LEONTOPITHECUS II

The Second
Population and Habitat Viability Assessment
for Lion Tamarins
(Leontopithecus)

Belo Horizonte, Brazil
20-22 May 1997

Final Report
May 1998

Edited by
Jonathan D. Ballou, Robert C. Lacy, Devra Kleiman, Anthony Rylands and Susie Ellis

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EXECUTIVE SUMMARY

The four endangered species of lion tamarins, *Leontopithecus*, (*L. rosalia*, the golden lion tamarin; *L. chrysomelas*, the golden-headed lion tamarin; *L. chrysopygus*, the black-lion tamarin; and *L. caissara*, the black-faced lion tamarin) are endemic to the Atlantic forest in eastern and southeastern Brazil. Deforestation, hunting and commerce have caused their populations to decline drastically over the last 50 years. Current population estimates are about 630 for the golden lion tamarin (GLT), 6,000 to 15,500 for the golden-headed lion tamarin (GHLT), 1000 for the black lion tamarin (BLT) and as few as 400 for the black-faced lion tamarin (BFLT). Populations of the GLT and BLT are highly fragmented with the majority of animals in protected areas (Poço das Antas Biological Reserve in the state of Rio de Janeiro and Morro do Diabo State Park in the state of São Paulo, respectively). Less fragmented is the population of GHLTs, located in and around the Una Biological Reserve (state of Bahia). The distribution and status of the BFLT are less well known as they were only discovered in 1990; the majority exist in the protected Superagüi National Park, Parana.

All four species are currently the subject of intensive conservation programs that, depending on the species, include scientific global management of captive populations (GLT, GHLT, BLT), studies on the ecology and behavior of wild populations (all species), translocation of threatened wild groups (GLT, BLT), habitat restoration (GLT), local conservation education programs (all species) and reintroduction of captive-born individuals to natural forest (GLT). Four International Research and Management Committees (IRMC) advise the Brazilian government (IBAMA) on the research and conservation activities for these species.

This is the second Population and Habitat Viability Assessment for lion tamarins. The first, held in 1990, was organized jointly by the Fundação Biodiversitas, Belo Horizonte, and the IUCN/SSC Conservation Breeding Specialist Group (CBSG). Ulysses S. Seal, Chairman of CBSG, facilitated the meeting, which was a pivotal point in *Leontopithecus* conservation; for the first time integrated conservation strategies were developed for all four species. It was also as a result of this meeting that the IRMCs for the four species were officially established by IBAMA. The 1990 PVA served to focus the community of researchers, conservation biologists, reserve managers and administrators, and educators on the numerous conservation problems facing lion tamarins.

The second *Leontopithecus* PHVA was held upon the recommendations of the four IRMCs during their 1996 annual meetings in Brazil. Once again Fundação Biodiversitas offered to host the workshop in Belo Horizonte and CBSG (Susie Ellis and Robert Lacy) volunteered to facilitate. The PHVA was the second of three sequential meetings held during the week of May 20. A 25th Anniversary *Leontopithecus* symposium (the first lion tamarin conservation workshop was in 1972 - Bridgewater 1972) was held prior to the PHVA. Organized by D. Kleiman and A. Rylands, its purpose was to synthesize the current state of knowledge of the four lion tamarin species in preparation for the PHVA. The PHVA was followed on May 23 and 24 by the annual meetings of the IRMCs. Presentations from the symposium and the minutes of the IRMCs are distributed elsewhere. The objectives of this second PHVA were to evaluate the current status and threats facing the lion tamarin species and recommend and set priorities for conservation strategies to address problems that may exist. At the forefront of these threats and perceived needs were: 1) the recognition that the lion tamarin populations are extremely fragmented, with many small areas completely isolated from each other and therefore highly susceptible to the risks typically associated with small populations (loss of genetic diversity, vulnerability to catastrophes, environmental fluctuations); and 2) the acknowledgment that expansion of conservation education and community support programs would be vital to the success of lion tamarin conservation.

More than 50 managers, scientists, governmental officials, educators and biologists participated in the workshop. After opening welcomes, there was general open discussion identifying the various factors that participants thought needed to be addressed during the workshop. Based on these discussions, four working groups (and group coordinators) were identified. The groups were: Metapopulation Management Issues, Habitat and Research Issues, Social and Communication Issues, and Population Modeling. Participants were invited to join the working group of their choice, depending on their expertise and interests. Over the course of the next three days, each group was asked to: 1) list and describe all issues affecting the conservation and management of the four lion tamarin species; 2) identify 3 to 5 of the most important of these issues; 3) list 3 to 10 strategies or actions that might address these high priority issues; and 4) identify the resources (usually people) that will be needed to implement these recommendations. Each group presented the results of their work in three plenary sessions to ensure that everyone had an opportunity to contribute to the work of the other groups and to ensure that issues were carefully reviewed and discussed by all workshop participants. The recommendations that are part of this executive summary were accepted by all participants, thus representing a consensus.

The recommendations presented by the four working groups focus on three fundamental issues. It was remarkable how consistent the groups were in identifying similar issues of high priority and how interactions between working groups enhanced group discussions. The first major issue is that, conceptually, conservation of lion tamarins must proceed within a metapopulation context to maximize both the viability of lion tamarin populations and the conservation of habitat. Management of all fragmented populations, including captive populations if they exist, must be considered within a single "global" conservation objective, with goals set for separate populations so that each contributes to the viability of the whole. This approach acknowledges that movement, possibly frequent, of animals among populations is a necessary component of the management plan. Various considerations of the details of such a plan are outlined in the Metapopulation Management Working Group Report.

The second fundamental issue is the recognition that existing protected areas need to be maximally utilized, managed and safeguarded, with threats removed where they exist. For GLTs, GHLTs, and probably BFLTs as well, a significant proportion of the existing populations exist in unprotected areas. Where possible, protected areas need to be expanded to incorporate existing populations. The Habitat and Research Working Group Report focused on these needs to increase the quantity and quality of protected areas.

Finally, Social and Communications Working Group identified the effect of human-related factors (socio-economic, political, legislative, demographic and educational) as the preeminent challenge to the successful conservation of lion tamarins. The needs of viable lion tamarin populations must be reconciled with the needs of the people sharing the Atlantic forests of Brazil and the resource limitations of those involved with the conservation of these species and habitat. These issues are likely to be the primary foci of conservation action in the years to come.

RECOMMENDATIONS:

I. Metapopulation Management Group

1) The objective of the metapopulation management plan is ultimately the survival of the species, and preferentially, the survival of a population (or metapopulation) in its native habitat of sufficient size to undergo natural adaptive evolution. Quantitatively, the objective is a metapopulation of sufficient composition, size, and geographic distribution to survive for 100 years with a probability of at least 98%, with an overall effective size sufficient to retain at least 98% gene diversity for 100 years.

2) For each species, we must define the populations and habitats that will constitute the metapopulation, as well as the objectives, research, and management needed for each population in the metapopulation to ensure its contribution to the overall metapopulation viability as defined above. These objectives will be used to guide decisions about where, when, how many, and which individuals to translocate/reintroduce between populations.The captive populations must be considered a population within the taxa's metapopulation.

3) We must continue to develop and refine techniques for translocation/reintroduction so that animals can be successfully and efficiently moved among populations;

4) We must define and implement methods to increase the levels of communication between *in-situ* conservation efforts and zoos to strengthen the link between public education, public support and *in-situ* conservation programs.

II. Habitat and Research Working Group

For *L. rosalia*: The only officially designated protected area for this species is the 5,500ha Poço das Antas Biological Reserve (of which only 51% is forested). Protected areas for GLTs can be significantly increased by: 1) Creating an official protected area (conservation unit) of the 2,400 ha Fazenda União, currently owned by the Brazilian Federal Railway Company; and 2) annexing the 340 ha Fazenda Cambucais as part of the Poço das Antas Reserve (this forested fazenda containing GLTs is currently designated as an official Reserve but is being considered for a settlement project).

For *L. chrysomelas*: The Una Biological Reserve is the only protected area for the species. Of the 11,400 ha established in the decree creating the Reserve in December 1980, only 7,022 have been legally incorporated, and only 5,522 hectares is covered by forest, the remainder being composed of open areas or agricultural land worked by the 24 families still present within the reserve boundaries. The highest priority for the conservation of GHLTs is to provide indemnities for the removal of the 24 families of squatters within the Una Biological Reserve, and to intensify the current efforts to register and incorporate into the Reserve the remaining 4,378 ha to fulfill the original mandate in the decree for the Reserve.

For *L. chrysopygus*: The Morro do Diabo State Park (35,000 ha) and the Caitetus State Ecological Station (2,178 ha) are the only two protected areas containing populations of BLTs. However, there are a number of privately-owned forests where the species still occurs, they may be subject to agrarian reform settlements. Conservation priorities are to: 1) establish an institutional agreement between the Secretary of the Environment of the State of São Paulo, INCRA, MST and rural landowners to guarantee the permanence of the remaining forest fragments in the region of the Pontal do Paranapanema, incorporating forests into the Morro do Diabo State Park where possible ; and 2) provide incentives and accelerate the procedures involved in creating private reserves (RPPNs) in areas where there are populations of black lion tamarins, especially in the western part of the species' range.

For *L. caissara*: The only officially protected area for the black-faced lion tamarin, Superagüi National Park, is threatened by the construction of the BR-101 highway, which will bisect the continental range of the species and attract development. The island of Superagüi is also under considerable threat from deforestation, the establishment of lots for summer beach houses and, of principle importance, conflict of interests with Indians resident in the Park. In order to minimize or compensate for the impacts arising from the highway construction and threats to the island Park, protected areas should be established based on recommendations arising from population studies of *L. caissara*. The environmental impact studies for the highway should include recommendations arising from the PHVA Workshop and the International Committee for the species, and IBAMA.

III. Social and Communications Working Group

1) We must reduce the pressure of human occupation (land reform settlements and squatters) in and around existing conservation units (reserved and national parks) as well as reduce the negative impact of human practices in the region surrounding conservation units (fire, monoculture, changing watercourses, use of agrochemicals, etc.).

2) We must develop incentives for private land owners to preserve natural areas and improve enforcement to punish those who do not follow the law;

3) We must develop new and innovative economic alternatives for communities around conservation units;

4) We must improve communication and collaboration among institutions involved at all levels in land use and policy in the areas within the ranges of the lion tamarins.

The group prioritized the first issue as the most urgent and defined specific actions for each lion tamarin species:

L. caissara: IBAMA to negotiate with FUNAI to remove the Indians who have settled in Superagüi National Park;

L. chrysomelas: Allocate and prioritize resources within the IBAMA budget for indemnification of the squatters in the Una Biological Reserve;

L. rosalia: Legal protection of the Fazenda União;

L. chrysopygus: Ensure that criteria for redistribution of land in the Pontal Paranapanema are altered to include environmental concerns and protection of biodiversity.

In addition the group identified long-term actions needed in all four species to reach the first goal:

OBJECTIVE: Using a Participatory process, develop a regional plan for human occupation and land use for each region;

OBJECTIVE: Implementation of environmental education programs with the communities pressuring the conservation units.

IV. Population Modeling Working Group

1) If populations of each species were not fragmented and there were no further loss of habitat, we could marginally meet objectives defined by the metapopulation management plan (98% chance of survival and 98% maintenance of gene diversity for 100 years). However, this is not the case, and therefore any degree of fragmentation or loss of habitat endangers these populations.

2) Effects of fragmentation can be reduced by movement of animals. However, there needs to be enough movement to ensure that small populations contribute to overall metapopulation viability.

3) Models should continue to be refined and used to guide management as needed.

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Section 1

Introduction

INTRODUCTION

Devra G. Kleiman, Anthony Rylands & Susie Ellis

The four lion tamarin species are endemic to the Atlantic forest in eastern and southeastern Brazil. Three of them have coastal distributions: the golden lion tamarin, *Leontopithecus rosalia*, in the lowland forests of the state of Rio de Janeiro; the golden-headed lion tamarin, *L. chrysomelas*, in southern Bahia; and the black-faced lion tamarin, *L. caissara* in the northeast of the state of Paraná and extreme southeast of São Paulo. The fourth species, the black lion tamarin, *L. chrysopygus*, occurs inland in the west of the state of São Paulo (figure 1).

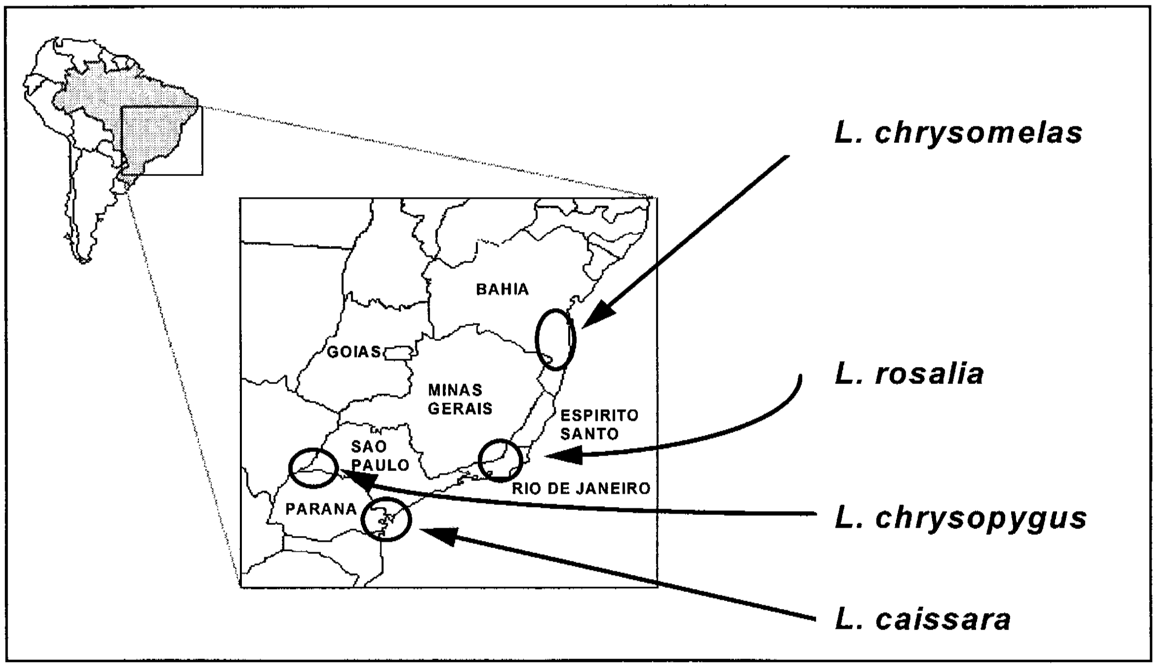

Figure 1. Distribution of the four *Leontopithecus* in Brazil.

