. Spironelo, 1987.

21. On the road Jordânia - Salto da Divisa, municipality of Salto da Divisa, State of Minas Gerais. 15°55'S, 40°10'W. I. B. Santos and W. L. R. Oliver, 1987 (Oliver and Santos 1991).

22. Right bank of the Rio Jequitinhonha, near the Serra do Putumujú, municipality of Itapebí. 15°58'S, 39°38'W. I. B. Santos, 1986

23. Vicinity of Salto da Divisa, right bank of the Rio Jequitinhonha. 16°01'S, 39°57'W. I. B. Santos and W. L. R. Oliver, 1987 (Oliver and Santos 1991).

Primate Conservation 1991-1992 (12-13): 24-30

The Distribution and Status of the Buff-Headed Capuchin Monkey, *Cebus xanthosternos* Wied 1820, in the Atlantic Forest Region of Eastern Brazil

Adelmar F. Coimbra-Filho[1], Anthony B. Rylands[2], Alcides Pissinatti[3] and Ilmar B. Santos[4]

[1] *Rua Artur Araripe 60/901, Gávea, Rio de Janeiro, Brazil*
[2]*Departamento de Zoologia, Universidade Federal de Minas Gerais, Belo Horizonte, Minas Gerais, Brazil*
[3]*Centro de Primatologia do Rio de Janeiro CPRJ/FEEMA, Rio de Janeiro, Brazil*
[4] *Fundação Biodiversitas, Belo Horizonte, Minas Gerais, Brazil*

Introduction

The buff-headed, southern Bahian capuchin monkey (*Cebus xanthosternos*) is a highly distinct form, clearly separate from the remaining tufted capuchin monkey subspecies in terms of its pelage as well as genetically (see Seuánez *et al.* 1986; Matayoshi *et al.* 1987). Today, the known distribution coincides with a number of other Brazilian primates which are also threatened, such as *Callithrix kuhli* and *Leontopithecus chrysomelas*, in a region where *Alouatta fusca* and the muriqui, *Brachyteles,* are already practically extinct. The very few remaining populations of *C. xanthosternos* were, until recently, thought to be restricted to forest remnants between the Rio de Contas and the vicinity of the Rio Jequitinhonha in the south-east of the state of Bahia (Kinzey 1982; Coimbra-Filho 1986). Coimbra-Filho (1986), Coimbra-Filho *et al.* (1991) and Seuánez *et al.* (1986) argued, on historical evidence, that the distribution of *C. xanthosternos* was formerly much larger, extending south to the Rio Jucurucu, and well inland in the states of Bahia and Sergipe, east and south of the Rio São Francisco. An examination of some old records along with recent surveys by Oliver and Santos (1991) are providing evidence confirming the northward extension, although the record for the Rio Jucurucu is evidently erroneous (an area occupied by *C. apella robustus*). Abundant in the past, this rare capuchin is now on the verge of extinction, and urgent measures are needed for its protection. In this paper we call attention to some new aspects regarding its distribution which we consider extremely important in terms of the biogeography of the entire region between the Rio São Francisco to the Atlantic coast in north-east Brazil, and also review recent efforts for its conservation.

Geographic Distribution

The original geographic distribution of *C. xanthosternos* included a very large area of uninterrupted tropical rain forest from the Atlantic coast of Brazil, to the north of the Rio Jequitinhonha, in the south-east of the state of Bahia, to certainly as far as the region of the mouth of the Rio São Francisco, in the state of Sergipe. The record of a skin by C. A. Camargo from the north bank of Rio Jucurucú, to the south of the Rio Jequitinhonha, in 1932 (Kinzey 1982; Coimbra-Filho 1986; locality no. 4 in Fig. 1) is enigmatic, the region being occupied by *C. a. robustus* (Rylands *et al.* 1988;

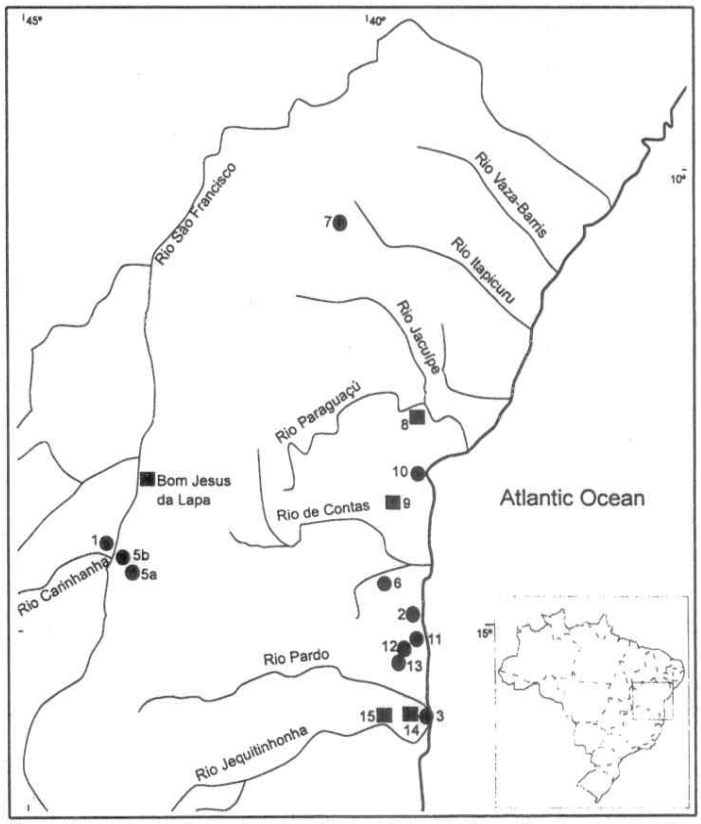


Fig. 1. Localities for the occurrence of *C. xanthosternos* in southern and western Bahia, Brazil. Numbered circles = museum specimens or sightings. Numbered squares = locally caught captive animals. See Appendix for gazetteer.

Oliver and Santos 1991).

A large part of the forest of the range of *C. xanthosternos* is on a specific soil formation, designated by Rizzini (1963, 1967) as the "Tertiary Plateau Formation". In the past, the tropical Atlantic coastal rain forest extended throughout this region in a wide belt, certainly never less than 100 km wide. Otherwise extremely rich in terms of its biota, the only evidence which remains today is a sparse mosaic of degraded fragments. Even the few Federal parks and reserves in southern Bahia, such as the Monte Pascoal National Park (22,500 ha) and the Una Biological Reserve (6,035 ha, created specifically for the protection of the golden-headed lion tamarin, *Leontopithecus chrysomelas*), are highly altered and degraded in terms of their fauna and flora. The magnificent tropical rain forest of only a few centuries past has been reduced to a few paltry and disjunct remnants where the last surviving representatives of numerous notable species survive, *C. xanthosternos* being just one of them.

Regarding the occurrence of *C. xanthosternos* within this region, perhaps the most significant register is that of three skins collected by E. Garbe at Vila Nova (now called Senhor do Bonfim), in the north-east of Bahia, near the upper reaches of the Rio Itapicuru (Pinto 1914: p.119), an area which today is covered mainly by dry thorn scrub. This region has suffered uninterrupted devastation since the discovery of Brazil, and the past occurrence of *C. xanthosternos* there testifies to the undoubted presence of rain forest in the past. The region's climatic conditions (proximity to the coast and to the Rio São Francisco) and the predominant soil formations have undoubtedly favored the persistence of tall tropical forests for thousands of years. The comments of Pinto (1941) and the records of Prince Maximilian zu Wied-Neuwied (1940) argue that the buff-headed capuchin had a very much wider distribution in the past, throughout coastal Bahia, extending inland over the Bahian plateau, and northwards and westwards as far as the Rio São Francisco in the state of Sergipe.

Vieira (1955), possibly using unverified citations from other authors, was mistaken in referring to the distribution of *C. xanthosternos* (= *C. variegatus*) as extending from southern Bahia (Belmonte and Vila Nova) to the states of Espírito Santo (Colatina) and Rio de Janeiro. Cabrera (1957) however, was correct in giving eastern Bahia as its true distribution, with the Rio Belmonte (= Rio Jequitinhonha) as its type locality. *C.a. robustus* occurs south of this river, as far as the Rio Doce in Espírito Santo (Kinzey 1982; Santos *et al.* 1987; Oliver and Santos 1991). Oliver and Santos (1991) observed *C. xanthosternos* just south of Salvador, in the vicinity of Valença, and found locally caught pets to the west at Três Braços (also reported from Firmino Alves and Dario Meira), and the north, just south of the Rio Paraguaçu, west of Salvador at Governador Mangabeira. Santos *et al.* (1987) reported on two skins in the U. S. National Museum from the Serra do Iuiú, in the vicinity of the towns of Carinhanha and Malhada, near the state border of Minas Gerais and Bahia. Carinhanha and the Rio Carinhanha are on the left (west) bank of the Rio São Francisco, indicating the possibility that the range of *C. xanthosternos* extends into an area otherwise recognized as being occupied by *C. apella libidinosus* (see Kinzey 1982). A skin of an adult female capuchin in the National Museum in Rio de Janeiro from the Serra Geral, Carinhanha, Bahia (MN23237), is clearly identifiable as belonging to the subspecies *libidinosus*. The skin in the National Museum, Rio de Janeiro, from Malhada (MN23231) shows a phenotype typical of *C. xanthosternos*. Malhada is on the right (east bank) of the Rio São Francisco, just some few kilometers south of Carinhanha, and we would suspect that the Carinhanha locality for *C. xanthosternos* might more correctly refer to the municipality which extends to the east of the river. The Serra do Iuiú is also to the east of the river. In 1991, Rylands (unpubl. data) observed a pet capuchin in the town of Jaíba, northern Minas Gerais, reportedly obtained from Bom Jesus da Lapa, further north in Bahia, also on the east bank of the Rio São Francisco, which closely resembled the dark form of *C. xanthosternos* recorded by Oliver and Santos (1991, p.55) from the Rio Paraguaçu (Governador Mangabeira) and likewise characterizing the Carinhanha and Malhada specimens in the U. S. National Museum. Dry thorn scrub and forest (*Caatinga* forest) now predominate throughout this region, where even the gallery forests of the Rio São Francisco have been almost completely destroyed. Oliver and Santos (1991) concluded that these capuchin monkeys may represent a transitional form or be isolated populations dating from a period when moist forests extended further inland in Bahia. Under any circumstances it would seem that historically the buff-headed ca-

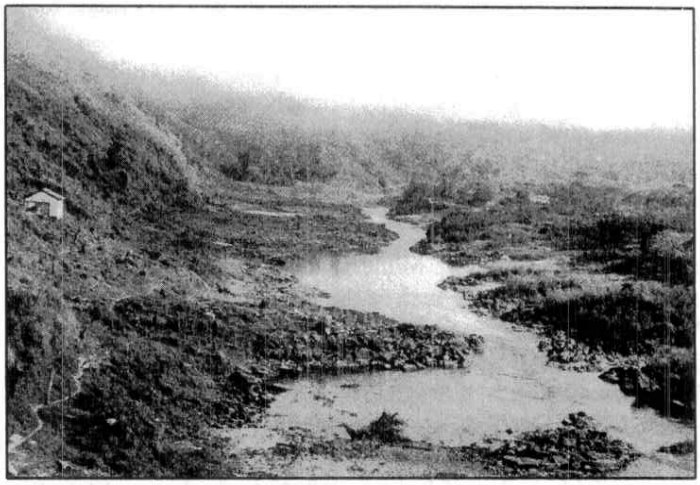


Fig. 3. The Rio Pardo, taken from a bridge on the BR-101 highway, in southern Bahia, in September 1973. Photograph by A. F. Coimbra-Filho.

Fig. 2. The Rio Cachoeira, Itabuna, southern Bahia, during the dry season (September) of 1973. Photograph by A. F. Coimbra-Filho.

puchin occurred throughout inland Bahia and part of Sergipe, from the Atlantic coast to the Rio São Francisco.

The remaining capuchin monkey populations in inland Bahia and northern Minas Gerais are extremely scarce, and the species has disappeared completely over very large areas. Even in southern Bahia, *C. xanthosternos* is today restricted to depauperate, scarce, fragmented, and largely privately-owned forests, with only one federal protected area of any significance, the Biological Reserve of Una (6,035 ha). Minimal and declining populations occur in some other areas such as the Canavieiras (500 ha), Lemos Maia (498 ha, partially forested with three forest fragments covering about 200 ha) and Djalma Bahia (200 ha, partially forested) Experimental Research Stations of the Cocoa Growing Authority (CEPLAC) nearby (Rylands 1982; Santos *et al.* 1987; A. B. Rylands and L. P. S. Pinto unpubl. data). The only population density estimate available is that of Rylands (1982) in the Lemos Maia Experimental Station. One group of 15 individuals was observed entering the reserve on a few occasions, and *C. xanthosternos* is today considered to be of the most endangered of Neotropical primates (Mittermeier *et al.* 1981, 1982, 1989; Coimbra-Filho 1986; Santos *et al.* 1987; Oliver and Santos 1991).

The Destruction of the Atlantic Forest in Bahia and Sergipe

The forests of the states of Bahia and Sergipe have undergone intense destruction since the earliest days of the colonization of Brazil, although most markedly following the arrival of Tomé de Sousa in March of 1549, more than four centuries ago. The natural environments of this region suffered significant impacts both through military activities during the war between Portugal and Holland, and through deforestation for cattle pasture on a very large scale. According to Vianna (1967), cattle ranching was considered the best option by the earliest colonizing governments of those parts. In the 16th century, large numbers of cattle were imported by the various *capitanias* (regional governments) from Cape Verde, and soon spread into inland areas of Bahia (for example the "Reconcavo", inland from Salvador), extending as far as Sergipe.

Most significant, however, regarding the destruction of these forests, was the arrival in Bahia of Garcia d'Avila. Accompanying the initial stages of the establishment of the new capital, now Salvador, Garcia d'Avila requested the concession for further land for pasture, while exchanging Brazilwood for cattle from the Azores. By 1550, the property of Garcia d'Avila extended along the bay of Itapagipe, north and inland from the Ponta do Padrão to the mouth of the Rio Vasa-Barris and along the Bay of Tatuapara, and the lower regions of such as the Rios Pojuca and Jacuipe. From 1549 to 1835, the dynasty of Garcia d'Avila expanded their cattle ranching empire throughout a large part of the states of Bahia and Sergipe at the cost of the almost complete loss of the forests (Calmon 1936, p. 6). In his treatise *Memorial e Declaração das Grandezas da Bahia de Todos os Santos*, Gabriel Soares de Sousa (1938 edition, commented by F. A. de Varnhagen) wrote that in 1587 the Reconcavo of Bahia was undergoing an extremely rapid transformation, and made reference to enormous herds of cattle north of the mouth of the Rio Paraguaçu, and widespread pastures along the entire basin of the Rio Itapicuru. This river, like all others in the region, was then perennial and deep enough for river transport, in those days especially for cattle. Commenting on the "Ciclo do Couro" (the temporary predominance of the leather industry in the regional economy), A. J. Antonil (1711) left no doubt that numerous rivers which today are annually dry were perennial and as such the main routes for transporting cattle to Salvador. He mentioned specifically the Rios Iguaçu, Carinhaem, Corrente, Guaraíra and Piagui-Grande. The growth of the cattle industry was such that by *c.* 1757 the entire region of the Reconcavo and the main part of the states of Bahia and Sergipe, was supplying more 300,000 heads per year, bred in pastures which were once tall tropical forest (Couto 1904).

It is barely imaginable that the enormous areas of dry thorn scrub and near desert conditions of northern and north-eastern Bahia, inland Sergipe, and the east of the Rio São Francisco were, in the recent past, a landscape of tall tropical forests and perennial rivers, with wide corridors of tall riparian forest extending along the tributaries and main channel of the Rio São Francisco. Sick and Teixeira (1979) reported that by 1938 only 0.1 per cent of the state of Sergipe was forested. The ability to ignore the impacts of the early colonizers on the natural ecosystems of the region was commented by Euclides da Cunha (1968), in a chapter "How to create deserts" in his book *Os Sertões*. He referred to Man as a "notable geological agent", and emphasized the destructive effects of fire, used on a large scale by even the earliest and most primitive farmers, a practice inherited from the Indians. Although enormous areas had by 1925 been converted to pasture and thorn scrub (Sampaio 1925), only a few decades ago some forests still remained in the region, evidenced by the export of valuable tropical timbers from areas near to Salvador (Irará, Santo Amaro and Feira de Santana), as well as further inland from such localities as Jequié and the Rio Jiquiricá basin, and inland from Ilhéus in the region of Mata de São João, Serrinha, and Santo Antônio de Jesus (Barros 1923; see also Mattos-Filho and Rizzini 1968, regarding tree species in Bahia). Barros (1923) mentions the presence of monkeys in the forests at Serrinha which were undoubtedly *C. xanthosternos*. The degradation of the forests of inland Bahia had serious consequences for the water regimes of the region, as evidenced by Magnanini and Coimbra-Filho in 1973, who by request of the government investigated the headwaters of a number of tributaries of

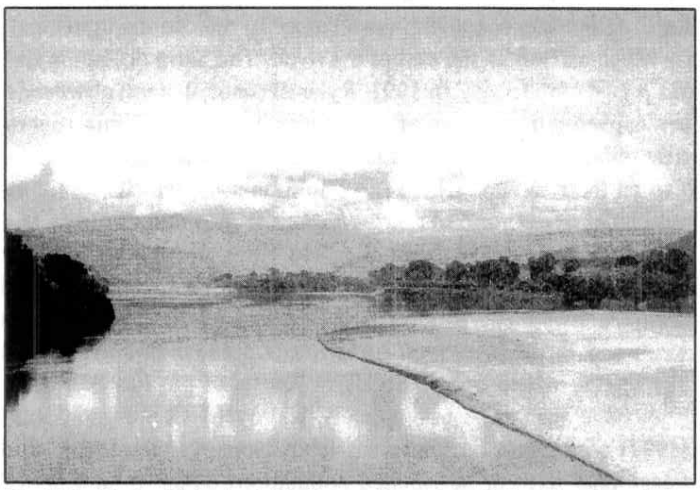


Fig. 4. The Rio Jequitinhonha (= Rio Belmonte), southern Bahia, taken from a bridge on the BR-101 highway in September 1973. The headwaters of this river were deforested centuries past. Photograph by A. F. Coimbra-Filho.

the Rio São Francisco in the west of the state (Magnanini and Coimbra-Filho 1974). Today the region is characterized by drought and dry desert-like thorn scrub, and the eroded and impoverished soils have been occupied by savanna vegetation (*cerrado*) and *caatinga*. According to Sampaio (1925), the soils of the headwaters of the Rios Itapicuru and Vasa-Barris were so dry and impoverished that they were fit only for goats, a process of advanced desertification resulting from human activities during only four and half centuries. Figures 2, 3 and 4 illustrate the degree of degradation and silting-up of three rivers in southern Bahia, Cachoeira, Pardo and Jequitinhonha, all within the distribution of *C. xanthosternos*, and resulting from forest destruction and, especially in the case of the Rio Jequitinhonha which marks the southern limit to its distribution, mining of the riverbed (Fig. 3). All these rivers have suffered from the total deforestation of their headwaters. Today the middle reaches of the Rio Jequitinhonha are characterized by degraded *caatinga*, with minimal and irregular rainfall (Rylands *et al.* 1988).

The connection between the Amazonian and Atlantic rain forest , extending to both sides of the Rio São Francisco is evidenced by the similarities of their flora. The primitive forests of north and north-eastern Bahia and Sergipe had at least 368 plants species in common (Dárdano A. Lima, cited by Rizzini 1967). Further evidence is supplied by the distribution of curassows and tinamous, two bird families which are forest dwellers. Pinto (1954, p.18) argued for the existence of the tinamou, *Tinamous solitarius*, throughout the region in the recent past. Burmeister (1856, p.349), likewise recorded the presence of a curassow, and we believe that to the south of the Rio São Francisco he was referring to the species *Crax blumenbachii*, now extinct in northern Bahia and Sergipe. *Crax blumenbachii* still survived, however, at least until recently, in southern Bahia (Coimbra-Filho 1970).

Conservation Program for *C. xanthosternos*

The buff-headed capuchin evidently had a widespread distribution in the past, but today it is limited mainly to southern Bahia. Populations inland are extremely rare, and have disappeared over enormous areas. In southern Bahia, they are evidently declining drastically, not only because of forest destruction, which has accelerated dramatically over the last two decades, but also because of hunting (Coimbra-Filho 1986; Santos *et al.* 1987; Oliver and Santos 1991). Beginning in 1980 with the acquisition of *pichi* by R. A. Mittermeier, the individual (still alive) that focused attention on the distinctiveness of this capuchin monkey, the Rio de Janeiro Primate Center of the Rio de Janeiro State Environmental Agency (FEEMA) acquired pets for a breeding program. Between 1980 and 1983, nine (5.4) animals were acquired by CPRJ. However, due to problems of accommodation, four (3.1) were subsequently sent to the Natural History Museum in Belo Horizonte, Minas Gerais. One female died in 1986, four months after giving birth, and the founding population in 1987 was, therefore, based on only two breeding pairs (Coimbra-Filho *et al.* 1992), with five births (3.2) between October 1984 and January 1987 (one male died at one day old) (Coimbra-Filho *et al.* 1992).

As a result of the field surveys carried out by William Oliver and Ilmar Santos in 1986/1987, recommendations were made for the expansion of the captive breeding program, not only at CPRJ, but also in additional zoos and breeding centers (Oliver and Santos 1991). This resulted in the preparation in 1990 of an "International Co-operative Breeding Programme", with the participation of the Mulhouse Zoo, France (see Lernould and Thouvenin 1992), Chester Zoo, England, and Zürich Zoo, Switzerland (Santos and Oliver 1991). Under the terms of the agreement, any participating/signatory institutions receiving animals on breeding loan should not only manage them under the conditions stipulated by the Agreement, but also contribute to other measures designed to enhance the protection of wild populations, and the provision of financial support for any relevant management, research, conservation education and training programs in the future. In 1989 a further two animals (1.1) were acquired by CPRJ, and in 1990, two pairs (captive born) were sent to the Mulhouse Zoo.

In October 1991, Santos and Oliver carried out a field expedition in order to acquire additional founders for the program. They located 37 animals kept as pets (23 males, 10 females and five unsexed) in 14 different localities, all in southern Bahia. Ten of these (6.4) were considered suitable for the breeding program and sent to the Rio de Janeiro Primate Center (CPRJ). With three animals now on loan to the Rio de Janeiro Zoo (1.2), in March 1992, CPRJ housed a colony of 20 animals (10.10), 12 wildborn (7.5) and eight captive born (3.5).

In 1992, the Brazilian Institute for the Environment and Renewable Natural Resources (IBAMA) established an international committee for the captive breeding program and conservation of *C. xanthosternos* and *C. a. robustus* (Edict No. 111, 16th October 1992). *C. a. robustus*, which occurs south of the Rio Jequitinhonha and north of the Rio Doce in southern Bahia and northern Espírito Santo, was included as a result of the findings of Oliver and Santos (1991), and their conclusions that it is heavily hunted, that its range is also seriously reduced, and that there is an urgent need for a structured breeding program (see also Santos and Oliver 1991). The role of the committee and its objectives are those which have been established for similar committees for the four lion tamarins, *Leontopithecus* (see Mallinson, 1986), and involve the establishment of a viable captive breeding population and studbook, the promotion of field projects, and advice on conservation issues which directly or indirectly affect the two capuchin monkey subspecies. Ilmar B. Santos (Fundação Biodiversitas, Belo Horizonte, Brazil) and Jean-Marc Lernould (Mulhouse Zoo, France) were designated Chairperson and Vice-chairperson, respectively.

Adelmar F. Coimbra-Filho
CNPq Research Fellow
Rua Artur Araripe 60/901,
Gávea, 22451-020 Rio de Janeiro
Rio de Janeiro, Brazil

Anthony B. Rylands
Departamento de Zoologia
Instituto de Ciências Biológicas
Universidade Federal de Minas Gerais
31270-901 Belo Horizonte
Minas Gerais, Brazil.

Alcides Pissinatti
Centro de Primatologia do Rio de Janeiro (CPRJ)

Fundação Estadual de Engenharia do Meio Ambiente (FEEMA)
Caixa Postal 23011
20940 Rio de Janeiro
Rio de Janeiro, Brazil

and

Ilmar B. Santos
Fundação Biodiversitas
Avenida do Contorno 9155
30110-130 Belo Horizonte
Minas Gerais, Brazil

Literature Cited

Antonil, A. J. 1711. *Cultura e Opulência do Brasil, suas Drogas e Minas*. Officina Real Deslandesiana, Lisbon.