All four species occur in the most densely populated regions of Brazil, where a long history of forest destruction has reduced the once widespread Atlantic forest to less than 6% of its original extent. As a result of this, and along with hunting and commerce, three species (*L. rosalia, L. chrysopygus*, and *L. caissara*) are currently classified by the World Conservation Union (IUCN) as "critically endangered", and the golden-headed lion tamarin (*L. chrysomelas)* is "endangered" (1996 IUCN Red List of Threatened Animals, J. Baillie and B.Groombridge, The World Conservation Union, Gland, 1996).

The first workshop concerning the plight of these species focused on the golden lion tamarin (GLT) and was held 25 years ago in Washington, D. C. (supported by the Wild Animal Propagation Trust, the New York Zoological Society and the National Zoological Park- NZP). The proceedings were published in a book Saving the Lion Marmoset, edited by D. D. Bridgewater in 1972 (Wild Animal Propagation Trust: Wheeling, West Virginia). It was carried out as a result of both Brazilian and non-Brazilian concerns that the species were rapidly heading towards extinction. A population of the black lion tamarin (BLT), long thought extinct, had just been rediscovered, but the black-faced lion tamarin (BFLT) was still unknown, being first described only in 1990. Numbers of the golden-headed lion tamarins (GHLT) were thought to be low and also approaching extinction.

At that time, priorities for action concentrated on research and management strategies necessary to protect and expand the captive zoo population of GLTs. There was just one protected area for the lion tamarins (the Morro do Diabo State Park in São Paulo state, protecting a population of BLTs), and the creation of further reserves for GLTs and GHLTs was identified as the first crucial step for the wild populations.

For the following 10 years, the focus of international activity was on expanding and managing the captive population of GLTs, while within Brazil, the Federal and State government agencies responsible for conservation of species and natural resources passed decrees creating reserves for the three known species. Regular implementation of endangered species laws (e.g., controlling exploitation of these areas from human pressure) and institutionalizing management of the decreed conservation units was yet to come. The situation of the lion tamarins at that time was reviewed by Adelmar F. Coimbra-Filho and Russell A. Mittermeier in the book, Primate Conservation, edited by H. S. H. Prince Rainier III of Monaco and G. H. Bourne ("Conservation of the Brazilian lion tamarins, *Leontopithecus rosalia*", pp.59-94, Academic Press, New York, 1977).

During the 1980s, scientific and conservation activities in Brazil for the three known species expanded dramatically, as did the organization of reserve management. A captive population for the GHLT was established from illegally-held animals confiscated outside of Brazil. Field studies (for GHLT, BLT, GLT), a reintroduction program using zoo-born animals (for GLT), and local education activities (for GHLT, BLT, GLT) were implemented, and metapopulation management strategies, based on the principles of conservation biology, were initiated.

In June 1990, the discovery of the black-faced lion tamarin was announced during the first Population Viability Analysis (PVA) Workshop for the genus, held in Brazil and organized jointly by the Fundação Biodiversitas, Belo Horizonte, and the IUCN/SSC Conservation Breeding Specialist Group (CBSG). Ulysses S. Seal, Chairman of CBSG, facilitated the meeting. The PVA resulted in the formal establishment by the Brazilian environmental institute IBAMA (Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis) of International Recovery and Management Committees for each of the four taxa. The task of these committees is to present recommendations on the research, management and conservation of the species to IBAMA; since 1990 they have met every year. The PVA also resulted in the establishment of a series of priorities for each species with regard to *in situ* and *ex situ* research, conservation and management, which have guided the activities of the Committees over the subsequent seven years (Leontopithecus Population Viability Analysis Workshop Report, Edited by U. S. Seal, J. D. Ballou, and C. V. Padua, Captive Breeding Specialist Group, Apple Valley, MN, USA. 1990).

Table I. Summary of the Status in Captivity, *L. rosalia, L. chrysomelas,* and *L. chrysopygus*

Population	*L. rosalia*	*L. chrysomelas*	*L. chrysopygus*
Size	488	627	103
Institutions	143	84	7
Founders	44 (7 still alive)	116-153[1]	18
Studbook	To 31/12/96	To 31/12/96?	To 31/12/95
Observations	Zero growth since 1994	5% growth since 31/12/94	
Source	Ballou and Sherr, 1996	H. de Bois, 1996 K. Leus, 1997	C. Padua, 1997

[1] Excluding unknown parentage - including unknown parentage

Table II. Summary of the Status in the Wild *L. chrysomelas, L. rosalia, L. chrysopygus* and *L. caissara*

Species	Population Size [f]	Distribution	Protected Areas
L. chrysomelas	*c.*6,000-15,500	*c.*19,462 km² (geographic range)	Una Biological Reserve (7,059 ha)[a] Population: *c.*465 Lemos Maia Experimental Station (240 ha)[b] Population: *c.*17 Djalma Bahia Experimental Station (270 ha)[b] Population: *c.*14 Canavieiras Experimental Station (500 ha)[b] Population: *c.*24
L. rosalia	*c.*813[c]	*c.*105 km² (actual occurrence)[d]	Poço das Antas Biological Reserve (5,500 ha)[a] Population: *c.*347
L. chrysopygus	*c.*930	*c.*286 km² (actual occurrence)	Morro do Diabo State Park (34,156 ha)[e] Population: *c.*821 Caetetus State Ecological Station (2,178 ha)[e] Population: *c.*25
L. caissara	*c.*400	*c.*300 km² (geographic range)	Superagüi National Park (21,400 ha)[a] Population: *c.*300 Jacupiranga State Park (150,000 ha)[e] Population: unknown

[a] Administered by the Brazilian Institute for the Environment and Renewable Natural Resources (IBAMA)
[b] Administered by the Regional Cocoa Growing Authority (CEPLAC), Bahia
[c] Includes the reintroduced population of 200 individuals.
[d] Excluding an estimated 1,700 ha occupied by re-introduced groups
[e] Administered by the São Paulo State Forestry Institute (IF)
[f] See the section on Population Modeling for further details on population size and distributions.

The current status of the captive populations and the wild populations for each form are presented in Tables I and II respectively. Captive GLTs are currently in 143 institutions and number fewer than 500, having been managed at zero population growth (ZPG) since the late-1980s. The GLT population has a lower than recommended founder population for the maintenance of their genetic diversity. The GHLT captive population exploded after its inception in the mid-1980s. It now numbers approximately 630 individuals, and accordingly needs to be reduced in number, especially in Europe and Brazil. The genetic diversity of the GHLT captive population is high, having a large number of founders arising from confiscated animals. There are fewer than 100 BLTs in captivity in only seven institutions. While both GLTs

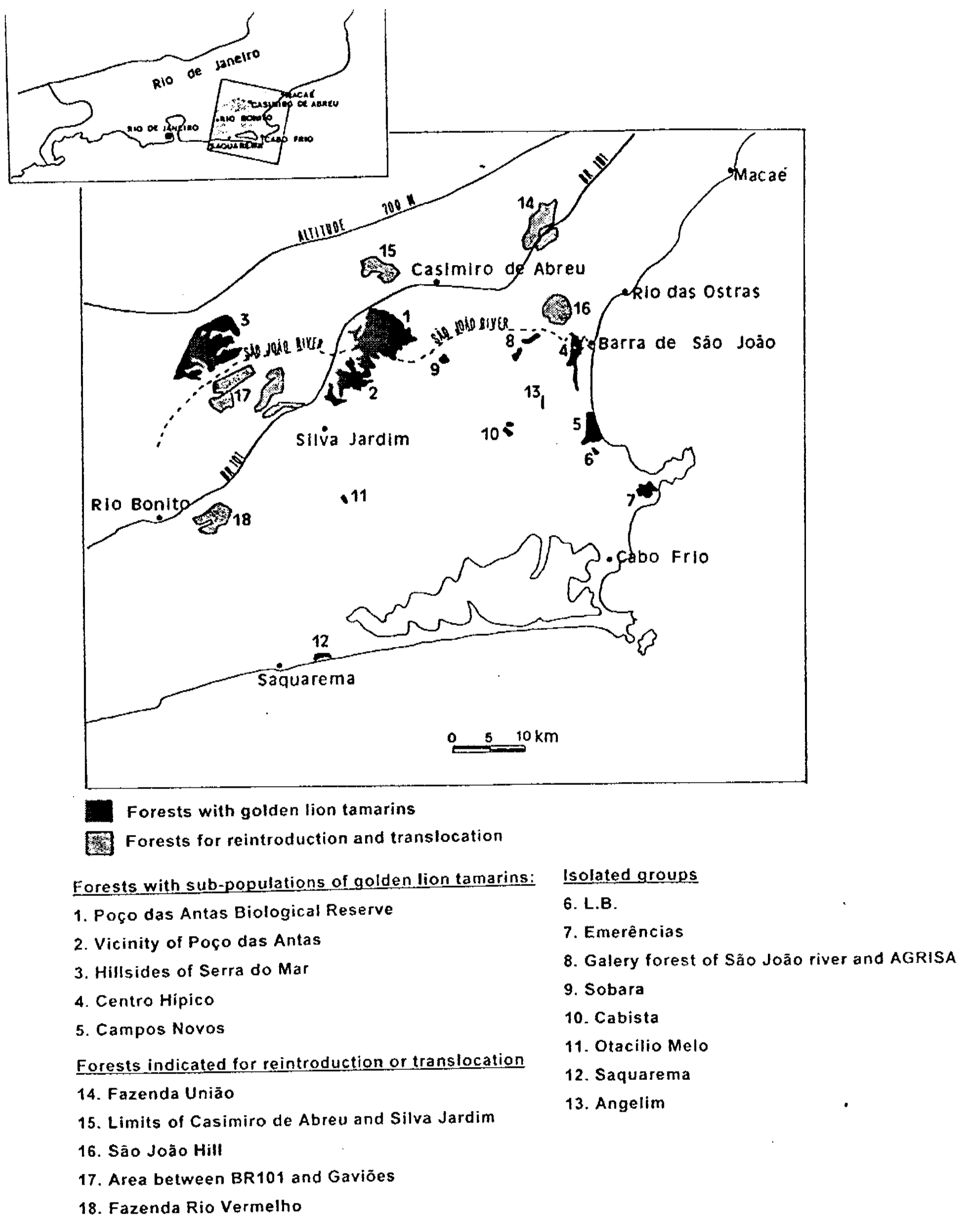

Figure 2. Location of existing and potential populations of *L. rosalia* (from C. Kierulff and P. Oliveira. 1996. Re-assessing the status and conservation of the golden lion tamarin *Leontopithecus rosalia* in the wild. Dodo J. Wild. Preserv. Trust 32:98-115.)

and GHLT captive populations are considered to be self-sustaining from the genetic and demographic standpoint, the BLT population is not, and it is currently being considered as a population within a metapopulation strategy involving all remaining wild populations.

Despite 25 years of focus on GLT conservation, including 15 years of intensive research and conservation activities in the region in and surrounding the Biological Reserve of Poço das Antas, the *officially protected* wild GLT population in Brazil (excluding the reintroduced population of about 200 animals on 13 ranches) probably numbers about 350. The overriding issue facing the conservation of GLTs is the inviability of the Poço das Antas Biological Reserve, due to its small size (5,500 ha), continued threats to its integrity, and the high level of degradation of the forests covering part of the Reserve. GLTs will not survive without a rapid expansion of protected forest within their range, both in terms of expanding the suitable forest within Poço das Antas Biological Reserve and formal protection of additional remaining forest blocks.

The black lion tamarin now survives in only two protected areas in the wild, although another five very small populations have been identified and are currently also the focus of conservation efforts. The total wild population is believed to be around 1000 animals, the large majority within the 34,000 ha Morro do Diabo State Park. Demographic, ecological, and behavioral research in the wild has been carried out since the late 1980s. Ambitious plans are underway for the active management of the metapopulation through the regular translocation of individuals or groups between the isolated forests where they occur in order to reduce the loss of genetic diversity.

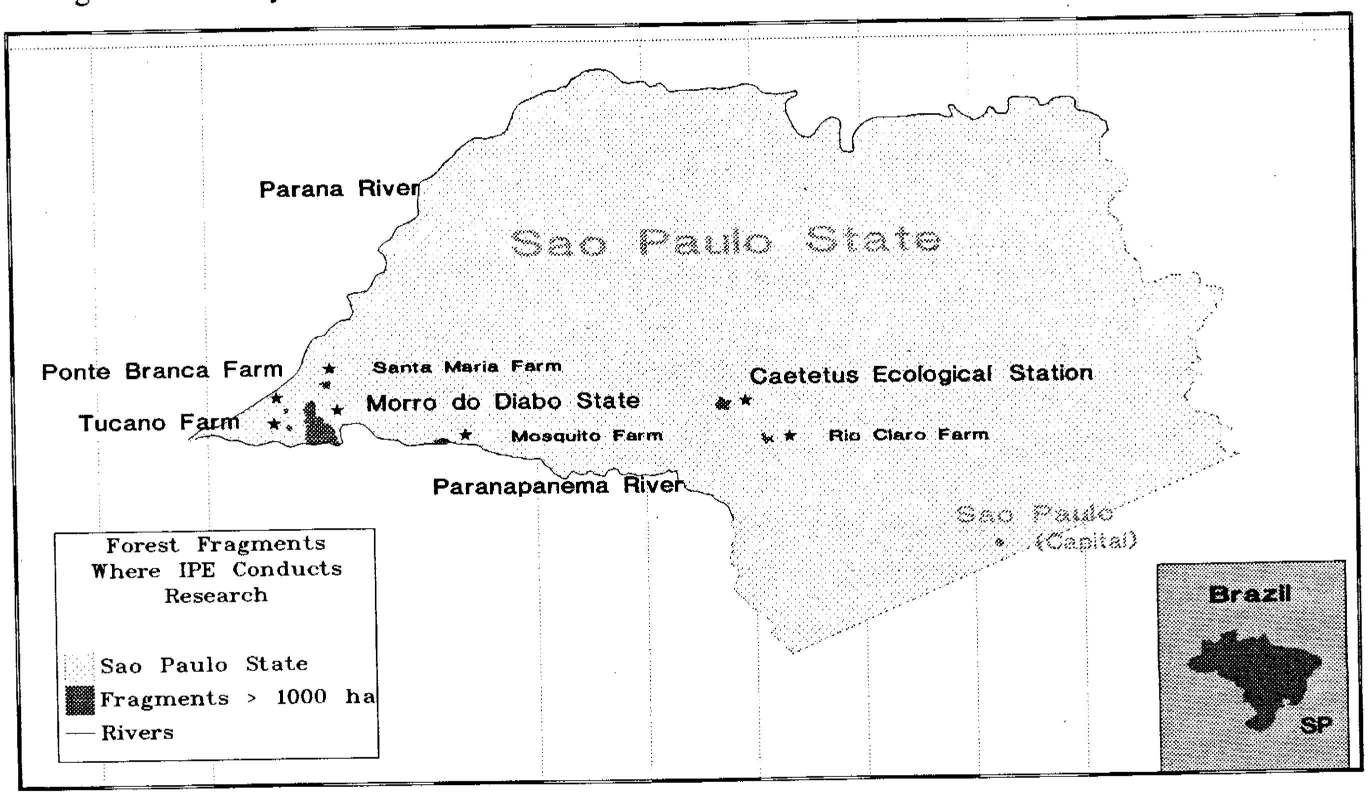

Figure 3. Distribution of *L. chrysopygus* in the state of São Paulo. From: Valladares-Padua, C. and L. Cullen, Jr.

The black-faced lion tamarins were recognized as being extremely endangered as soon as they were discovered on the island of Superagüi in the state of Paraná. They are protected in the Superagüi National Park, covering a large part of the island, which is their most important stronghold. The park itself, however, suffers numerous threats. These include tourism, political pressures regarding land use, and conflict with the National Indian Foundation (FUNAI) for the settlement of Indians. The continental populations, isolated from the island, are extremely fragmented and very rare (figure 4). The exact extent of the species range, therefore, is not clearly understood. The number in the wild is believed to be around 400.

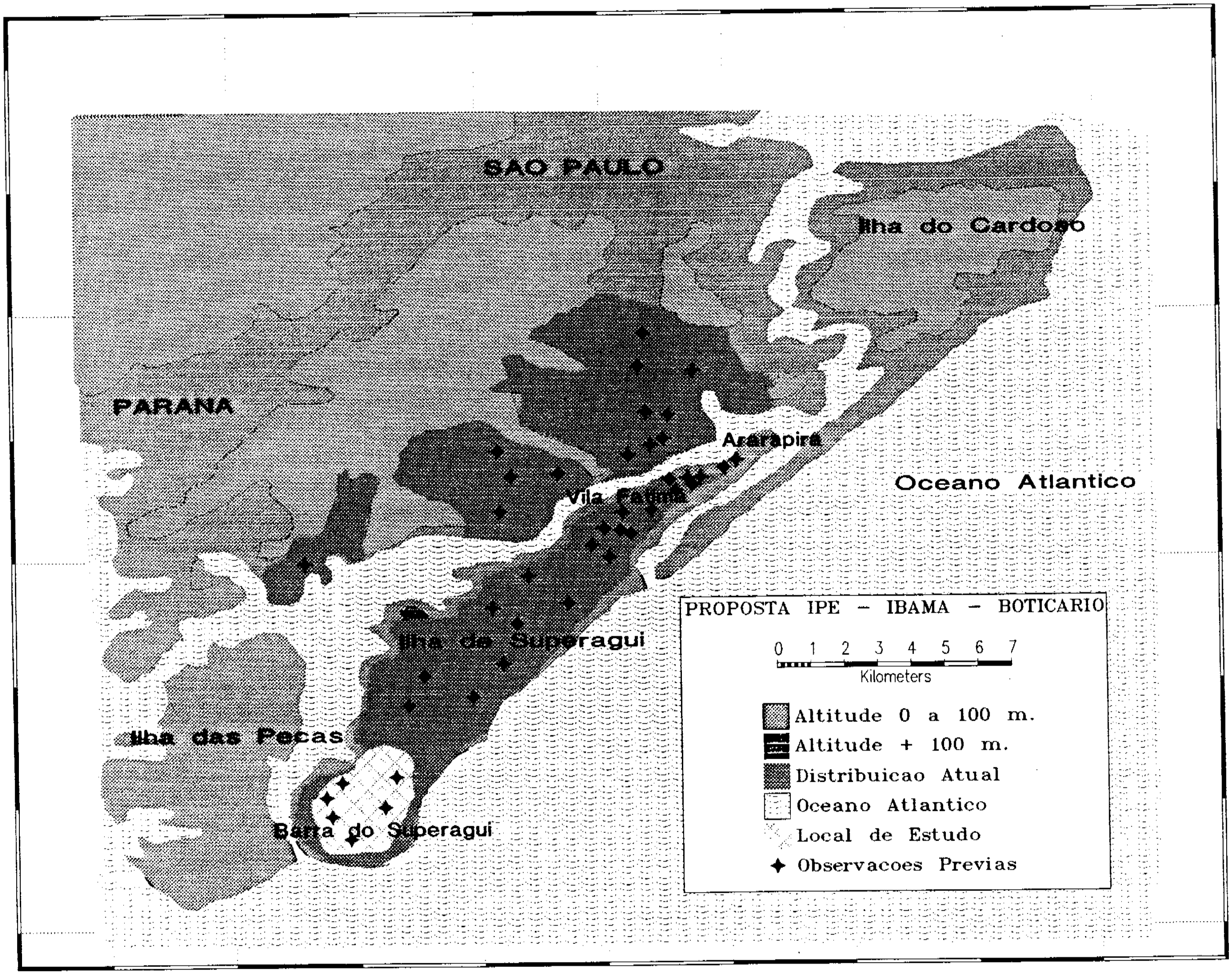

Figure 4. Geographic distribution of *L. caissara*. From: Valladares-Padua, C.

The golden-headed lion tamarin is currently in a situation which might well have been that of the other three species forty or fifty years ago. The options for establishing protected populations in the wild are considerably greater, but the forests are being destroyed and fragmented at an alarming rate. There is therefore great urgency for action to be taken while conservation options are still open. The single largest block of forest available for these animals is now the Una Biological Reserve (@ 7,059 ha) which is probably too small to maintain a viable population well into the future. Research on this species began in 1980, but only in the early 1990s was a systematic survey conducted to establish the extent of its range and overall population size , and a long-term behavioral, ecological and demographic project established. Considerable effort is now being given to increasing the size of the Una Reserve (and removing squatters) while this is still possible, and to establish reserves in other parts of the GHLT distribution.

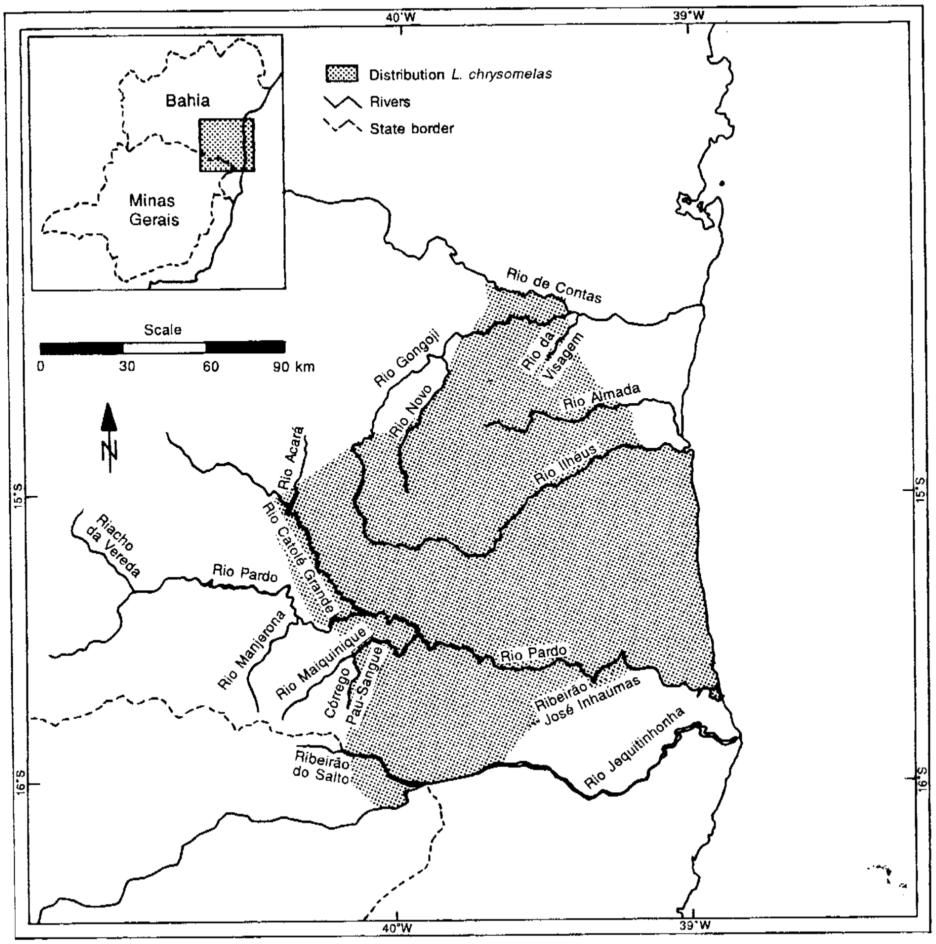

Figure 5. Current geographic distribution of *L. chrysomelas*. From: Pinto, L. P. and A. B. Rylands. 1997. Geographic distribution of the golden-headed lion tamarin, *Leontopithecus chrysomelas*: Implications for its management and conservation. Folia Primatol. 68:161-180.

The mobilization of many conservation organizations (not least among them the Brazilian Institute for the Environment - IBAMA), along with individual efforts of numerous people guided by the International Recovery and Management Committees, has guaranteed that these remarkable primates will survive into the next millennium. The proliferation of conservation and research programs and the numerous developments which have occurred since the 1990 Population Viability Analysis for the species stimulated the organization of this second Population and Habitat Viability Assessment Workshop, held in Belo Horizonte, Brazil, from 19-22 May 1997. The Workshop was a collaborative effort of the Fundação Biodiversitas, Belo

Horizonte; the Brazilian Institute for the Environment (IBAMA), Brasilia; and the Conservation Breeding Specialist Group - CBSG (SSC/IUCN), and was supported by the Jersey Wildlife Preservation Trust, Jersey, British Isles; Conservation International, Washington, D.C.; Conservation International do Brasil, Belo Horizonte; The Margot Marsh Biodiversity Foundation; TransBrasil Airlines; the U.S. Fish and Wildlife Service, Washington, D.C.; the National Zoological Park, Washington, D.C.; and the Friends of the National Zoo, Washington, D.C. The meeting was facilitated by the Conservation Breeding Specialist Group representatives, Drs. Susie Ellis and Robert Lacy.

The PHVA Process

Effective conservation action is best built upon critical examination and use of available biological information, but also very much depends upon the actions of humans living within the range of the threatened species. Motivation for organizing and participating in a PHVA comes from fear of loss as well as a hope for the recovery of a particular species.

At the beginning of a PHVA workshop, there is agreement among the participants that the general desired outcome is to prevent the extinction of the species and to maintain a viable population(s). The workshop process takes an in-depth look at the species' life history, population history, status, and dynamics, assessing also the kinds of threats putting the species at risk.

One crucial by-product of PHVA workshops is that an enormous amount of information can be gathered which, to date, has not been published. All participants are equal in the PHVA process, which recognizes the potential contributions of <u>all</u> people with a stake in the future of the species. Information contributed by game wardens, scientists, field biologists, ranchers, local and national government officials, local educators, and zoo managers all carry equal importance. To assess the status of a species accurately, all the information that can possibly be gathered is discussed by the workshop participants with the aim of reaching agreement on the state of current information. These data then are incorporated into a VORTEX computer simulation model to determine: (1) risk of extinction under current conditions; (2) those factors that make the species vulnerable to extinction; and (3) which factors, if changed or manipulated, may have the greatest effect on preventing species extinction. In essence, these computer-modeling activities provide a neutral way to examine what is going on currently and what needs to be done in the future to prevent extinction.

Complimentary to the modeling process is a deliberation or communication process. During the PHVA, participants work in small groups to discuss key issues, whether predator management, disease, human-animal interactions, or other emerging topics. A successful PHVA workshop depends on an outcome where all participants, with different interests and needs, "win" in developing a management strategy for the species in question. Local solutions take priority, with Workshop report recommendations developed by, and the property of, the local participants.

The Second PHVA for the Lion Tamarins of Brazil focused on evaluating the current status and threats facing the lion tamarin species and recommending and set priorities for conservation strategies to address existing problems. At the forefront of these threats and perceived needs were: 1) the recognition that the tamarin populations are extremely fragmented, with many small areas isolated from each other and therefore highly susceptible to the risks typically associated with small populations; and 2) the acknowledgment that expansion of conservation education and community support programs are vital to the success of lion tamarin conservation.

At the beginning of the workshop, 55 participants (Appendix A) worked together in plenary session to identify the major issues and concerns affecting the conservation of the four species (Table III).

Table III.
Identified issues and concerns affecting the conservation of the four species of lion tamarins (Not in priority order).

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1. We are concerned about the quality of data for captive populations.
1a. There are problems in implementing captive management plans.
2. There are questions as to whether protected areas are viable.
2a. We need to discuss habitat restoration and whether it can increase size and number of viable habitats.
3. We need to study interactions of animal prey and *Leontopithecus* and the effects of these interactions on biodiversity.
4. We need to study habitat degradation and whether restoration techniques lead to improvement of suitable habitats.
5. We need to consider social and economic pressures in terms of each of the *Leontopithecus* species.
5a. We need to determine the effects of pressures such as squatters, to deal with land use conflicts, and to investigate the effects of Agrarian reform.
6. We need to increase interaction at the state/local/federal governmental levels.
6a. We need to take into account how privatization affects conservation activities.
6b. We need to define and consider how socio-economic conditions affect economic-political factors.
6c. We need to mesh local concerns with <u>habitat</u> protection, with more emphasis on <u>forests</u> than on <u>species</u>.
6d. We need to determine to what extent species contribute to forest protection and biodiversity campaigns.
7. We need to increase public awareness through environmental education at many levels (e.g., schools, communities, and legislators).
7a. We need to enlist the aid of the media in bringing attention to the conservation of *Leontopithecus.*
7b. We need to ensure that technology- and knowledge-transfer takes place.
8. We need to continue to investigate and develop strategies for funding to ensure continuity of the existing programs as well as new ones, strengthening the support of NGOs as well as institutions.
9. We need to examine the role of reintroduction and translocation.

Table III Continued...

9a. We need to address problems of moving animals, whether for reintroduction/translocation or among captive facilities, including considerations of quarantine and veterinary care.
10. Economic alternatives for resource use for local people need to be explored and developed.
11. We need to carry out biodiversity studies in the regions where *Leontopithecus* are found.
12. We need to sensitize decision-makers concerning the importance of species/forests and the science/technology of conservation (e.g., *Saguinus oedipus).*
12a. We need to help create mechanisms to facilitate good decision-making by decision-makers.
13. We need to explore the benefits and disadvantages of ecotourism in *Leontopithecus* areas.
14. We need to examine the impacts of researchers and research on forest diversity, including potential disease transmission.
15. We need to develop strategies for the disposition of surplus animals (e.g., *L. chrysomelas).*
16. We need more basic information about the ecological and behavioral requirements of the species, life history, seasonality, breeding group size, etc.
16a. We need more information about the level of intraspecific variation in density as well as social and demographic aspects.
16b. We need to make comparisons between populations in degraded and non-degraded habitats.
17. We need to carry out investigations concerning the importance of corridors.
18. We need to improve collaboration between *in situ* and *ex situ* programs.
18a. We need to define more clearly the role of zoos in *Leontopithecus* conservation.
19. We need to carry out surveys of populations outside of protected areas.
19a. We need to examine genetic/behavioral/ecological variation between populations.
20. We need to investigate the behavioral flexibility of captive populations and determine if wild and captive populations are equivalent or comparable.
21. We need to develop strategies to implement the recommendations of the PHVA.
21a. We need to develop strategies to ameliorate the tension between academic development and conservation/management projects.
21b. We need to develop strategies to evaluate the structure of conservation efforts with *Leontopithecus.*
22. We need to evaluate the success of reintroduction and compare reintroduced groups with wild groups with respect to demography, ecology, etc.
23. We need to make genetic comparisons between species.
24. Protection of protected areas need to be improved in terms of finances, guards, infrastructure, fiscalization, and law enforcement.
24a. We need to determine whether activities around reserves/buffer zones can be controlled.
25. We need to take a multidisciplinary approach to *Leontopithecus* conservation.