Barros, F. B. de. 1923. *Diccionário Geográfico e Histórico da Bahia*. Imprensa Official do Estado, Salvador.

Burmeister, H. 1856. *Systematische Hebersicht der Thiere Brasiliens*. Part 3, Vogel, Vol. 3. Reiner, Berlin.

Cabrera, A. 1957. Catálogo de los Mamíferos de América del Sur. *Rev. Mus. Arq. Cienc. Nat. "Bernadino Rivadavia"* 1: 1-307.

Calmon, P. 1939. *História da Casa da Torre*. Coleção Documentos Brasileiros, 22. Livraria José Olímpio, Rio de Janeiro.

Coimbra-Filho, A. F. 1970. Sobre *Mitu mitu* (Linnaeus, 1777) e a validez das suas duas raças geográficas (Cracidae-Aves). *Rev. Brasil. Biol.* 30(1): 101-109.

Coimbra-Filho, A. F. 1986. Espécies ameaçadas de extinção - *Cebus apella xanthosternos* Wied, 1820. *FBCN-Inf.*, Rio de Janeiro, 10 (4): 3.

Coimbra-Filho, A. F; Rocha e Silva, R da and Pissinatti, A. 1991. Acerca da distribuição geográfica original de *Cebus apella xanthosternos* Wied, 1820 (Cebidae - Primates). In: *A Primatologia no Brasil - 3*. A. B. Rylands and A. T. Bernardes (eds.), pp.215-224. Sociedade Brasileira de Primatologia and Fundação Biodiversitas, Belo Horizonte.

Coimbra-Filho, A. F. Rocha e Silva, R da and Pissinatti, A. 1992. *Cebus apella xanthosternos*: its propagation in captivity. In: *Topics in primatology, Vol. 3: Evolutionary Biology, Reproductive Endocrinology and Virology*. S. Matano, R. H. Tuttle, H. Ishida and M. Goodman (eds.), pp.459-466. University of Tokyo Press, Tokyo.

Couto, D. D. do L. 1904. *Desaggravos do Brasil e Glórias de Pernambuco*. Officina Typográphica da Biblioteca Nacional, Rio de Janeiro.

Cunha, E. da. 1968. *Os Sertões*. 27th Edition. Paulo de Azevedo Ltda, Rio de Janeiro.

Kinzey, W. G. 1982. Distribution of primates and forest refuges. In: *Biological Diversification in the Tropics*. G. T. Prance (ed.), pp.455-482. Columbia University Press, New York.

Lernould, J.-M. and C. Thouvenin. 1992. Breeding, conservation and research programmes at the Mulhouse Zoo since 1978. *Folia Primatol.* 58: 171-172. (Abstract).

Magnanini, A. and A. F. Coimbra-Filho. 1974. Manutenção do sistema hidrográfico: Problemas de sobrevivência do Oeste Baiano. In: *Anais 1 Simpósio Florestal da Bahia*, Salvador, pp.19-24.

Mallinson, J. J. C. 1986. The Wildlife Preservation Trusts' (J. W. P. T./W. P. T . I.) support for the conservation of the genus *Leontopithecus*. *Dodo, J. Jersey Wild. Preserv. Trust* 23: 6-18.

Mattos-Filho, A. de and C. T. Rizzini. 1968. Madeiras da Bahia. *An. Brasil. Econ. Flor.* 19: 109-148.

Mittermeier, R. A., A. F. Coimbra-Filho and I. D. Constable. 1981. Conservation of eastern Brazilian primates. Project 1614. Unpublished report for the period 1979/80, World Wildlife Fund - US, Washington, D. C.

Mittermeier, R. A., A. F. Coimbra-Filho, I. D. Constable, A. B. Rylands and C. M. C. Valle. 1982. Conservation of primates in the Atlantic forest region of eastern Brazil. *Int. Zoo Yb.* 22: 2-17.

Mittermeier, R. A., W. G. Kinzey and R. Mast. 1989. Neotropical primate conservation. *J. Hum. Evol.* 18: 597-610.

Oliver, W. L. R. and I. B. Santos. 1991. Threatened endemic mammals of the Atlantic forest region of south-east Brazil. *Wildl. Preserv. Trust. Special Scientific Report* 4: 1-126.

Pinto, O. M. O. 1941. Da validez de *Cebus robustus* Kuhl e suas relações com as formas mais afins. *Papéis Avulsos, Dep. Zool., Secr. Agricultura, São Paulo* 1(15): 111-120.

Pinto, O. M. O. 1954. Resultados ornitológicos de duas viagens científicas ao Estado de Alagoas. *Papéis Avulsos, Dep. Zool., Secr. Agricultura, São Paulo* 12: 1-97.

Rizzini, C. T. 1963. Nota prévia sobre a divisão fitogeográfica do Brasil. *Rev. Brasil. Geogr.* 25(1): 1-64.

Rizzini, C. T. 1967. Delimitação, caracterização e relações da flora silvestre hileiana. *Atas do Simp. Biota Amazonica*, 4 (Botânica): 13-36.

Rylands, A. B., W. R. Spironelo, V. L. Tornisielo, R. M. Lemos de Sá, M. C. Kierulff and I. B. Santos. 1988. Primates of the Rio Jequitinhonha valley, Minas Gerais, Brazil. *Primate Conservation* (9): 100-109.

Sampaio, T. 1925. *O Estado da Bahia. Criação de Gado, Indústria e commercio*. Secretaria da Agricultura, Comércio e Obras Públicas, Salvador.

Santos, I. B. and W. L. R. Oliver. 1991. International co-operative breeding programme for the yellow-breasted capuchin monkey, *Cebus apella xanthosternos* - the acquisition of additional founders and preliminary recommendations for the future development of the programme. A report on the field project in S. E. Bahia in October 1991. Unpublished report to Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis (IBAMA), Brazil, Parc Zoologique et Botanique de la Ville de Mulhouse, France, Zoologischer Garten Zürich, Centro de Primatologia do Rio de Janeiro, Brazil, and Fundação Biodiversitas, Brazil. 25pp.

Santos, I. B., R. A. Mittermeier, A. B. Rylands and C. M. Valle. 1987. The distribution and conservation status of primates in southern Bahia, Brazil. *Primate Conservation* (8): 126-142.

Seuánez, H. N., J. L. Armada, L. Freitas, R. da Rocha e Silva, A. Pissinatti and A. F. Coimbra-Filho. 1986. Intraspecific chromosome variation in *Cebus apella* (Cebidae, Platyrrhini): The chromosomes of the yellow-breasted capuchin *Cebus apella xanthosternos* Wied, 1820. *Am. J. Primatol.* 10: 237-247.

Sick, H. and D. M. Teixeira. 1979. Notas sobre aves brasileiras raras ou ameaçadas de extinção. *Publ. Avulsas do Museu Nacional*, Rio de Janeiro, 62: 1-39.

Sousa, G. S. de. 1938. *Tratado Descritivo do Brasil.* 3rd Edition, with commentaries by F. A. de Vanhargen. São Paulo.

Torres de Assumpção, C. 1983. An Ecological Study of the Primates of Southeastern Brazil, with a Reappraisal of *Cebus apella* races. Unpubl. Ph.D. Thesis, University of Edinburgh, Edinburgh

Vianna, H. 1967. *História do Brasil.* Vol. 1. 5th Edition, Editora Melhoramentos, São Paulo.

Vieira, C. da C. 1955. Lista remissiva dos mamíferos do Brasil. *Arq. Zool.*, São Paulo, 8: 341-447.

Wied-Neuwied, M. 1940. *Viagem ao Brasil.* Translation by E. S. de Mendonça and F. P. de Figueiredo. Cia. Ed. Nacional, Rio de Janeiro.

Received for publication: July 1991
Revised: September 1992

Appendix

Localities for *Cebus xanthosternos.*

1. Carinhanha, west Bahia. 14°18'S, 43°47'W. 1947. Skin in the U. S. National Museum. Cited by Kinzey (1982: locality No. 14) and Santos *et al.* (1987). Carinhanha is located to the west of the Rio São Francisco. A skin from Serra Geral, Carinhanha, in the National Museum, Rio de Janeiro, (MN23237, S. E. P. F. A., III.1947), is referable to *C. a. libidinosus* (cited by Torres de Assumpção 1983: locality No. BA-6, p.208).

2. Ilhéus, south Bahia. 14°45"S, 39°42"W. Sea level. 1843, 1845. Cited by Torres de Assumpção (1983): locality No. BA-3, p. 307) and Kinzey (1982: locality No. 18, with the coordinates 14 49"S, 39 02"W).

3. Belmonte, Passuí, south Bahia. 15°51'S, 38°54'W. S. E. P. F. A. VII. 1949. Skins in the National Museum, Rio de Janeiro, MN 23228, 23229, 23230, 23232, 23233, 23234. Cited by Kinzey (1982: locality No. 24) and Torres de Assumpção (1983: locality No. BA-5, p.308).

4. Rio Jucurucú, south Bahia. 17°21'S, 39°13'W. C. A. Camargo, 1932. Cited by Kinzey (1982: locality No. 25). In 1969, L. Deane also collected a specimen of *C. a. robustus* from this locality (Kinzey, 1982). Kinzey (1982) also records a locality for *C. a. robustus* to the north of the Rio Jucurucú at Fazenda Pontal, Itamarajú, 17°04'S, 39°32'W. C. A. Camargo, 1932.

5a. Serra do Iuiú, west Bahia. 14°18'S, 43°48'W. Two skins in the U. S. National Museum. Collected in 1949. Nos. 00518266 and 00518267. Cited in Santos *et al.* (1987).

5b. Malhada, west Bahia, 14°18'S, 43°48'W. Skin in the National Museum, Rio de Janeiro. MN25231. Cited by Torres de Assumpção (1983: locality No. BA-7, p. 308).

6. Rio Gongogi, Bahia. C. A. Camargo and O. Pinto, 1932. 14°28'S, 39°50'W. Skins in Museum of Zoology, São Paulo. MZSP3848, 3849, 3850, 3851, 3858, 3859, 3860. Cited by Torres de Assumpção (1983: locality No. BA-1, p. 307).

7. Vila Nova (= Senhor do Bonfim), Bahia. 10°27'S, 40°12'W. E. Garbe, 1908 or 1915. Skins in Museum of Zoology, São Paulo. MZSP2582, 2583, 2584, 2585, 2586, 2587. Cited by Torres de Assumpção (1983: locality No. BA-2, p. 307).

8. Vicinity of Governador Mangabeira, east Bahia. 12°35'S, 39°04'W. A locally caught captive animal reported by Oliver and Santos (1991: locality No. 15).

9. Vicinity of Três Braços, east Bahia. 13°30'S, 39°43'W. A locally caught captive animal reported by Oliver and Santos (1991: locality No. 34).

10. Vicinity of Valença, east Bahia. 13°18'S, 39°01'W. Observed in the wild by Oliver and Santos (1991: locality No. 36).

11. Una Biological Reserve, south-east Bahia. 15°08'- 15°14'S, 29°05'-29° 1'W. Seen in the wild by Oliver and Santos (1991: locality No. 66).

12. Lemos Maia Experimental Station, Una, south-east Bahia. 15°15'- 15°17'S, 39°05'- 39°06'W. Observed in the wild (Rylands 1982), also reported by Oliver and Santos (1991: locality No. 67).

13. Canavieiras Experimental Station, south-east Bahia. 15°23 - 15°27'S, 39°12'- 39°13'W. Observed in the wild (L. P. de Souza Pinto and A. B. Rylands unpubl. data, 1992), also reported by Oliver and Santos (1991: locality No. 70).

14. Vicinity of Ouricana, south-east Bahia. 15°43'S, 39°05'W. A locally caught captive animal reported by Oliver and Santos (1991: locality No. 79).

15. Vicinity of Itapebí, north bank of the Rio Jequitinhonha, south-east Bahia. 15°43'S, 39°05'W. A locally caught captive animal reported by Oliver and Santos (1991: locality No. 83).

Localities in Sergipe, south of the Rio São Francisco, and north of the Rio Paraguaçú, Bahia, where unidentified capuchin monkeys have been reported by local people (Oliver and Santos 1991).