As a result of the plenary sessions, four working groups were formed to address key areas emerging from the identified issues: Habitats/Protected Areas/Wild Populations/Research; Metapopulation Management; Communication; and VORTEX Modeling.

Each working group was asked to:

1. Examine the list of problems and issues affecting the conservation of the species as they fell out under each working group topic, and expand upon that list, if needed.
2. Identify and amplify in text the 3-5 most important issues.
3. Develop and elaborate between three and ten action strategies to address the identified key issues.
4. Amplify and specify the actions or strategies that might improve each of the priority problems or issues in detail.
5. Identify the resources that would be needed to implement these recommendations.

Each group presented the results of their discussions in three plenary sessions to make sure that all participants had an opportunity to contribute to the work of the other groups and to assure that issues were carefully reviewed and discussed by everyone present. The recommendations from the workshop were accepted by all participants, thus representing a consensus. Individual working group reports can be found in Sections 2-6 of this document.

Concluding Remarks

This 1997 PHVA Workshop brought together all the major players in the current efforts for the survival of lion tamarins. The Workshop participants discussed the current status of each form of *Leontopithecus*, the major threats to their survival, and the best options and strategies available to ensure their survival and the recovery of their populations and habitats over the next ten years.

The past seven years has seen a significant maturation in the conditions required to achieve conservation progress for these four flagship species. First, emphasis has shifted from saving species to saving habitats within the Atlantic rainforest, a region of incredible biodiversity. Second, available biological knowledge, at least for the GLT, has permitted us to test models for the survival of viable populations and metapopulations, using concrete long-term data, thus providing us with real goals for preserving subpopulations of different sizes and numbers. Finally, non-biological areas of impact on the species and their habitats have emerged as the most significant new domains for future activities. Identifying the impact of socio-economic, political, legislative and educational forces on the conservation of the four forms of *Leontopithecus,* and developing the mechanisms to manipulate these forces in the promotion of conservation goals, are the two chief challenges facing the agencies and individuals concerned. As a last comment, incorporating non-biological issues having impact on species and habitats into the PHVA process also stands as a significant area for growth for those evaluating species and habitat viability and the progress of conservation efforts.

LEONTOPITHECUS II

The Second
Population and Habitat Viability Assessment
for Lion Tamarins
(Leontopithecus)

Belo Horizonte, Brazil
20-22 May 1997

Final Report
May 1998

Edited by
Jonathan D. Ballou, Robert C. Lacy, Devra Kleiman, Anthony Rylands and Susie Ellis

Section 2

Metapopulation Working Group Report

WORKING GROUP ON METAPOPULATIONS

Participants: Group Facilitators: Ben Beck and Claudio Padua. Group Members: Andy Baker, Jonathan Ballou, Ines Castro, Adriana Daudt Grativol, John Hartley, Bengt Holst, Cecilia Kierulff, Marina Janzantti Lapenta, Kristin Leus, Jeremy Mallinson, Rosemary Mamede, Cristiana Saddy Martins, Don Melnick, Carlos Ruiz-Mirande, Alcides Pissinatti, Beatrice Perez-Sweeney, Suzette Tardif.

Note: Although this group initially decided to call *L. rosalia*, *chrysomelas*, *chrysopygus* & *caissara* "conservation units" rather than species, it was later changed to "taxa" since in Brazil the term "conservation unit" refers specifically to geographic areas of conservation jurisdiction.

1. METAPOPULATION MANAGEMENT PLANS (MMP) FOR LION TAMARINS

The current distribution of populations of each of the *Leontopithecus* taxa is characterized by small isolated populations usually with one population consisting of up to several hundred individuals and multiple smaller isolated populations containing only several to several tens of individuals. This is unlikely to improve in the near future.

In addition, captive populations exist for three of the taxa: GLTs, GHLTs and BLTs, and a reintroduced population exists for GLTs. Because of the fragmented nature of these populations, a metapopulation management plan is recognized as an appropriate conservation strategy for these taxa. The metapopulation management plan (MMP) would encompass wild, reintroduced and captive populations.

The primary objectives of the metapopulation management plan for each taxa, in nested order, are to:

1) maximize the probability of survival of the taxa as a whole; and
2) maximize the probability of survival and adaptive evolution of the metapopulation in the wild.

We define these objectives quantitatively as establishing and maintaining metapopulations for each taxa of sufficient size, geographic distribution, and demographic and genetic structure to meet the following specific demographic, genetic and ecological goals:

Demographic - sustain a 98% chance of survival for next 100 years;

Genetic- retain 98% of its current genetic diversity for next 100 years. This will require that the effective size of the metapopulation be sufficient to ensure that natural selection, as opposed to genetic drift, dominates the evolution of these taxa.

Ecological- use lion tamarins as a keystone species to conserve all habitat types that contain lion tamarins at present, as well as those habitat types which contained lion tamarins in the recent past. Within the MMP, priority should be given to maintaining (or translocating lion tamarins to) habitat of unique character. This means that if , for example, a small forest fragment with a unique habitat containing only 2 groups of lion tamarins (which are likely to go extinct in a relatively short time), we would decide to maintain the presence of lion tamarins in the small fragment through translocations in order to preserve the habitat and the fauna and flora it contains. If the habitat of the small forest fragment is not unique, we would decide not to risk translocating lion tamarins into the small fragment.

These goals will be periodically evaluated using the VORTEX or similar computer model based on the most up-to-date PHVA parameters available for each of the lion tamarins. The models will be used to estimate how many animals and how much forest is needed to achieve these goals and to identify which management steps need to be undertaken to approach the above set targets as closely as possible.

Under this strategy, the focus of the conservation is the metapopulation, not the individual populations of the metapopulation. The MMP recognizes that multiple small fragmented populations contribute to the overall survival of the metapopulation. However, it also recognizes that the extinction and recolonization (=translocation) process is an integral part of the metapopulation dynamics, and therefore, that the long-term persistence of ALL populations in the metapopulation is NOT the primary objective. Temporary extinction of populations needs to be viewed as an acceptable part of the process, as long as these populations can be re-establish through translocation and/or reintroduction.

The MMP also recognizes that the conservation programs for these taxa use *Leontopithecus* as flagship species to preserve habitat. Thus, any habitat that could hold lion tamarins, but does not, should be included in the MMP. As such, the MMP should encompass both occupied habitat and suitable but currently unoccupied habitat. Priority should be given to colonizing larger as opposed to smaller patches of habitat. Besides the increase in habitat protected, these larger patches require less managed transfer in and out to maintain effective size and therefore reduces the artificial selection that might be involved in the process of conducting managed translocations.

Current MMP activities involve GLT translocation, BLT translocation, GLT reintroduction, GLT, GHLT and BLT global captive management and genetic surveys of BLT and GLT in wild and captive populations. We view all these activities as extremely high priorities and recommend that they continue to proceed as currently planned. However, these programs need to be continuously evaluated within the context of the priorities described in this document.

1a. Management of Wild Populations within the Metapopulation

Specific objectives and recommendations need to be developed for each population within the metapopulation to ensure its contribution to the overall metapopulation viability as defined above. These objectives will be used to guide decisions about where, when, how many, and which individuals to translocate between populations. The following issues need to be considered:

1) We need to know the minimum size of fragments and populations that can be used in metapopulation management and which fragments have the appropriate habitat for management;
2) We need to define explicitly which forest fragments to include in the metapopulation for each species;
3) It is important to decide if it will be more efficient for metapopulation management to use managed migration or to build corridors between fragments; and
4) Ownership of the fragments is an important issue. We need cooperation with the landowners to implement metapopulation management.

1b. Management of Captive Populations within the Metapopulation

The goals of the captive populations differ for the different species:

L. *chrysomelas*: The genetic goal of the program is retention of 90% of gene diversity of the source population for 100 years (this is the standard captive population management goal). On 31 December 1996, there were 627 living captive animals registered with the breeding program. The program contains sufficient founders and to date 98.8% of gene diversity has been retained. A major problem facing is the placement of surplus animals.

The GHLT habitat is under severe threat of deforestation. Since lion tamarins were found in all non-reserve forest fragments investigated so far, this continued deforestation is likely to result in a substantial number of orphaned animals. Since there is no immediate prospect or need to reintroduce this species, the captive population size should be reduced to ± the minimum size required to reach the genetic goal because: 1) there is, and will be, competition for cage space for other threatened callithrichid species; 2) it is likely there will be a substantial input of orphans from the wild in the next few years; and 3) it is becoming increasingly difficult to place surplus animals.

L. *rosalia*: There are now about 490 animals in the breeding program. The genetic goal for the moment is 90% retention of genetic diversity over 100 years. A zero population growth has been achieved during the last 7 years. For this species there is a higher risk of catastrophes affecting the wild population and therefore a higher chance that the captive population may be needed to secure the viability of the species. It may be advisable to increase the goal for % gene diversity retained.

L. chrysopygus: About 108 living animals are presently registered in the captive population. A metapopulation management plan was developed for this taxa in which the captive population is treated as one of the subpopulations (see *L. chrysomelas* Metapopulation Management Plan, Appendix B).

L. caissara: Still very little is known about the number of animals remaining and the general biology of this taxon. At present it is not recommended to start a captive breeding program.

1c. Role of Translocation and Reintroduction in the MMP

Metapopulation management will require transfer of individuals between populations. Thus, the successful MMP requires that the technology of translocation and reintroduction are sufficiently well developed to ensure recolonization with high confidence.

Social/behavioral as well as genetic concerns need to be considered and social concerns may require actions that are less than optimal at a genetic/demographic level. The "social rules" for such transfers have not been determined, but should derive from studies of wild conspecifics. Additionally, transfers from captive populations directly to wild populations are problematic due to behavioral deficiencies in zoo-born reintroduced animals.

We need to summarize current knowledge regarding the social aspects of moving animals between populations (wild-to-wild, wild-to-captive, and captive-to-wild) and formulate hypotheses to be tested in the field. Issues to explore based on current experience include:

a. effect of placing an entire group in an empty territory (whether or not this territory first had to be emptied by removing a formerly occupying group);
b. incorporate "new blood" into a group/population by taking out a male from an existing group and introducing a new male duo in its place;
c. to increase the chance that a newly established pair will stay together, is it effective to create the pair artificially first and place them in a cage inside their allocated territory?

This list may be revised/expanded once current knowledge has been summarized.

The practical logistics of moving animals from one place to another must also be considered. These include:

1. defining the release site of the animals
2. preparing specific documents (e.g., permit applications)
3. defining the correct transportation for the animals
4. developing methods for maintaining the animals in quarantine at the release site
5. adhering to the guidelines of IUCN Re-introduction Specialist Group and Veterinary Specialist group.

ACTION STEPS:

***Note**: Priority Actions for each species are marked with ✘; follow-up volunteers are identified only for priority action items*:

L. rosalia

a. ✘ Formulate the overall metapopulation objectives with regards to survival and evolutionary potential (*Jon Ballou/Claudio Padua*)

b. ✘ Formulate objectives for each population within each metapopulation (*Jon Ballou, overall concept/Cecilia Kierulff/Andy Baker*)

c. ✘ **NOTE**: Added after workshop: Identify which forests and habitats define the metapopulation (*Cecilia Kierulff/ Paula Oliveira*)

d. ✘ Summarize current knowledge regarding social aspects and formulate hypotheses to be tested (*Ben Beck/Cecilia Kierulff*)

e. Standardize data collection and analyses protocols for projects or components spanning more than one taxa

f. ✘ Explore possible scenarios to increase the amount of gene diversity retained in the captive population for the coming 100 years (*J. Ballou*)

L. chrysomelas

a. ✘ Formulate the objectives with regards to survival and evolutionary potential (*Jon Ballou/Claudio Padua*)

b. Formulate objectives for each population within each metapopulation.

c. ✘ Summarize current knowledge regarding social/behavioral aspects of translocation and formulate hypotheses to be tested (*Ben Beck/Cecilia Kierulff*)

d. Standardize data collection and analyses for projects or components spanning more than one taxa

e. ✘ Reduce the captive population size to ± the minimum size required to reach the genetic goal of 90% retention of gene diversity for 100 years (*K. Leus, J. Ballou*)

L. chrysopygus

a. ✘ Formulate the objectives with regards to survival and evolutionary potential (*Jon Ballou/Claudio Padua*)

d. ✘ Formulate objectives for each population within each metapopulation (*Jon Ballou, overall concept/ Claudio Padua)*

c. ✘ **NOTE**: Added after workshop: Identify which forests and habitats define the metapopulation (*Volunteers needed*)

b. ✘ Summarize current knowledge regarding social/behavioral aspects of translocation and formulate hypotheses to be tested (*Ben Beck/Cecilia Kierulff*)

e. Standardize data collection and analyses for projects or components spanning more than one taxa

f. ✘ Manage the captive population to retain continuously 95% of the wild population's gene diversity as specified in the Captive Metapopulation Management Plan of Padua and Ballou (See Appendix B, *C. Padua, J. Ballou*)

L. caissara

a. ✘ Formulate the objectives with regards to survival and evolutionary potential (*Jon Ballou/Claudio Padua*)

d. ✘ Formulate objectives for each population within each metapopulation (*Jon Ballou (overall concept)/ Claudio Padua)*

c. ✘ **NOTE**: Added after workshop: Identify which forests and habitats define the metapopulation (*Volunteers needed*)

d. Summarize current knowledge regarding social/behavioral aspects of translocation and formulate hypotheses to be tested.

e. Standardize data collection and analyses for projects or components spanning more than one taxa

f. Establishing a captive population is not recommended at this time

2. *IN SITU/EX SITU* COLLABORATION - THE ROLE OF ZOOS

At the moment, many zoos do not feel actively involved in *Leontopithecus* conservation and do not understand the significance of their combined potential participation in the programs. As a result there is: a) a failure to capitalize on the resources that the zoo community could provide to the conservation projects and vice versa, and b) a reluctance on the part of the zoos to comply with recommendations made by the program coordinators, which may result in surplus animals which are difficult to place. There is a need to communicate better what zoos can further do for the programs and what the programs can do for the zoos. .

ACTIONS:

For All Four Species:

a. ✘ Improve *in-situ* and *ex-situ* communication through continued publication and extended distribution of the *Tamarin Tales* newsletter. In the newsletter the importance of individual zoo's participation in the overall program should be highlighted. Mutual needs/expectations for both parties should be evaluated (*Jon Ballou/Bengt Holst/Kristin Leus/IPÊ staff*)

b. ✘ Increase personal communication through schemes such as Adopt-a-Group programs and Regional workshops (*Bengt Holst/Kristin Leus*)

c. ✘ Maximize zoo support for the Lion Tamarin of Brazil Fund (*Jeremy Mallinson*)

3. DISTRIBUTION OF BEHAVIORAL AND ECOLOGICAL DIVERSITY IN WILD AND CAPTIVE POPULATIONS

The degree of ecological and behavioral variation in different populations (including the captive population), and the causes for this variation, must be determined. Idiosyncratic and unique variations in behavior and ecology, e.g., in different populations living in different microhabitats, should be identified. This information may allow us to anticipate the responses of animals to management practices and environmental changes. For example, there is a need to understand better the extent to which captivity and reintroduction affect the behavior of animals and the permanence of such effect. In order to assess how captive rearing affects behavior we must observe captive-born animals after reintroduction. Moreover, reintroduction must be considered as both an act that may influence behavior in the short run, and as a process that affects behavior within and between generations. The latter is akin to the feralization of domesticated animals.

We need to summarize current knowledge of behavioral and ecological differences regarding:

1. Small vs. large populations;
2. Comparisons of behavior in captivity and in the wild;
3. Comparison of demographic patterns of wild, reintroduced and captive populations; and to initiate studies in these three areas where information is lacking. Standardized data collection techniques are recommended across species.

ACTIONS:

L. rosalia

Ecology

a. ✘ Summarize current knowledge of the range of ecological diversity and formulate hypotheses to be tested.
b. Standardized data collection and data management protocols.
c. ✘ Carry out more research in the understudied areas.

Behavior

d. Summarize current knowledge of the range of behavioral diversity and formulate hypotheses to be tested.
e. Standardized data collection and data management protocols.
f. ✘ Carry out more research in the understudied areas.

L. chrysomelas

Ecology

a. ✘ Summarize current knowledge of the range of ecological diversity and formulate hypotheses to be tested.
b. Standardized data collection and data management protocols.
c.✘ Carry out more research in the understudied areas.

Behavior

d. Summarize current knowledge of the range of behavioral diversity and formulate hypotheses to be tested.
e. Standardized data collection and data management protocols.
f. Carry out more research in the understudied areas.

L. chrysopygus

Ecology

a. ✘ Summarize current knowledge of the range of ecological diversity and formulate hypotheses to be tested.
b. Standardized data collection and data management protocols.
c. ✘ Carry out more research in the understudied areas.

Behavior

d. Summarize current knowledge of the range of behavioral diversity and formulate hypotheses to be tested.
e. Standardized data collection and data management protocols.
f. ✘ Carry out more research in the understudied areas.

L. caissara:

Ecology

a. Summarize current knowledge of the range of ecological diversity and formulate hypotheses to be tested.

b. Standardized data collection and data management protocols.

c. ✘ Carry out more research in the understudied areas.

ehavior

d. Summarize current knowledge of the range of behavioral diversity and formulate hypotheses to be tested.

e. Standardized data collection and data management protocols.

f. Carry out more research in the understudied areas.

4. EVALUATION OF REINTRODUCTION AND TRANSLOCATION AND CRITERIA FOR BEGINNING AND ENDING REINTRODUCTION AND TRANSLOCATION

How is success measured? Criteria include survival rates and reproduction over time after release. Additional criteria might include comparability with the wild population in demography (life expectancy, reproductive rates), ecology (habitat use, territory size) and behavior (substrate use, food selection). Another measure of success is contribution to the genetic and demographic health of the wild population. Standardization of criteria would allow comparison of reintroduction and translocation of the four taxa.

IUCN guidelines stipulate criteria for beginning; all of these criteria should be met. However simply because the criteria can be met, the reintroduction/translocation does not have to occur. What triggers the process? Once underway, how do we know when to stop? Are these criteria (assuming success) genetic/demographic, habitat availability, financial, educational value, habitat protection and/or others?

Evaluation of reintroduction and translocations can begin with collecting and entering data in SPARKS Software in order to generate life expectancy, mortality rates and reproductive rates. Analyze survival after 30, 185, 365 and >730 days. Compare behavior (inter-group encounter behavior, communication, shelter seeking, food finding, predator avoidance, parental behavior, daily travel distance, height of travel/time on ground, territory size ...) and ecology (food choice, nest sites ...) of pre- and post reintroduction/translocation animals.

ACTIONS:

High Priority (✘) for L. rosalia and L. chrysomelas, Low priority for L. chrysomelas and L. caissara:

a. Translate objectives of metapopulation management into decisions about when, where and which animals to reintroduce/translocate and for how long (*Beck/Cecilia Kierulff/Paula Procópio de Oliveira)*

b. Specify and standardize criteria for evaluation (*Ben Beck/Cecilia Kierulff/Paula Procópio de Oliveira)*

c. Investigate methods of cost reduction for translocation/reintroduction (*Ben Beck/Cecilia Kierulff/Paula Procópio de Oliveira)*

5. UNDERSTANDING OF THE DISTRIBUTION OF GENETIC DIVERSITY IN ORDER TO MANAGE THE METAPOPULATION BETTER

If one of the explicit goals of metapopulation management is the long-term preservation of genetic diversity, we need to develop a map of genetic variation for each taxa (including the captive members of that taxa). This map will help us determine how best to apportion conservation efforts, through sampling and preservation, in order to maximize genetic and evolutionary potential of the taxa. Without a picture of the distribution of genetic variation within each taxa, our strategies of metapopulation management of genetic diversity will be based on a set of statistical assumptions that may not be true (e.g., founders of the captive populations represent a random sample of genetic diversity from the wild population). There are many examples of non-intuitive geographic structuring of genetic variation that strongly caution us against the blind applications of general statistical models.

Analysis of the distribution of genetic diversity includes the evaluation of population size and distribution, sampling of genetic material, and analysis of samples. These three topics are discussed below:

5a. Census of population size and distribution

Current status of the census and distribution for each species:

L. rosalia	already done
L. chrysopygus	mostly done, a few more fragments needed but is under way
L. chrysomelas	in progress
L. caissara	still needed, especially in north of range

Potential investigators: *Need to be identified*

5b. Genetic sampling

Still needed from the following populations:

L. rosalia	Serra, Marinha, Loteamento, the captive population
L. chrysopygus	Morro do Diabo, forest fragments, the captive population
L. caissara	Continental and island population
L. chrysomelas	Across geographical range, the captive population

When samples are taken, utilization of these should be maximized (e.g. parasitology etc.)

Potential investigators: *Adriana Grativol*

5c. Genetic Analyses

Techniques to be used based on research experience already carried out on *Leontopithecus*:

a. sequencing D-loop of mitochondrial DNA (maternal)
b. Y-chromosome sequencing (paternal)
c. microsatellites (bi-parental)

Once a technique is developed and is working for one taxon, it should be tested on the other taxa.

Potential Investigating laboratories: *Don Melnick & Beatrice Perez-Sweeney, Columbia University; Adriana Grativol and Rob Fleischer, National Zoo, Washington.*

ACTIONS:

All species:

a. ✘ Complete survey of forest fragments for lion tamarins in order to know exactly how many can be found and where (this has already been done for *L. rosalia*).

b. ✘ Make an intensive effort to genetically sample individuals across the range of each habitat (including the captive populations). Analyze fully genetic material collected, including the sequencing of mitochondrial, Y-chromosome and autosomal nuclear genetic markers and the use of nuclear-encoded microsatellite loci (*Adriana Grativol*)

c. Genetic data must be combined with parallel data on behavior and ecology.

6. ISSUES RELATED TO ORPHANED AND CONFISCATED ANIMALS

Occasionally, orphaned and confiscated animals may appear. The Management Committees must develop policies that outline the appropriate actions to be taken. These should include:

1. Determining the destination of the animal (translocate, reintroduce or transfer to captive population);
2. If appropriate, identifying the proper institutions to receive the animals temporarily (this includes evaluation of quarantine facilities). The destination institutions must be prepared to receive the animals (with cages and financial support);
3. Preparing the official specific documents (CITES etc.);
4. Identifying the correct transportation for the animals;
5. Receive recommendations from the metapopulation coordinator about a permanent locale to hold the animals.

LEONTOPITHECUS II

The Second
Population and Habitat Viability Assessment
for Lion Tamarins
(Leontopithecus)

Belo Horizonte, Brazil
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Final Report
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Edited by
Jonathan D. Ballou, Robert C. Lacy, Devra Kleiman, Anthony Rylands and Susie Ellis

Section 3

Habitat and Research Working Group Report

WORKING GROUP ON RESEARCH AND HABITAT

Sub-group: RESEARCH

Participants: Group Facilitators: Anthony B. Rylands, James M. Dietz. Group Members: Admiral Ibsen de Gusmão Câmara, Adelmar F. Coimbra-Filho, Fernando Passos.

Golden lion tamarin, *L. rosalia* (GLT)

1. STUDIES OF FEEDING BEHAVIOR AND THE IMPACTS OF PREDATION BY LION TAMARINS ON THE LOCAL INVERTEBRATE FAUNA

The Problem:
Although food habits of GLTs in Poço das Antas Reserve have been studied by several researchers, we still do not have adequate information on how food availability (fruits and animal prey) may limit tamarin population growth or on the effect of tamarin predation on density and diversity of insects and small vertebrates. The latter point is particularly important given the relatively high density of tamarins in the reserve and the fact that the reserve is a forest island.

Action:
Design a research project, possibly the subject of a graduate thesis, to:

1. Identify those species of invertebrates that are consumed by wild-born GLTs. This could be accomplished by offering a variety of potential prey species to wild-born tamarins in captivity, e.g., those in the Rio de Janeiro Primate Center (CPRJ).
2. Systematically sample diversity and density of invertebrates and small vertebrates (identified as GLT prey items) in areas of low, medium and high tamarin foraging pressure within the reserve.
3. Measure prey recovery rates in areas where foraging was intense, or do removal experiments and then measure prey recovery rates (for an example see P. Waser's study on insect recovery rates following mongoose predation). (AMLD researchers will try to identify researchers to carry out this work).

2. THE EFFECTS OF FOREST DEGRADATION AND FRAGMENTATION ON THE ECOLOGY AND DEMOGRAPHY OF LION TAMARINS

The Problem:
Development of appropriate long-term strategies for conservation of GLTs in the Poço das Antas Biological Reserve requires accurate estimates of current and future carrying capacity. Current carrying capacity was estimated by extrapolating from approximately 20 tamarin groups now under study. However, much of the habitat in areas not included in sampled territories is fragmented and degraded. If reforestation efforts are successful, then, through ecological succession, the future predominant vegetation in Poço das Antas can be expected to resemble primary forest more closely than is now the case. It is necessary to be able to predict the effects of these changes on tamarin carrying capacity in the reserve.

Action:
Apply statistical techniques and modeling procedures to existing data on tamarin density in primary and secondary habitats in the reserve to project future densities. (J. Dietz and students will conduct this analysis).
Compare GLT densities in the relatively degraded forests of Poço das Antas with those in the more pristine forests of Fazenda União. (C. Kierulff, P. Procópio, A. Baker and J. Dietz).

3. COMPARATIVE STUDIES OF THE GENETICS OF ISOLATED POPULATIONS

The Problem:
Preliminary genetic analyses done by Adriana Grativol suggest that there are detectable genetic differences between isolated populations of GLTs. Translocation and reintroduction strategies to date have not taken genetic differences into account.

Action:
Complete genetic screening of all isolated populations (A. Grativol?)
Use state-of-the-art population management theory to plan translocations and reintroductions in order to minimize loss of genetic diversity at the species level (J. Ballou).

4. *CEBUS APELLA*: PREDATOR AND/OR COMPETITOR OF GLTS?

The Problem:
Although long-term research on GLTs in Poço das Antas Biological Reserve suggests that predation and interspecific competition pressure have not limited tamarin population growth in the past, recent observations indicate that the *Cebus* population there is rapidly increasing. *Cebus* attacks on GLT groups have been observed and they now often displace GLTs from feeding sites. Also, there are relatively few natural predators that might limit growth of the *Cebus* population in the reserve. The reserve's GLT population may begin to decline if *Cebus* numbers continue to grow and competition with and/or predation on GLTs increases.

Action:
Researchers studying GLTs should systematically record all interactions with *Cebus* in order to quantify changes in interspecific relations. (AMLD researchers will do this).
Ideally, a research project on *Cebus* should be initiated in the Reserve. However, such a study would require habituation and systematic following of *Cebus* groups, tasks that will not be easily accomplished (AMLD researchers will try to locate an individual to conduct this study.)

Golden-headed lion tamarin, *L. chrysomelas* (GHLT)

1. THE EFFECTS OF FOREST DEGRADATION AND FRAGMENTATION ON THE ECOLOGY AND DEMOGRAPHY OF THE LION TAMARINS

The Problem:
Ecological and demographic studies of GHLTs have been carried out in one relatively small and fragmented forest near the Una Biological Reserve and in the relatively pristine eastern half of Una Reserve. GHLT territory size was *c.* 42 ha in the former study and 117 ha in the latter study. No comparable research has been carried out in the fragmented and degraded western half of the reserve. In order to estimate current and future carrying capacities for Una Biological Reserve we need to extrapolate using one of the two studies and we have no basis on which to make that decision.

Action:
Use computer modeling techniques to estimate the probability of population survival under both scenarios (J. Ballou)
Habituate groups of tamarins and sample GHLT density in the western half of the reserve. (J. Dietz could initiate this activity if financial resources were available).
The following studies are also recommended: a) Comparative studies of population dynamics in fragments of different sizes; b) studies of feeding ecology in groups in fragments of different sizes based on a knowledge of resource availability in each; c) studies of successional processes following different types and degrees of disturbance; and d) studies of edge effects in forest fragments of different sizes.

2. MONITORING POPULATIONS IN THE UNA BIOLOGICAL RESERVE

The Problem:
The Una Biological Reserve is the only significant remaining protected forest for *L. chrysomelas*. Recent analyses, however, suggest that the population is not viable over the long term. Monitoring the population is, therefore, vital for an understanding of the key factors which determine population fluctuations and those limiting carrying capacity. James Dietz has begun demographic studies on groups in the eastern part of the Reserve but this needs to be extended to the western part, taking into consideration differences in the forests and the degrees of human disturbance between these two areas.

Action:
Continue with demographic research in the eastern part of the Reserve. (J. Dietz, B. Raboy)
Carry out vegetation surveys and analyses in representative habitats throughout the Reserve (W. Thomas, A. Carvalho)
Contract two resident biologists as part of the full-time staff in the Reserve.