16. Vicinity of Arauá, Sergipe. 11°14'S, 37°37'W. Oliver and Santos (1991: locality No. 4).

17. Vicinity of Estância, Sergipe. 11°15'S, 37°25'W. Oliver and Santos (1991: locality No. 5).

18. Vicinity of Umbaúba, Sergipe. 11°20'S, 37°40'W. Oliver and Santos (1991: locality No. 6).

19. Vicinity of Cachoeira do Abadia, Sergipe. 11°30'S, 37°45'W. Oliver and Santos (1991: locality No. 7).

20. Vicinity of Jandaira, north-east Bahia. 11°32'S, 37°41'W. Oliver and Santos (1991: locality No. 8).

21. Vicinity of Araçás, north-east Bahia. 12°12'S, 38°12'W. Oliver and Santos (1991: locality No. 10).

22. Vicinity of Catú, north-east Bahia. 12°22'S, 38°12'W. Oliver and Santos (1991: locality No.11).

Localities in eastern Bahia, south of the Rio Paraguaçú, and north of the Rio de Contas, where unidentified capuchin monkeys were reported by local people but which were presumed to have been *C. xanthosternos* by Oliver and Santos (1991).

23. Vicinity of São Miguel das Matas, east Bahia. 12°57'S, 39°25'W. Oliver and Santos (1991: locality No. 22).

24. Vicinity of Santo Antônio de Jesus, east Bahia. 13°00'S, 39°15'W. Oliver and Santos (1991: locality No. 23).

25. Vicinity of Nazaré, east Bahia. 12°59'S, 39°00'W. Oliver and Santos (1991: locality No. 24).

26. Vicinity of Mutuípe, east Bahia. 13°14'S, 39°32'W. Capuchin monkeys reported extinct in the area. Oliver and Santos (1991: locality No. 29).

27. Vicinity of Jiquiriçá, east Bahia. 13°15'S, 39°36'W. Oliver and Santos (1991: locality No. 30).

28. Vicinity of Ubaíra, east Bahia. 13°16'S, 39°42'W. Oliver and Santos (1991: locality No. 31).

29. Vicinity of Guaibim, east Bahia. 13°17'S, 38°59'W. Oliver and Santos (1991:

locality No. 35).

30. Vicinity of Taperoá, east Bahia. 13°27'S, 39°05'W. Oliver and Santos (1991: locality No. 37).

31. Vicinity of Nilo Peçanha, east Bahia. 13°36'S, 39°07'W. Oliver and Santos (1991: locality No. 38).

32. Vicinity of Teolandia, east Bahia. 13°35'S, 39°30'W. Capuchin monkeys reported extinct in the area. Oliver and Santos (1991: locality No. 39).

33. Vicinity of Piraí do Norte, east Bahia. 13°46'S, 39°23'W. Oliver and Santos (1991: locality No. 40).

34. Vicinity of Ituberá, east Bahia. 13°45'S, 39°10'W. Oliver and Santos (1991: locality No. 41).

35. Vicinity of Camamú, east Bahia. 13°56'S, 39°07'W. Oliver and Santos (1991: locality No. 43).

36. Vicinity of Itamaratí, east Bahia. 14°03'S, 39°23'W. Oliver and Santos (1991: locality No. 44).

37. Vicinity of Travessão, east Bahia. 14°10'S, 39°30'W. Oliver and Santos (1991: locality No. 45).

38. Vicinity of Ibirapitanga, east Bahia. 14°10'S, 39°23'W. Oliver and Santos (1991: locality No. 46).

39. Vicinity of Ipiaú, east Bahia. 14°08'S, 39°45'W. Oliver and Santos (1991: locality No. 47).

40. Vicinity of Ubatã, east Bahia. 14°12'S, 39°32'W. Oliver and Santos (1991: locality No. 48).

Localities between the Rio de Contas and Rio Pardo where unidentified capuchin monkeys were reported by local people, but which were presumed to have referred to *C. xanthosternos* by Oliver and Santos (1991).

41. Vicinity of Aurelino Leal, south-east Bahia. 14°20'S, 39°20'W. Oliver and Santos (1991: locality No. 49).

42. Vicinity of Itajiba, south-east Bahia. 14°16'S, 39°52'W. Oliver and Santos (1991: locality No. 50).

43. Vicinity of Dario Meira, south-east Bahia. 14°25'S, 39°55'W. Oliver and Santos (1991: locality No. 51).

44. Vicinity of Ibitupã, south-east Bahia. 14°30'S, 39°53'W. Capuchin monkeys possibly ovvur in the area. Oliver and Santos (1991: locality No. 53).

45. Vicinity of Uruçuca, south-east Bahia. 14°36'S, 39°17'W. Capuchin monkeys reported extinct in the area. Oliver and Santos (1991: locality No. 55).

46. Vicinity of Almadina, south-east Bahia. 14°42'S, 39°39'W. Oliver and Santos (1991: locality No. 54).

47. Vicinity of Barro Preto, south-east Bahia. 14°48'S, 39°40'W. Capuchin monkeys reported extinct in the area. Oliver and Santos (1991: locality No. 55).

48. Vicinity of Ibicaraí, south-east Bahia. 14°52'S, 39°36'W. Oliver and Santos (1991: locality No. 56).

49. Vicinity of Salobrinho, south-east Bahia. 14°47'S, 39°12'W. Capuchin monkeys reported extinct in the area. Oliver and Santos (1991: locality No. 58).

50. Vicinity of Ponto do Pitú, south-east Bahia. 14° 47'S, 39° 05'W. Capuchin monkeys reported extinct in the area. Oliver and Santos (1991: locality No. 59).

51. Vicinity of Itabuna, south-east Bahia. 14°50'S, 39°19'W. Oliver and Santos (1991: locality No. 60).

52. 7 km south of Ilhéus on BA-001 road to Olivença, south-east Bahia. 14° 51'S, 39° 02'W. Oliver and Santos (1991: locality No. 61).

53. Vicinity of Olivença, south-east Bahia. 15°02'S, 39°00'W. Capuchin monkeys reported extinct in the area. Oliver and Santos (1991: locality No. 62).

54. Vicinity of Firmino Alves, south-east Bahia. 14°59'S, 39°56'W. Capuchin monkeys possibly occur in the area. Oliver and Santos (1991: locality No. 63).

55. Vicinity of Itororó, south-east Bahia. 15°57'S, 40°04'W. Capuchin monkeys reported extinct in the area. Oliver and Santos (1991: locality No. 64).

56. 4 km south of Una on BA-001 road to Canavieiras, south-east Bahia. 15°20'S, 39°02'W. Oliver and Santos (1991: locality No. 68).

57. Vicinity of Vila São João, near Canavieiras Experimental Station, south-east Bahia. 15°22'S, 39°12'W. Oliver and Santos (1991: locality No. 69).

58. Vicinity of Potiraguá, south-east Bahia. 15°36'S, 39°57'W. Oliver and Santos (1991: locality No. 69).

59. Vicinity of Itarantim, south-east Bahia. 15°39'S, 40°04'W. Capuchin monkeys reported extinct in the area. Oliver and Santos (1991: locality No. 73).

60. Vicinity of Maiquinique, south-east Bahia. 15° 37'S, 40° 16'W. Capuchin monkeys reported extinct in the area. Oliver and Santos (1991: locality No. 74).

61. Vicinity of Santa Maria Eterna, south-east Bahia. 15°50'S, 39°24'W. Oliver and Santos (1991: locality No. 80).

Localities south of the Rio Pardo and north of the Rio Jequitinhonha where unidientified capuchin monkeys have been reported by local people (Oliver and Santos, 1991).

62. Vicinity of Bandeira, north-east Minas Gerais. 15°53'S, 40°34'W. Oliver and Santos (1991: locality No. 75).

63. Vicinity of Jordania, north-east Minas Gerais. 15°50'S, 39°24'W. Oliver and Santos (1991: locality No. 76).

64. Rio Jequitinhonha ferry terminal, on north bank, east of Almenara, north-east Minas Gerais. 16°05'S, 40°32'W. Oliver and Santos (1991: locality No. 77).

65. Vicinity of Almenara, north-east Minas Gerais, 16°10'S, 40°42'W. Oliver and Santos (1991: locality No. 78).

Primate Conservation 1991-1992 (12-13): 31-33

Hoolock Gibbons (*Hylobates hoolock*) in Arunachal Pradesh, Northeast India: The Lohit District

R. P. Mukherjee, S. Chaudhuri and A. Murmu

Zoological Survey of India, New Alipore, Calcutta, India

Introduction

The hoolock gibbon (*Hylobates hoolock*) occurs in the rain forests south and east of the Brahmaputra river in India. In these parts it inhabits mostly the hill tops, slopes and valleys of the dense forests. The forest which contains these apes is resonant with their calls in the morning. The wildlife, including the hoolock gibbon, in India is now under great pressure due to hunting for food and to large scale destruction of their habitats. Population growth, increased land demand for cultivation, and exploitation of forests for hardwood and firewood, are the factors promoting the large scale destruction of forests. These are compounded by hunting for food and shifting cultivation (*jhum*) in most of the gibbon habitats, and have resulted in a decrease in their numbers, causing considerable conservation problems for this ape in India. To ascertain the impact of these factors and to know the present status of the gibbons in India, censuses were initiated in certain parts of its habitat. Under this program, censuses were carried out in two of the three districts that are known to be inhabited by the hoolock gibbon: Tirap, Lohit and part of the Dibang valley (east of Dibang river) of Arunachal Pradesh. The first part, dealing with the hoolock gibbon of the Tirap district has been published (Mukherjee *et al.* 1988). This is the second part of the series which deals with the hoolock gibbon of the Lohit district. The survey methods adopted are the same as discussed in Mukherjee *et al.* (1988).

The Study Area

The Lohit district is situated on the north eastern extremity of Arunachal Pradesh. The district derived its name from one of its principal rivers, the Lohit, which enters the district from the eastern side, flowing southward and meeting the Dibang and Siang rivers, and finally giving rise to the Brahmaputra river. It emerges from the higher Himalayan region. The district lies approximately between the latitudes 27°33'N and 29°22'N, and longitude 95°15'E and 97°24'E. It is bounded on the north by Tibet, on the east by Burma, on the west and south by the Dibang valley and Tirap districts, respectively, of Arunachal Pradesh. It is very sparsely populated by a number of rural, tribal groups. About 62% of the area of Arunachal Pradesh is comprised of forest. Mountains are the most imposing features of the topography of this district, including many high ranges and towering peaks, some above 5000m. The ranges along the northern border are permanently snow-covered, and the source of all the rivers. The plains belt of Lohit forms the eastern continuity of the upper Assam plain. The lesser Himalayan region rises abruptly from the Lohit plains, and comprises rugged mountains and forested terrain.

The hills of this district are covered by unusual vegetation which has attracted numerous botanists. The tall grass that grows on the banks of the flood plains of several small rivers is *Neyraudia reynaudiana*, intermixed with *Equisetum* sp., and dotted with trees of *Bombex ceiba*. The regions adjacent to the Lohit river, and in the lower elevations, support deciduous forests with patches of evergreen species. The trees are dense and closely packed, with tall boles carrying a broad canopy: ideal habitat for non-human primates, particularly the hoolock gibbon. The dominant tree species are *Dipterocarpus macrocarpus*, *Terminalia myriocarpa*, *Acrocarpus fraxinifolius* and *Chikrassia tabularia*, with a second stratum of trees nearly as tall, including *Mesuaferrea* sp., *Lagerstroemia parviflora*, *Ptersospermum acerifolium*, *Bischofia javanica*, *Cinnamomum* sp. and *Phoebe* sp. Mixed with these are scattered specimens of *Adina cordifolia*, *Schina wallichi*, *Macaranga* sp., *Mallotus* sp., *Bridelia* sp., *Gmelina arborea*, *Albizia* sp., *Bauhinia* sp., *Talauma hodgsoni* and *Dillenia indica*. The chief climbers belong to the families Vitaceae, Menispermaceae, Cucurbitaceae, Acanthaceae and Minosaceae, and the cane palm (*Calamus*) is common. The forest also contains several kinds of bamboo. The subtropical forests commonly consist of evergreen species at higher elevations from 100 to 200 m. The local tribal inhabitants of these areas thrive on the tubers, foliage, flowers, fruits and seeds harvested from the forest.