3. EVALUATE THE DISTRIBUTION AND POPULATION SIZES IN THE EASTERN PARTS (HYGROPHYLLOUS FOREST) AND WESTERN PARTS (MESOPHYLLOUS FOREST) OF THE RANGE OF THE SPECIES

The Problem:
The geographic range of *L. chrysomelas* is divided into regions which are distinct in terms of climate, forest types and socio-economy. The west is characterized by drier more seasonal forest

and cattle farming. The eastern portion of the species' range is less seasonal, receives more precipitation, and has cocoa farming as the predominant agricultural activity. The majority of the species' range is in the west, but the majority of the surviving populations of *L. chrysomelas* are in the east.

Action:

Develop GIS based on remote-sensing data to map the size and location of forest fragments in both regions (IESB?).

Initiate botanic inventories in representative forest fragments in the western region.

Identify and census tamarin populations in forests that have potential to serve as conservation units in the western region.

Black lion tamarin, *L. chrysopygus* (BLT)

1. INCREASE THE RESEARCH EFFORT ON ECOLOGICAL AND GENETIC STUDIES OF THE VARIOUS POPULATIONS

The Problem:

The complete isolation of the different populations has arisen as a result of the extreme reduction and fragmentation of the forests throughout the species' range. The surviving populations occur in varied habitats and each is of extreme importance for the conservation of the species. There is an urgent need for the development of techniques and strategies for monitoring these possibly genetically distinct populations, evidently adapted to different habitats in terms of climate, structure and floristic composition.

Action:

Carry out studies on the genetic variability of the different populations to evaluate the degree of inbreeding and establish genetic markers for the species.

Increase the research effort on ecological studies to supply information on the carrying capacity of the areas where it occurs, the size and composition of the groups, the mating systems and home range sizes. (F. Passos: Caetetus State Ecological Station; Other areas ?).

2. ESTABLISH A LONG-TERM PROGRAM IN MORRO DO DIABO STATE PARK TO MONITOR THE POPULATION OF LION TAMARINS

The Problem:

A more exact and detailed estimate of the population size and demographic structure of the BLT population in the Morro do Diabo State Park is needed. Current estimates are based on only a few surveys and studies of four groups. The majority of the remaining forest occupied by BLTs is concentrated in this Park. Studies of four groups by Padua et al. have shown that different habitats characterize the home range of each and group size was also variable. The importance of this Park, with its size and diversity of forest types, emphasizes the importance of a closer and more complete monitoring of the BLT groups there.

Action:

Increase the number of groups being monitored in the Park in representative habitats in order to permit more precise understanding of the demography of the population there.

Carry out periodic population censuses to allow for a comparison with other BLT populations.

Black-faced lion tamarin, *L. caissara* (BFLT)

1. RESEARCH ON THE DISTRIBUTIONAL LIMITS, INCLUDING PARTICULARLY THE JACUPIRANGA STATE PARK, SÃO PAULO

The Problem:

The distributional limits of this species are well defined in the state of Paraná, including the majority of the island of Superagüi and part of the adjacent continent. However, the range limits in the north are poorly defined. Some sightings of this species have been made in the state of São Paulo, and reports have been obtained from local informants. The localities for the occurrence of BFLTs in this area however are widely separated and many unconfirmed. It is vital, therefore, that surveys be carried out in the north-east part of its range, including coastal São Paulo and to establish the extent of its occurrence in the Jacupiranga State Park, which is varied in its topography and not uniformly occupied by the BFLTs.

Action:

Re-examine the geographic distribution in the state of Paraná to confirm the continued existence of populations already recorded there (there is evidence that one isolated population has become extinct in the last couple of years).

Carry out a detailed survey of the available habitat in the north-east portion of its known and suspected range in the state of São Paulo.

Carry out a detailed survey of the Jacupirange State Park, São Paulo.

2. ECOLOGICAL AND DEMOGRAPHIC STUDIES

The Problem

Although demographic and ecological studies have been carried out in the known range of the species, nothing is known about geographic variation in demographic parameters probably associated with varying habitat types. The only detailed study available to date is on one group in the south -west of the island of Superagüi (Fabiana Prado). More data on this aspect are vital for improving population estimates and understanding the ecological requirement of the various and isolated populations of the BFLTs on the continent as well as on the island.

Action:

Continue the research program already underway on the south-west of the island of Superagüi, with emphasis also on improving the methodology used to date.

Extend this research program to other localities on the island and the continent to increase our knowledge of the species' habits and ecological requirements.

3. CONTINUE AND EXPAND STUDIES OF THE FLORA AND VEGETATION OF THE SUPERAGÜI NATIONAL PARK

The Problem

The flora of the Park has never been studied in depth. Information on this is vital for studies of the habitat ecology and behavior of the species. The difficulty in identifying a fungus found to be an important food item for the BFLT groups studied in the south-west of the island of Superagüi exemplifies the problem. Most important too is an understanding of the effects of human activities on the region's plant communities and their effects on the ecology of BFLTs.

Action:

Carry out taxonomic studies in the near future of the flora in the Park, as well as the area proposed for annexing.

Carry out research on the effects of human activities on the plant communities.

4. COMPARATIVE GENETIC STUDIES OF POPULATIONS ON THE ISLAND OF SUPERAGÜI AND THE CONTINENT

The Problem

There are two major populations, the continent and island of Superagüi, which have been separated by the construction the Varadouro canal for more than forty years. Subpopulations on the continent are also highly fragmented, although the time-scales involved are unknown. Forty years is relatively little time to suppose that any significant genetic differentiation has occurred, but the possibility remains that genetic drift has already resulted in some differences between them. It is important to examine and quantify any genetic differentiation which might have occurred by comparing a number of populations on the continent

Action:

Carry out genetic studies on the subpopulations on the island of Superagüi and the continent.

Carry out genetic studies on different subpopulations on the continent, taking into account geographic distance and the degree of isolation.

5. IDENTIFY POTENTIAL PREDATORS OF *L. CAISSARA*

The Problem:

Practically nothing is known of the predators and effects of predation on the remaining *L.* caissara populations. It is possible that predators are absent from Superagüi, and the predation patterns differ between the island and the continent. Information on this is necessary for a better understanding of the demography of the two subpopulations.

Action:

Identify the predators of *L. caissara* on the continent and on the island.

Evaluate the effects of predation, considering the likelihood of different predator communities in the two subpopulations.

Subgroup: Habitat

Participants: Group Facilitator: Paula Procópio de Oliveira. Group Members: Fabiana Prado, Dionísio Pessamilio, Francisco Neo, José Luis Camargo, Luis Paulo Pinto and Saturnino Neto de Sousa.

1. LACK OF PROTECTED HABITAT IN THE REGIONS WHERE THE FOUR SPECIES OCCUR

Golden lion tamarin, *L. rosalia* (GLT)

The Problem:
The biggest problem to guaranteeing the survival of the golden lion tamarin is the fragmentation and degradation of the remaining forests within its geographic distribution. The Poço das Antas Biological Reserve is the only officially protected area for the species. The Reserve covers 5,500 ha but only approximately 2,800 ha is covered by forest, the rest being occupied by abandoned pasture, some areas in the early stages of forest succession , and others of peat bogs. An area of 340 ha of forest in the Fazenda Cambucais (adjacent to the Reserve) contains lion tamarins, and was recently transformed into a Reserve and registered officially as such. The Institute for Colonization and Agrarian Reform (INCRA) has, however, divided up the area for a settlement project.

The twelve lion tamarin groups, known to occur in nine isolated forests in nine widely separated localities, representing about 10% of the wild population, are being translocated to a forest of 2,400 ha in the Fazenda União, currently owned by the Brazilian Federal Railway Co. (Rede Ferroviária Federal S.A. - RFFSA). The railways have recently been privatized and the future of this ranch and its forest is still uncertain. Five groups have already been translocated to the ranch. All other populations (including the reintroduced population now numbering over 200 animals) and remnant forests are on private properties, with no guarantees of their conservation. All forests containing populations of lion tamarins, and including the Poço das Antas Biological Reserve, are subject to hunting, fires and other threats arising from human activities due to the lack of human resources for law enforcement.

Action:
We need to initiate measures to guarantee the preservation and long term protection of the forest in the Fazenda União by creating an official protected area (conservation unit). The legal procedure required for such a step has already been initiated by IBAMA, and the RFSA has demonstrated its interest in creating a conservation unit as proposed, if the federal authorities provide the appropriate indemnities. This forest would represent an increase of 23% in the protected habitat available for the species. If it proves impossible to create a federal protected area, action should be taken to guarantee that the future owner of the land preserves it. (AMLD, IBAMA, International Committee, other NGO's)

With regard to the forest on the Fazenda Cambucais, the International Committee should send an official letter to the President of IBAMA, the Minister of the Environment, and the

President of INCRA urgently requesting that the settlement project be abandoned and the area annexed to the Poço das Antas Biological Reserve. (International Committees).

Provide incentives and support to increase the number of official private reserves (RPPNs) in the region, for forests both with and without lion tamarins. There are currently 16 ranches with re-introduced groups which represent approximately 2,700 ha of forest. These areas of forest represent an increase of about 25% in the total area of occurrence of the species. (AMLD, IBAMA)

Increase the quality and quantity of human resources to improve law enforcement within and outside of the protected areas. IBAMA should prioritize restructuring personnel in order to supply the conservation units with forest defense agents. Collaborative agreements could also be arranged with environmental law enforcement agencies at the municipal and state levels. Training courses are necessary to increase the qualification levels of the personnel involved. (IBAMA)

Establish the necessary infrastructure and teams, in the medium to long term, to work specifically on the recuperation of degraded habitats in the Poço das Antas Biological Reserve, and, eventually, surrounding areas, focusing also on basic research projects (for example, the efficiency of forest corridors and agroforest systems, recovery and successional processes). (IBAMA, AMLD)

Elaborate an action plan (through workshops to involve all players), identifying financing sources, specific projects, improvements infrastructure, the training of teams and prioritization of strategic areas for habitat restoration, including a schedule for executing priority actions. (AMLD)

Work towards incentives for setting up effective forest corridors (e.g., agroforest systems in areas outside of the conservation units).

Communicate experiences obtained during the execution of these measures (AMLD, IBAMA).

Golden-headed lion tamarin, *L. chrysomelas* (GHLT)

The Problem:

Continuing loss of habitat in the entire range of this species is inevitable and expedited by the transfer to the region of major sawmill and timber companies in the last five years, which have been attracted there by the relatively large expanses of Atlantic forest still present in the area. Furthermore, economic crisis currently faced by the cocoa industry, ongoing since the middle of the 1980s, has provoked the conversion of the traditional cabruca plantation into alternative cultivation practices that are more damaging to the forest ecosystems and the natural environment. Land use patterns and land ownership around the Una Biological Reserve, the only protected area for the species, is also a significant factor which must be considered. Of the 11,400 ha established in the decree creating the Reserve in December 1980, only 7,059 have been legally incorporated, and only 5,522 hectares is covered by forest, the remainder being composed of open areas or agricultural land worked by the 24 families still present within the reserve boundaries. There is also a need for the creation of further protected areas within the 19,500 km^2 of the distribution of the species, especially in the western portion, where no action of any sort has been taken to protect it.

Action:

Provide indemnities for the removal of the 24 families of squatters within the Una Biological Reserve, and intensify the current efforts to register and incorporate the remaining 4,378 ha which comprise the original decree of the Reserve, and carry out the recommendations as outlined and stated in the Reserve's Management Plan (IBAMA?).

Research in the vicinity of the Una Biological Reserve has indicated the presence of at least 10,000 ha of contiguous forest which is in the hands of private landowners. In order to secure the preservation of the main forested areas, alternative and financially attractive land use options should be proposed and means obtained to guarantee that the effectiveness of state and federal environmental legislation (monitoring and law enforcement). Incentives should also be provided for the creation of official private reserve (RPPNs) by rural property owners, along with the creation of mechanisms which can improve their sustainablility and those of the public reserves (fiscal incentives) (IBAMA, IESB, CI)

Training to raise the educational level of park guards and agents. (IBAMA)

The black-faced lion tamarin, *L. caissara* (BFLT)

The Problem:

The only officially protected area for the black-faced lion tamarin is the Superagüi National Park. The construction of the BR-101 highway (São Paulo-Uruguay), a project of Mercosul, will bisect the continental range of the species and attract considerable development. The island of Superagüi is also under considerable threat from deforestation, the establishment of lots for summer beach houses and conflict of interests with Indians resident in the Park.

Action:

Minimize or compensate for the impacts that will arise from the construction of the BR-101 highway by establishing protected areas based on recommendations arising from population studies of *L. caissara*. The environmental impact studies for the highway should include recommendations arising from the PHVA Workshop and the International Committee for the species, and IBAMA.

Increase the quality and quantity of human resources as a measure for the improvement of law enforcement within and outside of the protected areas.

The black lion tamarin , *L. chrysopygus* (BLT)

The Problem:

Fragmentation of the available forests for the species. The Morro do Diabo State Park (35.000 ha) and the Caitetus State Ecological Station (2.178 ha) are the only two protected areas containing populations of BLTs. Currently there are a number of privately-owned forests such as those at the Fazendas Tucano/Rosanela, Ponte Branca and Santa Maria, where the species still occurs, and the possibility exists that they might be subject to agrarian reform settlements through INCRA. The inhabitants are not the legal land owners and are squatters ("grileiros"). The Fazenda Mosquito, with 1,344 ha of officially registered forest is considered to be unproductive, and therefore highly susceptible to invasion by the so-called "Movimento dos Sem Terra (MST)" (Mobilization of the Landless). All the forested areas, officially protected or otherwise, also suffer from poor or non-existent protection from forest cutting, timber extraction and hunting.

Action:

Set up an institutional agreement between the Secretary of the Environment of the State of São Paulo, INCRA, MST and rural landowners to guarantee the permanence of the remaining forest fragments in the region of the Pontal do Paranapanema to be incorporated into the Morro do Diabo State Park. (IPÊ)

Provide incentives and accelerate the procedures involved in creating private reserves (RPPNs) in areas where there are populations of lion tamarins, especially in the western part of the species' range. (IPÊ)

Increase the quality and quantity of human resources as a measure for the improvement of enforcement within and outside of the protected areas.

Establishment necessary infrastructure and teams in the medium to long term to work specifically on the recuperation of degraded habitats in the Morro do Diabo State Park, and, eventually, surrounding areas, focusing also on basic research projects (for example, the efficiency of forest corridors and agroforest systems, recovery and successional processes).

Elaborate an action plan (through workshops to involve all players), identifying financing sources, specific projects, improvements infrastructure, the training of teams and prioritization of strategic areas for habitat restoration, including a schedule for the execution of priority actions.

Work towards incentives for setting up effective forest corridors (e.g., agroforest systems in areas outside of the conservation units).

Communicate experiences obtained during the execution of these measures (AMLD, IBAMA).

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Section 4

Communications Working Group Report

WORKING GROUP ON COMMUNICATIONS

Participants: Group Facilitator: Lou Ann Dietz and Alex Dehgan; Group Members: Maria Iolita Bampi, Devra Kleiman (computer note taker), Suzana Padua (presenter), Valeria Pinto, Denise Rambaldi, Gabriel Santos, Mariaz das Graças Souza (flip chart note taker), Humberto Giraldo, Guadalupe Vivekananda.

Goal I. Reduce Pressure of Human Occupation in and Around Conservation Units (Land Reform Settlements & Squatters) and Negative Impact of Human Practices in the Region Surrounding Conservation Units (e.g., Use of Fire, Monoculture, Changing Watercourses, and Using Agrochemicals)

The group identified this problem as requiring the most urgent attention for all four species. Specific priority short term actions were prioritized for each species.

***L. caissara*, black-faced lion tamarins:**

1. SETTLEMENT OF INDIANS IN SUPERAGÜI NATIONAL PARK

The Problem:
Guarani Indians have recently settled with FUNAI's blessing in the Superagüi National Park. These people create continuous human presence in *L. caissara* habitat throughout the National Park. They are degrading the habitat with their houses and crops in about 10 ha, but they move through 16,000 ha (the entire island), principally hunting. They may be hunting lion tamarins to some extent. We estimate that there is a potential to protect 52 lion tamarin groups in 14,000 ha of the Superagüi Park if we could clear it of human impact. Thus Indian occupation currently compromises the existence of 52 groups of *L. caissara*. If Indians degrade 20 ha of the park annually, and attract other Indians and reproduce such that the percent of the island degraded each year doubles, then it will not take many years before the island is completely degraded and the *L. caissara* population is lost.

IBAMA (the federal government environment agency which is responsible for the park) has tried to negotiate with FUNAI (the federal agency responsible for Indians) for the removal and resettlement of the Indians, but with no success. Negotiations must continue at a Federal level. State level is insufficient to resolve the problem. However, while IBAMA has the environment as its priority, FUNAI's priority is the Indians. The two institutions have reached an impasse in negotiations, and dialogue has stopped.

ACTION STEPS:
Negotiate with FUNAI to remove the Indians from Superagüi National Park settling them in another more appropriate location.

1. Send correspondence to the Attorney General/ Public Defender of the State of Paraná, Dr. Mario Gisi, requesting a return to negotiations between FUNAI and IBAMA, sensitizing them to the environmental cause.

WHO: International Committee

TIME LINE: immediately

2. Send correspondence to the President of IBAMA and Ministry of Environment, requesting a return to the negotiations with FUNAI.

WHO: International Committee

TIME LINE: immediately

3. Mobilize NGOs to support this negotiation.

WHO: IBAMA/ Guadalupe

TIME LINE: immediately

4. Ensure that the heads of conservation units with indigenous invasions are kept informed about the negotiations conducted with FUNAI at the federal level

WHO: IBAMA/DEUC/UC

TIME LINE: immediately

2. TOURIST PRESSURE

The Problem:
There are increasing numbers of tourists in and around Superagüi National Park, principally on the beach and on neighboring islands. Already many tourists want to enter the forest to see the lion tamarins. This tourism is likely to increase tremendously as it has in many nearby areas. There is no infrastructure or policy to minimize its impact or to determine carrying capacity. Tourism must be organized and controlled to avoid negative pressure and impact on the habitat and on the lion tamarins.

The lion tamarin habitat under direct pressure by tourism annually between the months of December through March is approximately 2,000 ha, an area which may contain 8 lion tamarin groups. Thus 8 groups could be affected by habitat destruction, transmission of disease from humans, and capture.

ACTION STEPS:
Organize tourism in the area surrounding the park to avoid negative impact inside the park.

1. Conduct actions with the government of the State of Paraná to guarantee the participation of IBAMA/Superagüi National Park in the development of policy for tourism along the northern coast of the state of Parana, thus assuring the conservation of lion tamarin habitat.

WHO: International Committee with DIREC

TIME LINE: Immediately

2. Implement a program of environmental education with the focus on the importance of ORGANIZED tourism and the risks of DISORGANIZED tourism:

- to avoid large scale tourism and construction of houses for tourists;
- to avoid changes in the local cultures;
- to avoid trade of animals;

- to avoid degradation of the area surrounding the park.
  WHO: IBAMA- local and IPÊ
  TIME LINE: Short, medium and long time line.

***L. chrysomelas*: Golden-headed lion tamarins:**

1. SQUATTERS IN UNA

The Problem:
Within Una: Squatters still exist within REBIO Una. They occupy about 2,000 ha which could protect 21 groups of GHLTs. Within REBIO, they have deforested areas and planted crops, are hunting and have brought in domestic animals and pesticides. People are passing through the reserve and introducing exotic plants. The solution is completely financial; it would cost $250,000 to remove the squatters. The more general objective is to allocate resources to solve the problems of the land tenure problems within Una.

A) OBJECTIVE WITHIN PROTECTED AREA: guarantee the allocation of funds for the solution of the land tenure problems within the Una Biological Reserve.

ACTION STEPS:

1. Prioritize within the IBAMA 98 budget resources for indemnifying squatters within the Una Reserve.
   WHO: DIREC/ WWF/ Saturnino Sousa
   TIME LINE: 2 months
2. Mobilize regional politicians to develop budget amendments to guarantee these resources.
   WHO: IBAMA ; NGO's (Rede Mata Atlantica); Committee GHLT; Prefeitura UNA; Federal University of Bahia; International zoos are all to contact and put pressure on the following politicans- Senador Antonio Carlos Magalhaes; Federal Deputies Waldeck Ornelas, Roland Lavigne, and João Leao.
   TIME LINE: next 6 months
3. Negotiations between IBAMA/WWF to allocate resources to resolve land tenure issues within Una.
   WHO: WWF is going to organize meetings with IBAMA to resolve issues concerning allocation of currently available resources and to develop a strategy for involving other donors.
   TIME LINE: 2 months
4. Document the land ownership and land tenure issues within and around Una Reserve. Provide assistance, support, collaboration and endorsement from IBAMA for Heloisa Orlando (lawyer affiliated with Fed. Univ. Bahia and CNPq) to carry out these activities.
   WHO: WWF- Brazil will try to use their resources to leverage IBAMA to provide resources / financial support to achieve this goal.
   TIME LINE: Immediate

B) OBJECTIVES OUTSIDE PROTECTED AREA: Prevent invasion of buffer zone by additional settlers (10 kms. in all directions around REBIO). Potential impact might be the immediate loss of 5000 ha. of forest habitat.

ACTION STEPS:
Promote meetings and agreements among stakeholders involved with the agrarian reform movement in the area around Una (e.g., relevant GOs, NGOs, settlers) so that areas around Una Reserve are not invaded or prioritized for land settlement.

1. Organize meetings with IBAMA, INCRA, IESB, Jupara, MST, WWF, and others to discuss the importance of the buffer zone, new alternatives of areas for land settlements in the region, obeying environmental legislation on the part of INCRA and MST landless movement, discuss the environmental impact of the social/agrarian movements in the fragments of the Mata Atlantica in the area around Una.
   WHO: IESB
   TIME LINE: Next 2 months
2. Mobilize the Ministry of Agrarian Reform (Raul Jungmann) about the importance that INCRA obey and follow existing environmental legislation in the planning and implementation of new land settlements.
   WHO: WWF, IBAMA, NGOs, International Committee
   TIME LINE: 6 months

***L. rosalia*, Golden lion tamarins**:

1. PROTECTION OF FAZENDA UNIÃO

The Problem:
The Fazenda União is the largest remaining intact block of protected forest within the range of the GLT and is available to be made into a Reserve. Legal protection of Fazenda União of 2400 ha. as a Federal Reserve or Conservation Unit must be accomplished. If Fazenda União becomes a conservation unit, it would permit application of relevant legislation for conservation units, thus resulting in a reduction of hunting pressure, provision of resources and fiscalization of the area, and infrastructure for a conservation unit. Protection would provide area for 40 new GLT groups through reintroduction and/or translocation.

ACTION STEPS:

1. Send letter to Minister Gustavo Krause and Pedro Malan
   WHO: International Committees
   TIME LINE: tomorrow
2. Follow the process in Brasilia
   WHO: Consultant
   TIME LINE: within 6 months
3. Look for financial help for the development of environmental education program in surrounding communities and for local public authorities.
   WHO: Valeria
   TIME LINE: next 6 months

4. Encourage and support the development of other research projects in the area
WHO: AMLD
TIME LINE: next 5 months
5. Contact and help the forestry police to conduct systematic law enforcement within and in the area surrounding Fazenda União.
WHO: AMLD/ Denise
TIME LINE: next 6 months
6. Promote and organize a visit of local authorities to União.
WHO: Alba/ AMLD
TIME LINE: next 3 months
7. Have published within local and national journals information about the situation in F. União.
WHO: AMLD/ Alba
TIME LINE: immediately
8. Organize large event to mobilize the local and regional community, e.g., "Embrace / Hug F. União".
WHO: AMLD/ Alba/ Defensores da Terra (NGO)
TIME LINE: next 6 months
9. Inaugurate the REBIO F. União.
WHO: IBAMA/ AMLD
TIME LINE: By April 1998

2. EXPAND AND PROTECT AVAILABLE HABITAT FOR GLTS

ACTION STEPS:

1. Plant agroforestry demonstration corridors in at least 4 ranches that already have reintroduced GLTs.
WHO: Alba/ Valeria/ Oscar/ owners
TIME LINE: Dec 1998
2. Provide technical support in the planting of agroforestry corridors in the fazendas in the region around Poço das Antas.
WHO: AMLD
TIME LINE: next 5 years
3. Promote training courses for owners and workers, to increase the value of raw products, increasing the family income and the potential for an improvement in the quality of life within the communities.
WHO: AMLD/ Oscar/ EMATER/ Secr. Agriculture in local communities (SJ and CdA).
TIME LINE: next 2 years
4. Provide support and orientation in the creation of RPPNs and promote their utilization as a form of sustainable ecological and economically viable activity, through providing help in the implantation of demonstration projects.
WHO: AMLD (Denise, Alba, Oscar) & farm owners
TIME LINE: begin immediately - next 5 years

5. Orient and motivate local owners and regional decision makers in the development of ecotourism as an activity to generate resources for the local/ regional community.

WHO: AMLD (Denise, Alba,)/ WWF/ Ecobrasil

TIME LINE: next 2 years

6. Analyze, propose and support the creation of new incentive mechanisms for the legal protection of private forests .

WHO: Denise, legislative assistant (federal, state, municipal)

TIME LINE: next 5 years

7. Provide technical support for the establishment of agroforestry corridors on the farms surrounding the REBIO Poço das Antas.

WHO: AMLD

TIME LINE: next 5 years

***L. chrysopygus*, Black lion tamarin**:

1. PROTECTION OF LAND IN THE PONTAL

The Problem:

The land in the Pontal (SW São Paulo) has been decreed as a Reserve. However, the imminent redistribution of the land in the Pontal (12,000 ha) is the greatest threat to survival of the BLT. The State must change the decree such that the criteria for the regulations concerning the distribution of land are altered. Otherwise, we will lose approximately 500 ha/ year which will result in a loss of 50 animals, but also future carrying capacity. Need pressure on state of São Paulo to include environmental concerns and protection of biodiversity in the planning process for land redistribution.

ACTION STEPS:

1. Influence the government of São Paulo state (The relevant individual with the decision-making authority is the Secretary of Justice.)

WHO: IPÊ, International Committee, IBAMA

TIME LINE: 1997

2. Plan strategies of action.

WHO: IPÊ, IBAMA

TIME LINE: 1997

3. Look for help from other NGOs, and persons

WHO: IBAMA, IPÊ

TIME LINE: 1997

4. Identify people and institutions that can contribute in the development of these actions, e.g., prepare a list of the most powerful individuals that might be brought into the process of pressuring the Minister of Justice.

WHO: IPÊ/ IBAMA

TIME LINE: 1997

Longer Term Objectives and Actions of Equal Importance for Each of the Four Species under Goal I:

OBJECTIVE: Develop a regional plan for human occupation and land use for each region.

ACTION STEPS:

1. Organize an initial meeting of all the stakeholders (MST, Department of Agriculture, Secretariat of Education, INCRA, IBAMA, farmers, municipal governments, NGOs, individuals with technical expertise, etc.)
2. Conduct a participatory diagnosis to identify problems and develop solutions.
3. Develop a regional planning policy which includes the environment (especially conservation of forests and other natural resources, solution of land tenure problems in existing conservation units, and establishment of new conservation units).

WHO/TIME LINE:

L. rosalia: AMLD and IBAMA/ already begun and continuing through medium and long term.
L. caissara: IBAMA/ short to long term (initiation depends on imminent signature of decree to increase the size of the park).
L. chrysopygus: IPÊ and IBAMA / to begin in 1 month.
L. chrysomelas: IESB/ already begun and continuing through medium and long term.

OBJECTIVE: Implement environmental education programs with the communities pressuring the conservation units.

ACTION STEPS:

1. Exchange among the four species programs for planning and implementation of environmental education strategies. Include in the agenda of the Management Committee meetings
   WHO: Each of the four Management Committees
   TIME LINE: May 1998 and annually thereafter.
2. Develop local strategies of environmental education: directed toward the increase of community understanding of what the environment is and the relation among the components of the environment (including humans). Strategies should include messages directed toward the needs of local populations (not the lion tamarins) and include educational activities which show local, national, and international models of ecotourism.
   WHO/TIME LINE:
   L. chrysomelas: IESB, IBAMA, Jupara, Municipality of Una/ 1997
   L. rosalia: AMLD, EMATER, local municipal governments, IBAMA/ 1998
   L. caissara: IBAMA (Superagüi Park)/ already begun
   L. chrysopygus: IPÊ, Delegacia de Ensino, Instituto Florestal de São Paulo/ Caitetus is already begun; Morro do Diabo will begin when agreement is signed between IPÊ and IF.

Goal II: Develop Incentives for Land Owners to Preserve Natural Areas and Improve Law Enforcement for Legal Infractions (All Species).

The Problem:
LEGISLATION: Survey existing legislation, disseminate information about legislation, promote new legislation, and enforce legislation.