The climate of the district is largely influenced by the nature of its terrain. It is cool and very humid in the lower elevations and valleys, and intensely cold in the higher elevations. The winter months are from November to March. The coldest months are January and February. On many days the minimum temperature

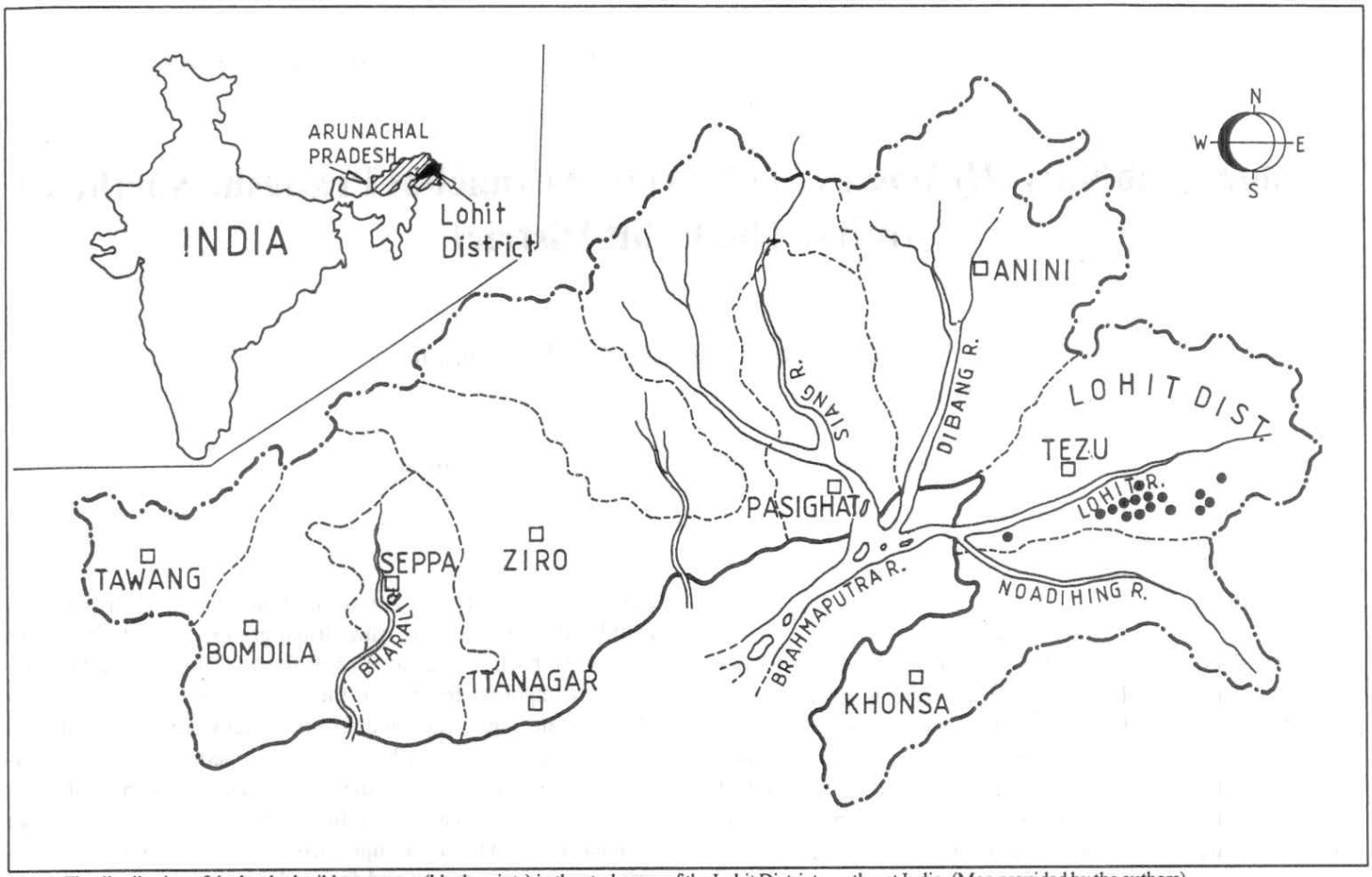


Fig. 1. The distribution of the hoolock gibbon groups (black points) in the study area of the Lohit District, northeast India. (Map provided by the authors).

falls below freezing. The period from March to May is the pre-monsoon, and June to October is the monsoon season. The average annual rainfall in the south-western part of the district is 2,000 mm. The entire district of Lohit is characterized by heavy rainfall, and humidity is high throughout most of the year.

Results

The hoolock gibbon occurs in the forests of the Lohit district, but is rare in some areas and very common in the others. Groups inhabit forests on hill tops, slopes, and valleys, as well as the flat plains. The forests where they are found are generally tall and dense, with a heavy undergrowth. The censuses carried out in various parts reveal that the concentration of gibbons is higher in the Kamlang Nagar area than in any other part of the district. The distribution of groups that were located during censusing are shown in Figure 1. Sixteen hoolock gibbon groups were sighted and studied, and the calls of a number of other groups were heard. The group size and composition of these 16 groups are given in Table 1. Of the 16 groups, 15 contained just one male and one female. Only one group contained seven members, and all of them were males. This is the first record of an all male group in hoolock gibbons. It was observed in the forest near the village of Manthi, about 15 km from Zero point on the Deban road, and contained three adults, two sub-adults, and two juveniles. The group size of the bisexual groups varied from two to five. Only two groups were comprised of pairs, six groups contained three individuals, another six contained four gibbons, and one group had five members. This indicates that the majority of the groups were composed of three to four individuals: an adult male, adult female, and a juvenile or infant or both. Eleven of the groups had juveniles: in all except two just one. Single infants were seen in only eight groups.

Of the 15 bisexual groups counted, sizes were of two (13.3%), three (40%), and four individuals (40%), and only 6.7% of the groups had five members. The adult female to juvenile/infant ratio was 1:1.4. In the last census, carried out during the last part of October to the middle of November 1987, three females were observed with new born infants of one to two months old. This indicates that infants, in this region, are born in the months of August and September. The 16 groups contained a total of 58 gibbons, 20 of which were adult males, 15 were adult females, 15 were juveniles and eight were infants. As stated earlier, the maximum concentration of groups were recorded in the Kamlang Nagar area. Based on the sightings of groups and their calls, it was estimated that each hoolock family occupied an area of 1-2 km^2. Boundaries of many of the groups overlapped. Many groups had closed neighbors, but no interactions were recorded. On one occasion two groups were found feeding in trees opposite to each other, on either side of the road connecting Kamlang Nagar and Zero point, and close to Kamlang Nagar. They did not vocalize and no interactions were observed. On another occasion, we observed four groups concentrated in an area of little more than 1 km^2. Two groups were feeding, one was resting, and the fourth group was vocaliz-

Table I. Group composition and size of hoolock gibbons at Kamlang Nagar and Namsai.

Area	Group composition				Group
	Males	Females	JJ	II	Size
Kamlang Nagar	1	1	1	1	4
Kamlang Nagar	1	1	-	1	3
Kamlang Nagar	1	1	1	-	3
Kamlang Nagar	1	1	1	1	4
Kamlang Nagar	1	1	1	-	3
Kamlang Nagar[1]	5	-	2	-	7
Kamlang Nagar	1	1	1	1	4
Kamlang Nagar	1	1	2	-	4
Kamlang Nagar	1	1	1	-	3
Kamlang Nagar	1	1	-	-	2
Kamlang Nagar	1	1	1	1	4
Kamlang Nagar	1	1	2	1	5
Kamlang Nagar	1	1	1	1	4
Kamlang Nagar	1	1	1	-	3
Kamlang Nagar	1	1	-	1	3
Namsai	1	1	-	-	2
Total	20	15	15	8	58

[1]All male group

ing, without showing any interactions between the groups. This indicates that when the home ranges of different groups overlap, the groups may congregate temporarily at certain places during their daily activity, but depart without showing any interactions. The habitats of the hoolock gibbon in most places were dense forest, and the daily range length of each family was limited, varying from 100 to 200 m in the winter months. The foods and feeding behavior were the same as those observed in the hoolock gibbons of the Tirap district (Mukherjee *et al.* 1988). Like the Tirap gibbons, the groups spend much of their time vocalizing.

Discussion

The abundance, distribution, and current status of many non-human primate species in India have become a cause of great concern due to diverse forms of interference in their natural habitat. The hoolock gibbon is listed under Schedule-I of the Indian Wildlife Protection Act and is restricted in its distribution to just a few of the states of northeastern India (Mukherjee 1986). Field studies, and a review of the literature, indicate that it enters India through Burma and is now restricted between the two rivers - Brahmaputra in India and Chindwin in Burma. In this paper we have discussed the distribution, relative abundance and present status of hoolock gibbon in Lohit district of Arunachal Pradesh. Arunachal has extensive forests on the hills, and in the valleys and plains. During the census carried out in Lohit district, hoolock gibbons were observed in the forests of Namsai and Kamlang Nagar to Wakro and Zero point and to Deban. These forests support an important hoolock gibbon population; more than in any other site surveyed so far in eastern India. Their largely frugivorous diet, and their preference for mature, undisturbed, tall and dense forest, with a continuous canopy, set them apart from other non-human primate species of this area. These requirements make this species particularly susceptible to the effects of habitat destruction and unlikely to survive in the secondary forests which macaques and langurs can survive in. There is, therefore, an urgent need to establish a reserve for the long term conservation of hoolock gibbons in the Lohit district. Most of the forests in the Lohit district are still ecologically viable, and able to sustain a high densities of primates, including the hoolock gibbon, but the greatest threats to their survival are hunting for food, shifting cultivation and timber extraction. One all-male group of hoolock gibbon was observed during the survey, and the census also indicated the tendency for relatively large groups (three to four members), when to Manipur and Tripura (Mukherjee 1986). They are similar, however, to the group sizes observed in the Tirap district of Arunachal Pradesh (Mukherjee *et al.* 1988). The ratio of adult females to juveniles/infants is favorable in terms of recruitment to the breeding population, and the groups appear to be reproductively vigorous, particularly in the Kamlang Nagar region.

R.P. Mukherjee
S. Chaudhuri
and
A. Murmu
Zoological Survey of India
"M" Block
New Alipore
Calcutta 700 053
India

Literature cited

Mukherjee, R. P. 1986. The ecology of hoolock gibbon, *Hylobates hoolock*, in Tripura, India. In: *Primate Ecology and Conservation*, J. G. Else and P. C. Lee (eds.), pp.115-123. Cambridge University Press, Cambridge.

Mukherjee, R. P., S. Chaudhuri and A. Murmu. 1988. Hoolock gibbons in Arunachal Pradesh, Northeast India. *Primate Conservation* (9): 121-123.

Received for publication: October 1991
Revised: September 1995

Primate Conservation 1991-1992 (12-13): 34-40

Captive Gibbons in Thailand and the Option of Reintroduction to the Wild

Ardith A. Eudey

164 Dayton Street, Upland, California 91786, USA

Introduction

Both theoretical discussion of, and actual attempts at, rehabilitation of captive primates for release in the wild have focused primarily on the great apes (Family Pongidae). A recent exception is the review of management techniques for liberation and rehabilitation of lesser apes (Family Hylobatidae) by Leighton and Whitten (1984). The reasons for the pongid bias are apparent. Not only are most great ape populations in peril, perhaps especially so in Africa, but biomolecular and fossil evidence suggest that the human lineage (Family Hominidae) and pongid lineages shared a longer common ancestry after the divergence of the Hylobatidae than was previously thought (see, for example, Ciochon and Corruccini 1983) and likewise, field and captive studies, including language research, indicate greater similarities in behavioral potential among the pongids and ourselves than was formerly acknowledged (see, for example, Hamburg and McCown 1979; Gardner and Gardner 1985). As a consequence, the lesser apes (or gibbons) have tended to be eclipsed by the great apes in both conservation and rehabilitation efforts, although the biological significance of the hylobatids and the threats to their survival in the wild have been amply documented (Preuschoft *et al.* 1984). The far greater absolute losses being sustained by hylobatids throughout their habitat distribution than by pongids have been largely overlooked.

Lesser apes are found only in moist evergreen and moist deciduous forest in insular and continental Southeast Asia and adjacent areas of the Burma-Bangladesh-Assam (India) forest region and south China. In the 1970's, Chivers (1977) estimated the total number of all hylobatids to be almost four million, but projected that by 1980 the number could be reduced by as much as 84% to about 621,000, primarily as a result of habitat loss. No updated estimates of numbers are available, but as many as five populations already may have reached relict status and the foreseen decline of all species during the next twenty years may result in the restriction of viable populations to national parks and wildlife sanctuaries (Brockelman and Chivers 1984).

The potential area of tropical moist forest in Asia has been estimated at about 3.87 million km², but by 1975 the actual area of forest may have been reduced by 43.7% to 1.87 million km² (Myers 1980). The evergreen forests of insular Southeast Asia constitute one of the richest biological zones on earth, and one that is especially vulnerable to commercial exploitation due to the abundance of tropical hardwoods that are used for plywood and veneers. According to Myers (1980), all lowland forest outside of parks may be completely logged in Peninsular Malaysia by 1990, and in Indonesia by the year 2000. Although the conversion of moist deciduous or monsoon forest in continental Southeast Asia may not be proceeding as rapidly in some countries, notably Thailand, the rate of loss is comparable (see below). Because the lesser apes are exclusively arboreal, destruction of forest habitat not only results in immediate loss of populations but also makes those that remain on the forest fringe more vulnerable to human exploitation.

This paper reviews the problem of captive gibbons and the prospects for their rehabilitation in Thailand. Thailand appears to be the appropriate country with which to begin such a review because of the excessive illegal trade in Thai gibbons, both internally and internationally, and because rehabilitation of captive gibbons already has been attempted there.

Captive Gibbons in Thailand

Three gibbon species are found in Thailand: the agile or black-handed gibbon (*Hylobates agilis*), which is restricted to the peninsula on the border with Malaysia; the pileated or capped gibbon (*H. pileatus*), which is restricted to the southeast; and the lar or white-handed gibbon (*H. lar*), which is widely distributed in both moist evergreen and moist deciduous forest. Although all three species are exploited by local human populations and therefore may enter captivity, the greater abundance of the lar gibbon means

that members of this species are more apt to be candidates for rehabilitation than are individuals of the other two species.

According to government inventories, forest may have covered about 70% of Thailand at the end of World War II. By the Royal Forest Department's estimate, forest cover had decined to no more than 29% by 1985. This figure must be considered as inflated, however, because it does not differenatiate between primary forest and secondary scrub (Suthisamarn 1988); statements that Thailand's forest cover may be no more than 18% recently have appeared in print (Anon. 1989a). Although the deforestation rate is higher in Indonesia, losing more than 480,000 ha of forest land each year, the problem is more acute in Thailand, where more than 320,000 ha of forest were being cut down every year in a country which is, at approximately 520,000 km², only one-fourth the size of Indonesia, at approximately 1.9 million km² (Secter 1982). Illegal logging and forest encroachment by private concessions, including operations authorized in wildlife sanctuaries and prime watershed areas, recently were identified as the primary cause of forest loss in Thailand. Public outrage at flooding and mudslides, that killed 350 people in southern Thailand in 1988 and were blamed on illegal felling, led to two royal decrees banning all logging in January 1989 (Anon. 1989b). Commercial interests in Thailand now have obtained logging concessions in primary forest in border areas of Myanmar (Burma) and Laos (Anon. 1989a).

Fig. 1. Gibbon skulls taken as trophies by sport hunters in Nam Naew National Park, Thailand (photo: K. Buri).

Fig. 2. A Thai woman living on the outskirts of Bangkok with her two pet lar gibbons, which were reported to have been obtained from peninsular Thailand (photo: A. A. Eudey).

Chivers (1977) estimated the number of lar gibbons in Thailand to be 125,000 and projected that the population could experience a 52% decline to 60,000 by 1980. In spite of the fact that the lar gibbon is widespread in Thailand, it is presently considered to be endangered due to loss of forest habitat (Brockelman and Chivers, 1984).

The Wild Animal Preservation and Protection Act BE 2503 (1960) is the legal basis for the protection of wildlife in Thailand (see Saiwichian 1978; Jintanugool *et al.* 1984). In 1961, gibbons (*Hylobates* spp.) were listed under the act as protected animals of the first category[1]. No quotas have been issued for hunting or trading of gibbons, which means, in effect, that they are legally protected from these activities.

Among the hill tribes, including the Karen and Hmong, which comprise the largest cultural minorities in Thailand and together number around 237,000 (Thailand 1982), gibbons have traditionally been hunted as a source of food. Gibbons also fall prey to the more recent phenomena of market hunting and sport hunting, which are based on the use of sophisticated transportation and weapons. Infant gibbons found clinging to their dead or wounded mothers frequently enter commercial trade, and one incentive for shooting a female gibbon is to obtain her clinging baby. Young gibbons are kept as pets by Thais both in up-country villages and in Bangkok and other urban areas, and they are even reported to be the "favorite pet for Thais" (Treesucon 1984). In the field a female lar gibbon was observed to carry her infant continuously until it was about fifteen months old (Treesucon 1984), and such a long period of dependency makes young gibbons especially attractive as pets. Animal dealers and others in Bangkok, in spite of the illegality of their activity, continue to offer gibbons for sale: on their premises; at the Weekend Market, which has been relocated from Sanam Luang to Pahon Yothin (Jatujak) Road; and at a variety of tourist attractions such as the Ancient City (pers. obs.; Anon. 1982; Kavanagh and Bennett 1984; Treesucon 1984). A provi-

[1]The first category of protected animals legally includes wild animals which are not usually hunted for food or sport, which destroy plant pests, or which should be protected for their natural beauty or for increasing their population numbers.

sion in the law permitting individuals to possess as many as two gibbons - "a potential pair to promote breeding" - makes it difficult to prosecute sellers (see Kavanagh and Bennett 1984). In 1984, the price of a young gibbon was 1500-1200 baht per animal, the equivalent of US$65-85 (Treesucon 1984).

Full independence of a young gibbon is not achieved until seven or eight years of age (Chivers and Raemaekers 1980). Gibbons are characterized by an absence of sexual dimorphism, and as they mature both males and females experience an increase in strength and aggressiveness that may cause their owners to lose interest in them as pets. Solutions to the problem of unwanted gibbons include donating them to a Buddhist temple (*wat*); giving them to a zoo, such as the Dusit Zoo in Bangkok, or to the Wildlife Conservation Division of the Royal Forest Department, which sometimes may be forced simply to release the gibbons into the forest adjacent to holding facilities; or to sell or give them to animal dealers. An illegal commercial shipment of Thai gibbons obtained by an American university laboratory in 1974 was reported to have included adult animals with collars, thought to be indicative of their former status as pets (J. B. Harrold pers. comm.).

Expatriates and foreign tourists, as well as Thais, have ample opportunities to purchase lar gibbons in Thailand. Some of these purchases may be motivated by humane reasons, but attempts to take gibbons to home countries may prove futile since the United States and the United Kingdom and several other European countries have health regulations banning or restricting the importation of primates as pets (see Mack and Eudey 1984; Kavanagh and Bennett 1984; Kavanagh *et al.* 1987). The relative abundance of lar gibbons in reputable zoos in these countries (Mootnick 1984; Fox 1984; Schilling 1984) makes it unlikely that such institutions would be interested in negotiating for the legal acquisition of the animals.

The lesser apes likewise have been subject to illegal traffic for the international pet trade, exhibition, and biomedical research. In the United States, the lar gibbon was used in oncological research during the 1970's. Gibbons were smuggled to the United States for experimental use from Thailand and from Singapore, where no species is native, until all *Hylobates* spp. were added to the U.S. Endangered Species List in 1976 (Anon. 1980). In 1975, all gibbons were added to Appendix I of the Convention on International Trade in Endangered Species (CITES), which went into effect in 1977. Some illegal traffic in gibbons continued between non-CITES parties such as Laos, which appears to have exported primates illegally obtained from Thailand, and Belgium (Anon. 1978) and Japan (Anon. 1981; Nishida and Uehara 1982). Although Japan ratified CITES in November, 1980, gibbon smuggling from Thailand to Japan appears to continue. TRAFFIC (Japan) uncovered uninterrupted trade in Appendix I species through monitoring Tokyo pet shops, where lar gibbons and Indochinese white-cheeked gibbons (*H. concolor*) are reported to have been offered for sale at prices ranging from the equivalent of US$880 to US$2,175 (Anon. 1984a; Anon. 1984b). Bangkok has been implicated as the source of this illegal trade. In 1983, eleven primates, including gibbons, were confiscated in the hand luggage of a Japanese citizen returning from Thailand (Anon. 1984a). Efforts to control this illegal traffic would be enhanced if an effective program of gibbon confiscation, with the potential for rehabilitation, were to be developed, as occurred for the orang-utan (*Pongo pygmaeus*) in Indonesia (see Rijksen 1978; Aveling and Mitchell 1982, n.d.).

The Potential for Gibbon Rehabilitation in Thailand

Efforts to breed lar gibbons in captivity are relevant to the problem of rehabilitation for release in the wild. Successful breeding under typical laboratory and zoo conditions has not been exceptional, although the situation may be improving (Kawakami and Kollias 1984; Fox 1984; Mootnick 1984; Schilling 1984). This qualified success may reflect the fact that mechanisms by which pair bonds are formed by wild gibbons still remain a matter of speculation.

Gibbons live for about 20-30 years and appear to pair for life (Chivers and Raemaekers 1980). They form small, territorial family groups consisting of an adult male and female and up to four offspring, although the usual group size in the wild is about four.

Fig. 3. Animals for sale at the Weekend Market, Bangkok (photo: A. A. Eudey).

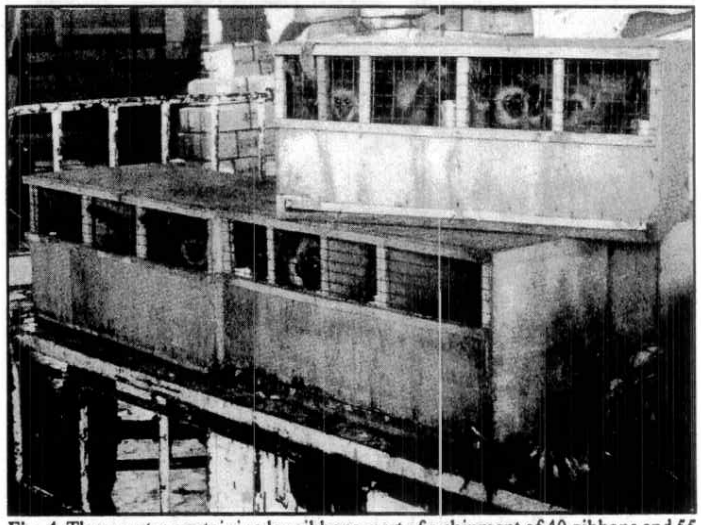


Fig. 4. Three crates containing lar gibbons, part of a shipment of 40 gibbons and 55 macaque monkeys consigned to an animal dealer in Belgium, in transit from Laos at Don Muang air Port, Bangkok in August 1978. All the primates may have been captured in Thailand (photo: A. A. Eudey).

Young are born at intervals of two-three years, with sexual behavior tending to occur for only a few months at comparable intervals. The ways in which gibbons form new pairs still are problematic. Young males may be peripheralized by their fathers at the end of the family's range or in adjacent areas, from which they attract females. Alternately, young within a family might replace an aging animal, especially the same-sex parent. A male subsequently might attract a new female to his territory after the death of his mother.

Only a few free-ranging colonies of gibbons have been attempted. A colony of 14 gibbons released on the island of Cayo Santiago, Puerto Rico, was abandoned due to gibbon attacks on personnel and to the harassment of the gibbons by rhesus macaques, *Macaca mulatta* (Carpenter 1971). Ten gibbons were released for behavioral modification experiments on Hall's Island, Bermuda, during 1970-1971 (Baldwin and Teleki 1976). Illegal acquisition of the gibbons from Thailand seems highly probable (Anon. 1976). Five of the gibbons died, most probably as a consequence of the experimentation on them, and another was removed and sacrificed.

The most significant free-ranging colony of lar gibbons was established on the island (*koh*) of Klet Kaeo near Sattahip in the Gulf of Siam as an experiment to breed animals for biomedical research in Thailand (Berkson *et al.* 1971; Brockelman *et al.* 1973, 1974). The project was undertaken by the SEATO Medical Research Laboratory, a facility of the U.S. Army Walter Reed Hospital in Bangkok, in collaboration with the Delta Regional Primate Center, Covington, Louisiana. The laboratory subsequently has become known as the Armed Forces Research Institute for Military Science (AFRIMS).

Between April 1967 and June 1968, 20 gibbons were introduced to *Koh* Klet Kaeo in successive pairs. The gibbons were obtained from commercial animal dealers and no information on provenance, age, or history was available. Most were housed in the Bangkok laboratory for at least one month with the gibbon with whom they were released on the island. The number of gibbons present on the island at any one time did not exceed 14.

Koh Klet Kaeo is 24 ha in size and no more than 80 m in elevation, with dense, scrubby vegetation 5-15 m in height - "not natural habitat for gibbons" (Brockelman *et al.* 1973). Food and water stations were scattered over the island. Wilder gibbons relied primarily on natural foods, but all visited watering points. A small, natural population of long-tailed macaques (*Macaca fascicularis*) was fed at the food stations but did not harass the gibbons. The released gibbons established territories on the island that were about 4 ha, one-tenth to one-third the size of those of wild groups (Brockelman *et al.* 1973).

Four males and four females remained until near the end of the project in 1970. The four females each gave birth to one infant, all of whom were conceived four or five months after pair bonds and ranges had stabilized (Brockelman *et al.* 1973). Three of the four females were the most wild ("feral"), and the fourth was a young female who within one month changed from being extremely friendly to being aggressive on her own territory. Females excluded one another from ranges to an even greater extent than did males (Brockelman *et al.* 1973).

The tameness of the gibbons to humans appeared to influence their ability to enter into social relationships with conspecifics: "tame" gibbons formed less stable pair bonds and their behavior toward other gibbons was less predictable. They are described as regarding humans as "peers of some sort," and, lacking fear of

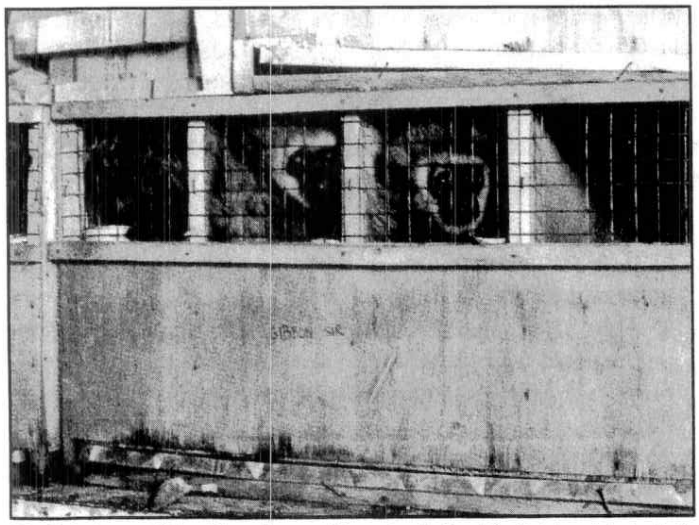


Fig. 5. A closeup of the gibbons in one of the crates destined for Belgium (photo: A. A. Eudey).

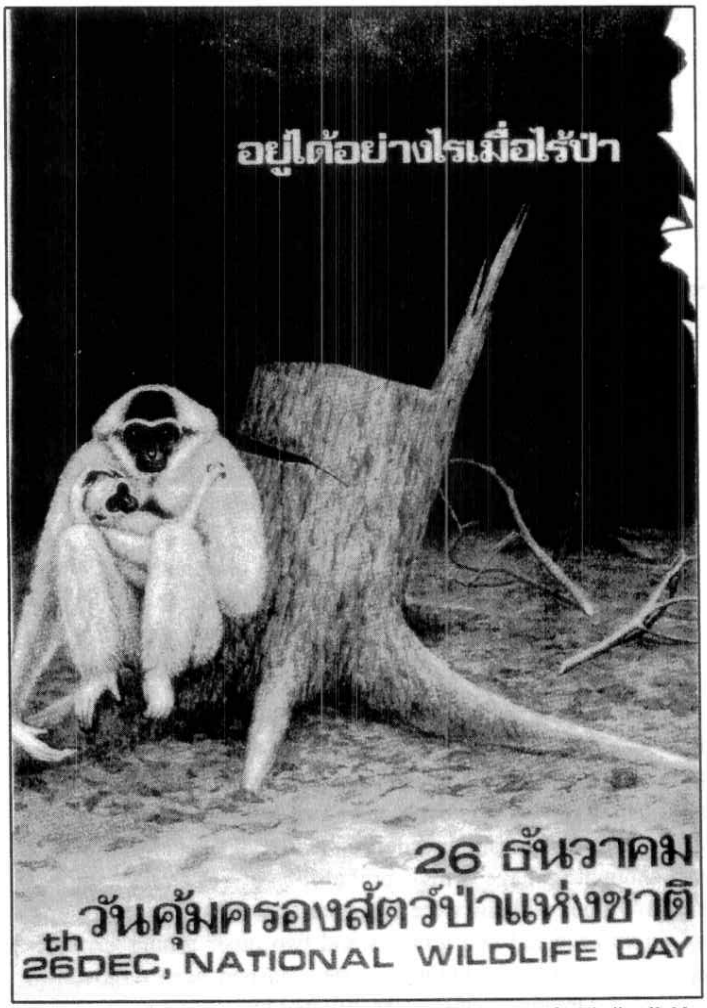


Fig. 6. A female pileated gibbon and her infant adorn this poster for Thailand's National Wildlife Day, 26 December 1983. The poster was based on an original painting by Kamol Komolphalin.

them, resorted to biting and hitting people (Brockelman *et al.* 1974).

From the standpoint of breeding, the colony was considered to be "too expensive and limited" to produce more than a small number of gibbons (Berkson *et al.* 1971); but, from the standpoint of rehabilitation, the program was considered to be a success in that four stable groups resulted, each of which produced an offspring (Brockelman 1981).

Subsequently, in 1976, AFRIMS discontinued its gibbon program, which at one time included as many as 200 animals originally intended for use in the study of human malaria. Thirty-one gibbons were released and observed intermittently for 17 months by the release team and by local (formally untrained) villagers (Tingpalapong *et al.* 1981).

The release area was 225 km² of predominantly dry evergreen forest without dry season rain (November through April) adjoining the headquarters of the Royal Protein Expansion Programme (PEP) in Saiyok, Kanchanaburi Povince, in west-central Thailand (Tingpalapong *et al.* 1981). The area contained a population of wild gibbons, and there is no indication that annual fluctuations in resources as they relate to the carrying capacity of the environment had been established.

The following factors figured in the selection of the release area (Tingpalapong *et al.* 1981):

1. the area was natural habitat for gibbons, as determined by the presence of a wild population;
2. the native gibbon population was considered to be not so large that it could not accommodate rehabilitants;
3. fruit and water, at least as contained in vegetation, were considered to be adequate for year-round consumption;
4. there appeared to be protection from hunters because of the presence of PEP, and local people were enlisted to help with the rehabilitation efforts.

Four release sites were established, only two of which were remote from the PEP headquarters (at a distance of 2 km or more). Two methods of release were used (Tingpalapong *et al.* 1981).

1. Anesthetized gibbons were released from two large wire cages, identical in size to their laboratory cages, from which they could hear but not see one another. Food (monkey chow) was provided in cages for 14 days. Sixteen gibbons were released in this manner: two families with one offspring each; four pairs; and two individuals.
2. The second method involved laying out anesthetized gibbons on the forest floor. Fifteen gibbons were released by this procedure: three families with one offspring each; one pair; and four individuals.

Of the 31 gibbons, two died at the release site: a twenty-day old infant within twelve hours of release, and a female during the first day after release. Eleven adults were not observed after the day of release, in what was considered to be "inaccessible habitat." These included three successful breeders on *Koh* Klet Kaeo, two of which were thought to have a high probability of surviving "without trouble." Four gibbons were accepted into wild resident groups: one group accepted two gibbons and two other groups each accepted one gibbon, including a male who had been removed to Bangkok for treatment of injuries inflicted by wild gibbons. Other instances of the acceptance of released gibbons by wild gibbons are reported in Brockelman and Chivers (1984). Three tame gibbons had to be recaptured, and one of them, because of her preference for humans, was eventually donated to a *wat*. The rest were seen for short periods of time following release. Some gibbons were observed to obtain water by licking condensed moisture from their fur (J. T. Marshall pers. comm.). Seven adults were seen eating natural fruits, including figs, but observations were made difficult by the failure of the released gibbons to call. The most successful gibbons were among the first released: they may have rapidly saturated the area (Tingpalapong *et al.* 1981).

The *Koh* Klet Kaeo colony and, especially, the Kanchanaburi release suggest that rehabilitation is feasible for lar gibbons. Recognition of the following factors appears to be critical for the design and implementation of any future rehabilitation efforts.

1. The major difficulty in any release program is rehabilitating gibbons who prefer humans to conspecifics.
2. Careful preparation of gibbons for release is essential. Pairs should be established before release, although the extent to which pair bonds might be reinforced by the birth of an infant before release is unclear.
3. The release habitat must be carefully selected. Preferably, wild gibbons should be absent from the area, or, at most, they should occur at a low density. Appropriate areas for release in Thailand would include reserved areas in which wild gibbons had been locally extirpated by hunting. The total area included within national parks and wildlife sanctuaries is about 4.7 million ha, or 9.2% of Thailand's area (Brockelman 1987).
4. Control over the human population is necessary in respect to hunting and forest exploitation.
5. Continuous monitoring of the adjustment and health status of the released gibbons must take place. Animals should be removed from the release area if they prove unable to adjust or become ill or sustain injury.
6. Local people must be involved in the project, with an opportunity for employment, in order to create a positive attitude toward the release.

Conclusion

The rapid loss of forest habitat in Thailand, leading to the increasing vulnerability of gibbons, appears to demand a new conservation strategy. One component of this strategy might be a national gibbon rehabilitation program undertaken in conjunction with a conservation education campaign. The objectives of this integrated approach would be the following:

1. to discourage Thais from obtaining gibbons as pets;
2. to alert foreigners to the fact that it is illegal to capture and trade in gibbons;
3. to create a center for donated gibbons and those confiscated in international trade, where they would receive expert and humane care, with the possibility of rehabilitation for release in the wild.
4. To promote conservation, using the gibbon as a symbol of forest conservation.

Brockelman (1981; Brockelman and Chivers 1984) has suggested that rehabilitation for release might also be incorporated

within a broader program of long-term gibbon management and captive-breeding, in which research on social behavior, reproductive biology, nutritional physiology, and diseases of gibbons would be an integral part.

Recently, there has been some debate over the appropriateness of gibbons as symbols for forest conservation in the Southeast Asian countries where they occur (Leighton and Whitten 1984; Brockelman and Chivers 1984). The negative position of Leighton and Whitten appears to be based, at least in part, on what they consider to be the inadequacy of scientific knowledge about the role that gibbons play in tropical forest ecosystems rather than the intrinsic appeal of these primates, which are among the most conspicuous animals in the Southeast Asian forests (Brockelman and Chivers 1984). In Thailand, the appeal of gibbons as pets should be exploited for conservation action. The highly endangered pileated gibbon was used as a symbol for National Wildlife Day in Thailand in 1983.

Acknowledgments

The present discussion of rehabilitation and conservation in Thailand cannot help but reflect the ideas of Joe T. Marshall and Warren Y. Brockelman, with whom I have discussed the problem at length. Special thanks are due to Elsie Marshall and H. Elliott McClure, whose heroic efforts made possible my informed participation and initial presentation of this paper in the IUCN/SSC Primate Rehabilitation Symposium in Madrid, Spain, in 1984. Travel to Madrid was made possible by awards from IUCN and the College of Arts and Science, University of Nevada, Reno.

Ardith A. Eudey
164 Dayton Street
Upland
California 91786
USA

Literature Cited

Anonymous. 1976. The Hall's Island gibbons project. *IPPL Newsletter* 3(1):1-7.

Anonymous. 1978. Laotian-Belgium traffic in mammals.*IPPL Newsletter* 5(3): 2-5.

Anonymous. 1980. Origin of Comparative Oncology Laboratory gibbons. *IPPL Newsletter* 7(1) : 2-4.

Anonymous. 1981. Japanese imports of smuggled gibbons. *IPPL Newsletter* 8(3): 7.

Anonymous. 1982. Primates suffer on Bangkok's infamous Sunday Market. *IPPL Newsletter* 9(1):5.

Anonymous. 1984a. Japan doing little to stop gibbon smuggling. *The Nation Review*, Bangkok, 3 July, 1984.

Anonymous. 1984b. Primate smuggling to Japan. *IPPL Newsletter*11(3):11.

Anonymous. 1989a. The cost of wood. *The Economist*, 23 December, 1989.

Anonymous. 1989b. Thailand bans all logging. *Oryx* 23:110.

Aveling, R. J and A. H. Mitchell. 1982. Is rehabilitating orangutans worthwhile? *Oryx* 16:263-271.

Aveling, R. J. and A. H. Mitchell. n.d. Problems and prospects of orangutan rehabilitation. Unpublished manuscript.

Baldwin L.A. and G. Teleki. 1976. Patterns of gibbon behavior on Hall's Island, Bermuda. *Gibbon and Siamang* 4:22-105.

Berkson G, B.A. Ross and S. Jatinandana. 1971. The social behavior of gibbons in relation to a conservation program. In: *Primate Behavior: Developments in Field and Laboratory Research, Vol. 2*, L. A. Rosenblum (ed.), pp.225-255. Academic Press, New York.

Brockelman, W. Y. 1987. Nature conservation. *Thailand Natural Resource Profile, Part II.* Prepared by the Thailand Development Research Institute, Bangkok, National Environmental Board, Department of Technical and Economic Cooperation, United States Agency for International Development, pp 91-119.

Brockelman, W.Y. 1981. Field research on primates in Thailand. *J. Sci. Soc. Thailand*, 7:9-17.

Brockelman,W.Y. and D. J. Chivers. 1984. Gibbon conservation: looking to the future. In: *The Lesser Apes*, H. Preuschoft, D. J. Chivers, W. Y. Brockelman and N. Creel (eds.), pp 3-12. Edinburgh University Press, Edinburgh:

Brockelman, W.Y., B. A. Ross and S. Pantuwatana. 1973. Social correlates of reproductive success in the gibbon colony on Ko Klet Kaeo, Thailand. *Am. J. Phys. Anthropol.* 38:637-640.

Brockelman, W. Y., B. A. Ross and S. Pantuwatana. 1974. Social interactions of adult gibbons (*Hylobates lar*) in an experimental colony. *Gibbon and Siamang* 3:137-156.

Carpenter, C. R. 1971. Breeding colonies of macaques and gibbons on Santiago Island, Puerto Rico. In: *Breeding Primates*, W. I. B. Beveridge (ed.), pp 76-87. S. Karger, Basel.

Chivers, D. J. 1977. The lesser apes. In: *Primate Conservation*, H. S. H. Prince Rainier of Monaco and G. H. Bourne (eds.), pp 539-598. Academic Press, New York.

Chivers, D. J. and J. J. Raemaekers. 1980. Long-term changes in behavior. In: *Malayan Forest Primates*, D. J. Chivers (ed.), pp 209-260. Plenum, New York.

Ciochon, R. L. and R. S. Corruccini (eds.). 1983. *New Interpretations of Ape and Human Ancestry*. Plenum Press, New York.

Fox, G. J. 1984. The conservation of gibbons in American zoos. In: *The Lesser Apes*, H. Preuschoft, D. J. Chivers, W. Y. Brockelman and N. Creel (eds.), pp 74-80. Edinburgh University Press, Edinburgh.

Gardner B. T. and R. A. Gardner. 1985. Signs of intelligence in cross-fostered chimpanzees. *Phil. Trans. Roy. Soc. Lond.* B, 308:159-176.

Hamburg, D. A. and E. R. McCown (eds.). 1979. *The Great Apes*. Benjamin/Cummings, Menlo Park, California.

Jintanugool, J., A. A. Eudey and W. Y. Brockelman. 1984. Species conservation priorities in Thailand. In: *Species Conservation Priorities in the Tropical Forests of Southeast Asia*, R. A. Mittermeier and W. R. Konstant (eds.), *Occasional Papers of the IUCN Species Survival Commission (SSC)* (1): 41-51.

Kavanagh, M. and E. Bennett. 1984. A synopsis of legislation

and the primate trade in habitat and user countries. In: *The International Primate Trade, Vol. 1: Legislation, Trade and Captive Breeding*, D. Mack and R. A. Mittermeier (eds.), pp 19-48. TRAFFIC (USA), Washington, D. C.

Kavanagh, M, A. A. Eudey and D. Mack. 1987. The effects of live trapping and trade on primate populations. In: *Primate Conservation in the Tropical Rain Forest*, C. W. Marsh and R. A. Mittermeier (eds.), pp 147-177. Alan R. Liss, New York.

Kawakami, T. G. and G. V. Kollias Jr. 1984. Breeding and rearing lar gibbons in captivity. In: *The Lesser Apes*, H. Preuschoft, D. J. Chivers, W. Y. Brockelman and N. Creel (eds.), pp.44-50. Edinburgh University Press, Edinburgh.

Leighton, D. S. R. and A. J. Whitten. 1984. Management of free-ranging gibbons. In: *The Lesser Apes*, H. Preuschoft, D. J. Chivers, W. Y. Brockelman and N. Creel (eds.), pp 32-43. Edinburgh University Press, Edinburgh.

Mack, D. and A. A. Eudey. 1984. A review of the U.S. primate trade. In: *The International Primate Trade, Vol. 1: Legislation, Trade and Captive Breeding*, D. Mack and R. A. Mittermeier (eds.), pp.91-136. TRAFFIC (USA), Washington, D. C.

Mootnick, A. 1984. Census of gibbons in North America. In: *The Lesser Apes*, H. Preuschoft, D. J. Chivers, W. Y. Brockelman and N. Creel (eds.), pp.61-73. Edinburgh University Press, Edinburgh.

Myers, N. 1980. *Conversion of Tropical Moist Forests*. National Academy of Sciences, Washington, D. C.

Nishida, T. and S. Uehara. 1982. Japanese ape imports. *IPPL Newsletter* 9(3):12-15.

Preuschoft, H, D. J. Chivers, W. Y. Brockelman and N. Creel (eds.). 1984. *The Lesser Apes.* Edinburgh University Press, Edinburgh.

Rijksen, H. D. 1978. *A Field Study on Sumatran Orang-utans (*Pongo pygmaeus abelii *Lesson 1827): Ecology, Behaviour and Conservation.* H. Veenman and B. V. Zonen, Wageningen.

Saiwichian, P. 1978. Primate conservation: regulations and problems. In: *Primate Research in Thailand: Opportunities, Problems, Solutions*. Mahidol University, Bangkok, Thailand, 8pp.

Schilling, D. 1984. Gibbons in European zoos, with notes on the identification of subspecies of concolor gibbon. In: *The Lesser Apes*, H. Preuschoft, D. J. Chivers, W. Y. Brockelman and N. Creel (eds.), pp.51-60. Edinburgh University Press, Edinburgh.

Secter, R. 1982. Southeast Asia fast losing lush forests. *Los Angeles Times*, 22 March, 1982.

Suthisamarn, S. 1988. The great jungle bungle. *The Nation*, Bangkok, 21 November,1988, pp.25, 27.

Thailand, Division of Development and Public Welfare. 1982. Problems of the hill tribes and opium planting. Ministry of the Interior, Bangkok, Thailand. (In Thai).

Tingpalapong, M, W.T. Watson, R. E. Whitmire, F. E. Chapple and J. T. Marshall, Jr. 1981. Reaction of captive gibbons to natural habitat and wild conspecifics after release. *Nat. Hist. Bull. Siam Society*, 29:31-40.

Treesucon, U. 1984. Social development of young gibbons (*Hylobates lar*) in Khao Yai National Park, Thailand. M.S. Thesis, Faculty of Graduate Studies, Mahidol University, Bangkok.

Received for publication: January 1994
Revised: May 1996

Regional Newsletters

Information on projects, research groups, events, recent publications, activities of primatologiacal societies and NGO's, and other newsworthy items of interest to primate conservationists should be submitted directly to the editors of the IUCN/SSC Primate Specialist Group regional newsletters to the editors at the addresses below.

Madagascar - *Lemur News*

Roderic B. Mast
Conservation International
1015 18th Street, NW, Suite 1000
Washington, D.C. 20036
U.S.A
Fax: +1 202 887 0192
E-mail: r.mast@conservation.org

Neotropical Region - *Neotropical Primates*

Anthony B. Rylands
c/o Conservation International do Brasil
Av. Antônio Abrahão Caram 820/302
31275-000 Belo Horizonte
Minas Gerais
Brazil
Fax: +55 (0)31 441 1795
E-mail: a.rylands@conservation.org.br

or, and for contributions in Spanish,

Ernesto Rodríguez-Luna
Instituto de Neuroetología
Universidad Veracruzana
Apartado Postal 566
Xalapa
Veracruz 91000
Mexico
Fax: +52 2812 5748
E-mail: saraguat@speedy.coacade.uv.mx

Asian Region - *Asian Primates*

Ardith A. Eudey
164 Dayton Street
Upland
California 91786
U.S.A
Fax: +1 909 982 9832

African Region - *African Primates*

Thomas M. Butynski
Zoo Atlanta
Africa Biodiversity Conservation Program
P.O. Box 24434
Nairobi
Kenya
Fax: +254 289 0615
E-mail: zoo-abcp@tt.sasa.unep.no

Instructions to Contributors

Articles Submitted to *Primate Conservation*

Manuscript Format

All manuscripts should be typewritten, double-spaced with generous margins, and accompanied by the text on diskette in Word 6.0, WordPerfect 5.1 or Write format. Please indicate on a separate cover page the author to which correspondence should be sent, including fax number and e-mail, the month and year the manuscript was completed, and a short running title. Abstracts are not published. Footnotes are to be avoided (except for tables and figures). Subdivision titles, for example Methods, Conclusions, etc., are not necessary. Please give all measurements in metric units. Please accent all foreign words carefully. The literature cited should be in the following style:

Example - journal article:

Struhsaker, T. T. 1972. Rain forest conservation in Africa. *Primates* 13:103-109.

Example - article in book:

Goodall, A. G. and C. P. Groves. 1977. The conservation of eastern gorillas. In: *Primate Conservation*, H. S. H. Prince Rainier of Monaco and G. H. Bourne (eds.), pp.599-637. Academic Press, New York.

Example - book:

Soulé, M. E. (ed.). 1987. *Viable Populations for Conservation.* Cambridge University Press, Cambridge.

Example - dissertation:

Homewood, K. M. 1976. Ecology and Behaviour of the Tana Mangabey (*Cercocebus galeritus galeritus*). Unpubl. Ph.D. thesis, University College, London.

Maps

Maps should always be made as concise as possible and should include an inset showing the location of the area discussed in relation to its home country or continent.

Photographs

Black and white prints are ideal. Original color slides from which we can make prints are also acceptable. However, please send only sharply focused, high-quality slides and photographs. Please label each slide or photograph with the photographer credit and number the identifying caption. Captions should be listed on a separate sheet, or after "Literature Cited". We are always interested in receiving high-quality photographs for our covers, especially those of little known and rarely photographed primates, even if they do not accompany an article.

All Figures

Please indicate on all figures the title and author of the manuscript to which they belong and package them carefully to avoid damage in the post. Figures will only be returned at the special request of the author. Maps, photograph and figures can be sent in any one the following types of file: Freelance Plus Release 2.0 (DRW); Windows Metafile (WMF); Graphics Interchange (GIF). Please, however, supply a hard copy of all drawn maps or figures, preferably in the size in which they should be published.

Please send your contribution to the editors:

Anthony B. Rylands
c/o Conservation International do Brasil
Av. Antônio Abrahão Caram 820/302
31275-000 Belo Horizonte
Minas Gerais
Brazil
Fax: +55 (0)31 441 1795
E-Mail: a.rylands@conservation.org.br

or

Russell A. Mittermeier
Conservation International
1015 18th Street, NW, Suite 1000
Washington, D.C. 20036
U.S.A.
Fax: +1 202 887 0192
E-Mail: r.mittermeier@conservation.org

Printed and bound by Consolidated Graphic Communications, Lock Haven, PA, U.S.A.

Back cover. Brown howler monkey (*Alouatta fusca clamitans*) from the Atlantic forest region of eastern Brazil. Photo by A. F. Coimbra-Filho.