ACTION STEPS:

1. Survey of environmental and agricultural legislation related to protection of the Atlantic Forest and privately owned forests
   WHO: IBAMA (Sonia Wiedmann) or a consultant paid by WWF
   TIME LINE: year 1
2. Based on the survey, develop strategies for credit incentives for protection of Atlantic Forest on private lands; credit lines from National Development Bank (BNDES) for the establishment of Private Reserves (RPPN's); a line of financial support within the PD/A (Pilot Project for the Protection of the Brazilian Rainforest established by the G7 countries - Demonstration Projects Fund) for the implementation of Private Reserves (RPPN's).
   WHO: Associação Mico-Leão Dourado (AMLD), IESB, IPÊ, Rede Mata Atlântica, ISA, and others
   TIME LINE: Years 1-5
3. Conduct a study of tax law to understand the possibilities of income tax exemptions.
   WHO: assistance of a tax attorney
   TIME LINE: Year 1
4. Conduct a study to develop a proposal for a law to give landowners exemption from property tax on an area double the size of the protected area on their land.
   WHO: Legislative assistant
   TIME LINE: Year 3
5. Create mechanisms to encourage the federal government to "municipalize" the federal rural property tax (ITR).
   WHO: Suzana and Claudio Padua (?) since they are located in Brasilia
   TIME LINE: Year 1-3
6. Political actions toward the proposal and approval of the "ICMS Ecologico" Law (a return of state value added tax revenues to municipalities in greater percentage proportional to the areas of protected areas. i.e., royalties for ecological services) for the states of Rio and Bahia. (This law is already in effect in the states of São Paulo and Parana).
   WHO: AMLD, IESB, and legal assistance from Wilson Loureiro
   TIME LINE: years 1-5
7. Disseminate INCRA's (Federal Agrarian Reform Agency) concept of "unproductive land" (taxed and subject to agrarian reform). Observation: Forested land is no longer considered unproductive. Registered forested land is not taxed or subject to land reform. This policy has not been disseminated and landowners are afraid that protecting forests will make them subject to land reform.
   WHO: IPÊ, IESB, AMLD, IBAMA

TIME LINE: beginning immediately

8. Conduct viability study for certification of products from properties with areas of forest which have been officially registered as "areas of permanent preservation" (Green Seal).

WHO: AMLD, IESB, IPÊ with CTA and AS-PTA

TIME LINE: year 2-5

9. Compile North American legislation on protection of private forests as a basis for creating and increasing the breadth extent of Brazilian legislation.

WHO: Denise Rambaldi and Devra Kleiman

TIME LINE: years 1-5

10. Study the viability of the creation of an annual international prize for individuals, institutions, and consortiums who most contribute to conservation of lion tamarins and the Mata Atlântica.

WHO: Devra Kleiman, Jeremy Mallinson, Adelmar Coimbra-Filho, and Admiral Ibsen de Gusmão Camara, International Committees.

TIME LINE: year 2-5

11. Contact "The Nature Conservancy" to determine possibilities for the joint development of new mechanisms for the protection of private areas.

WHO: Claudio Padua?

TIME LINE: ?

GOAL III. Economic Alternatives: Develop Economic Alternatives, Including Ecotourism and Support for Traditional Producers, in Communities Around Conservation Units for all Species.

Examples of economic alternatives include: agroforestry; apiculture; escargot; vegetable gardens; home industries such as fruit preserves, sweets, sausage, cheese; bioprospecting; herbal medicines; commercial rearing of native species such as capybaras and pacas; construction materials; employment in local conservation efforts; and ecotourism, including development of handicrafts.

A. OBJECTIVE: Identify ecologically, economically, and socially sustainable alternatives

ACTION STEPS:

1) Biological inventories of regional natural resources and their potential (in the areas of each of the four species)

WHO: IPÊ (BLT area), IESB (GHLT area), AMLD (GLT area), SPVS and IBAMA (BFLT area)

TIME LINE: beginning year 1 in all four areas, continuing through the long term

2) Community participatory survey of natural resources currently used, determining the economic value of these resources

WHO: Settlers Cooperative and IPÊ (BLT); EMATER and AMLD (GLT); Jupara (GHLT); IBAMA & SPVS (BFLT) and other institutions involved including universities.

TIME LINE: beginning year 1 in all four areas, continuing through the long term

3) Identify impacts of potential use and mitigating measures for negative social and ecological impacts

WHO: Researchers (for all species); IPÊ (BLT); IESB (GHLT), AMLD (GLT), IBAMA &SPVS (BFLT)

TIME LINE: beginning year 1 in all four areas, continuing through the long term

4) Conduct market research of potential alternatives and select alternatives for promotion

WHO: Researchers /universities, SEBRAE, cooperatives (for all species); IPÊ (BLT); IESB (GHLT), AMLD & EMATER (GLT), IBAMA &SPVS (BFLT)

TIME LINE: beginning year 1 in all four areas, continuing through the long term

5) Diversify and add value (through processing) to traditional production and increase productivity

WHO: IPÊ (BLT); IESB (GHLT), AMLD (GLT), IBAMA &SPVS (BFLT)

TIME LINE: beginning year 1 in all four areas, continuing through the long term

6) Analyze marketing processes, including transport, location of markets, and promotion of products

WHO: IPÊ (BLT); IESB (GHLT), AMLD (GLT), IBAMA &SPVS (BFLT)

TIME LINE: beginning year 1 in all four areas, continuing through the long term

7) Develop specific alternative strategies for large landowners which have protected forests.

WHO: IPÊ (BLT); IESB (GHLT), AMLD (GLT), IBAMA &SPVS (BFLT)

TIME LINE: beginning year 1 in all four areas, continuing through the long term

B. OBJECTIVE: Involvement of the community and adoption of the viable alternatives identified

ACTION STEPS:

1) Develop partnerships with community organizations. Where they don't exist, support and orient the creation of community organizations.

WHO: IPÊ (BLT); IESB (GHLT), AMLD and IBAMA (GLT), IBAMA &SPVS (BFLT)

TIME LINE: beginning year 1 in all four areas, continuing through the long term

2) Implement and disseminate demonstration projects.

WHO: IPÊ (BLT); IESB (GHLT), AMLD (GLT), IBAMA &SPVS (BFLT)

TIME LINE: medium term, continuing through the long term

3) Seek to employ local people in all conservation efforts

WHO: IPÊ (BLT); IESB (GHLT), AMLD (GLT), IBAMA &SPVS (BFLT)

TIME LINE: beginning year 1 in all four areas, continuing through the long term

C. OBJECTIVE: Build capacity of community organizations and individuals interested in adopting alternatives

ACTION STEPS:

1) Conduct training for each targeted economic alternative
   WHO: EMATER, SEBRAE, cooperatives, agricultural schools, IBAMA (fish culture, captive breeding of paca and capybara)
   TIME LINE: medium & long term

2) Encourage the creation of agricultural schools
   WHO: IPÊ (BLT); IESB (GHLT), AMLD (GLT), IBAMA &SPVS (BFLT); Municipal state governments
   TIME LINE: ?

Goal IV. Improve Communication and Collaboration among Institutions Involved at All Levels in Land Use and Policy in the Areas Within the Ranges of All the Lion Tamarins.

The Problem:
Maintain information flow among institutions involved in planning of areas of environmental interest at the federal, state and local levels

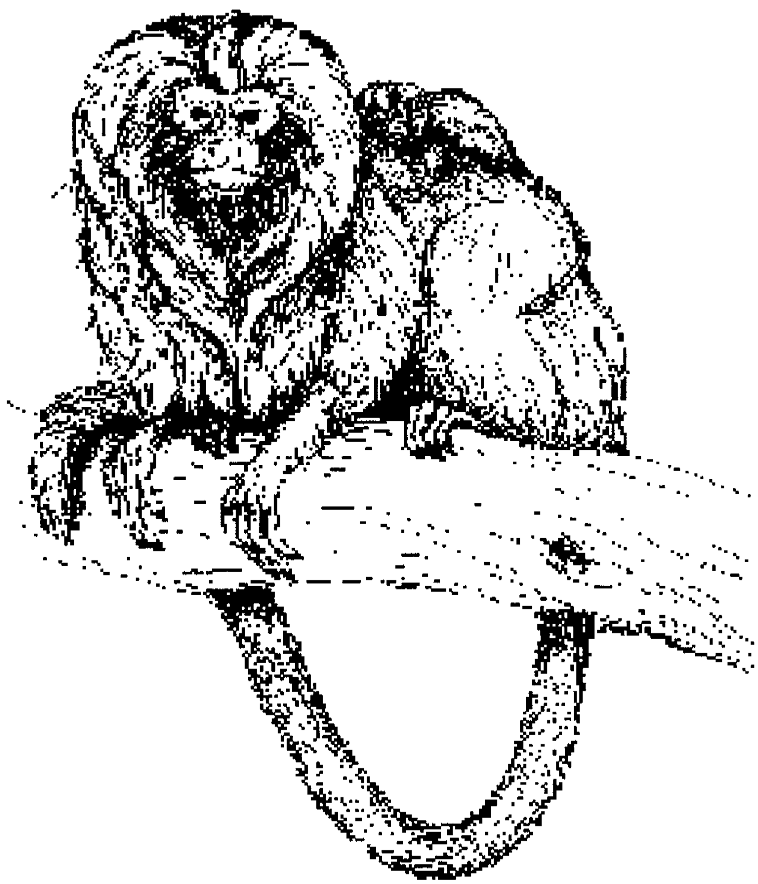
ACTION STEPS:

1) Organize a meeting of IBAMA-São Paulo with INCRA, Instituto Florestal (SP), Instituto de Terras e Cartografía (SP) and IPÊ to reach a consensus on the situation of the Vale do Paranapanema.
   WHO: IPÊ
   TIME LINE: immediately
2) Organize a second meeting with the leader of the landless movement (MST) with the objective of involving them in the process.
   WHO: IPÊ
   TIME LINE: immediately
3) Survey current legislation (laws and regulations) related to land use with the objective of revising those which are conflicting.
   WHO: IBAMA-DF
   TIME LINE: immediately
4) With the objective of involving them in the environmental cause and ensuring they are informed, invite individuals and institutions involved in activities in the ranges of the lion tamarins to participate in future events related to these primates.
   WHO: IBAMA & Presidents of the Committees
   TIME LINE: short, medium, and long term
5) Identify which institutions and individuals who could be involved in this context.
   WHO: Conservation Units and NGOs
   TIME LINE: short, medium and long term

6) Organize periodic meetings among the institutions, researchers, conservation units involved in the protection of the lion tamarins, to discuss problems and jointly identify solutions.

WHO: Conservation Units and NGOs

TIME LINE: short, medium, and long term



J. Weston, Hogle Zoo

LEONTOPITHECUS II

The Second
Population and Habitat Viability Assessment
for Lion Tamarins
(Leontopithecus)

Belo Horizonte, Brazil
20-22 May 1997

Final Report
May 1998

Jonathan D. Ballou, Robert C. Lacy, Devra Kleiman, Anthony Rylands and Susie Ellis

Section 5

Population Modeling Working Group Report

WORKING GROUP ON MODELING

Participants: Group Facilitator: Robert Lacy; Group Members: Maria Inês Castro, Joanne Earnhardt, Rosa Lemos de Sá, Emília Patrícia Medici, Jon Ballou

1. INTRODUCTION

Computer models that evaluate the probability of extinction, loss of genetic diversity, and metapopulation dynamics are an important part of population viability analysis. They provide a quantitative summary of the conservation status of populations and permit evaluation of the effects of different management actions on long-term survival and retention of genetic diversity.

The objective of this working group was to develop a series of baseline models for each of the *Leontopithecus* taxa which could be used to help evaluate objectives, management recommendations and priorities developed by the other working groups. During the workshop, several scenarios were examined: examination of survival and gene diversity maintenance of hypothetical tamarin populations of various size ranging from only one group to 1000 individuals; overall survival and maintenance of genetic diversity within and among metapopulations of *L. rosalia* and *L. chrysopygus* under different rates of translocations among populations; an examination of the ability of the current reintroduced population of *L. rosalia* to survive and maintain diversity if no future supplementation to the population occurs in the future (i.e., stop any further reintroductions); and exploring the viability of *L. chrysomelas* in and around Una given the various identified threats. Immediately after the workshop, additional scenarios were modeled and previously run models were refined by increasing the number of simulations run.

2. BACKGROUND - MODELING AND POPULATION VIABILITY ANALYSIS

A model is any simplified representation of a real system. We use models in all aspects of our lives, in order to: (1) extract the important trends from complex processes, (2) permit comparison among systems, (3) facilitate analysis of causes of processes acting on the system, and (4) make predictions about the future. A complete description of a natural system, if it were possible, would often decrease our understanding relative to that provided by a good model, because there is "noise" in the system that is extraneous to the processes we wish to understand. For example, the typical representation of the growth of a wildlife population by an annual percent growth rate is a simplified mathematical model of the much more complex changes in population size. Representing population growth as an annual percent change assumes constant exponential growth, ignoring the irregular fluctuations as individuals are born or immigrate, and die or emigrate. For many purposes, such a simplified model of population growth is very useful, because it captures the essential information we might need regarding the average change in population size, and it allows us to make predictions about the future size of the population. A detailed description of the exact changes in numbers of individuals, while a true description of the population, would often be of much less value because the essential pattern would be obscured, and it would be difficult or impossible to make predictions about the future population size.

In considerations of the vulnerability of a population to extinction, as is so often required for conservation planning and management, the simple model of population growth as a constant annual rate of change is inadequate for our needs. The fluctuations in population size that are omitted from the standard ecological models of population change can cause population extinction, and therefore are often the primary focus of concern. In order to understand and predict the vulnerability of a wildlife population to extinction, we need to use a model which incorporates the processes which cause fluctuations in the population, as well as those which control the long-term trends in population size (Shaffer 1981). Many processes can cause fluctuations in population size: variation in the environment (such as weather, food supplies, and predation), genetic changes in the population (such as genetic drift, inbreeding, and response to natural selection), catastrophic effects (such as disease epidemics, floods, and droughts), decimation of the population or its habitats by humans, the chance results of the probabilistic events in the lives of individuals (sex determination, location of mates, breeding success, survival), and interactions among these factors (Gilpin and Soulé 1986).

Models of population dynamics which incorporate causes of fluctuations in population size in order to predict probabilities of extinction, and to help identify the processes which contribute to a population's vulnerability, are used in "Population Viability Analysis" (PVA) (Lacy 1993/1994). For the purpose of predicting vulnerability to extinction, any and all population processes that impact population dynamics can be important. Much analysis of conservation issues is conducted by largely intuitive assessments by biologists with experience with the system. Assessments by experts can be quite valuable, and are often contrasted with "models" used to evaluate population vulnerability to extinction. Such a contrast is not valid, however, as *any* synthesis of facts and understanding of processes constitutes a model, even if it is a mental model within the mind of the expert and perhaps only vaguely specified to others (or even to the expert himself or herself).

A number of properties of the problem of assessing vulnerability of a population to extinction make it difficult to rely on mental or intuitive models. Numerous processes impact population dynamics, and many of the factors interact in complex ways. For example, increased fragmentation of habitat can make it more difficult to locate mates, can lead to greater mortality as individuals disperse greater distances across unsuitable habitat, and can lead to increased inbreeding which in turn can further reduce ability to attract mates and to survive. In addition, many of the processes impacting population dynamics are intrinsically probabilistic, with a random component. Sex determination, disease, predation, mate acquisition -- indeed, almost all events in the life of an individual -- are stochastic events, occurring with certain probabilities rather than with absolute certainty at any given time. The consequences of factors influencing population dynamics are often delayed for years or even generations. With a long-lived species, a population might persist for 20 to 40 years beyond the emergence of factors that ultimately cause extinction. Humans can synthesize mentally only a few factors at a time, most people have difficulty assessing probabilities intuitively, and it is difficult to consider delayed effects. Moreover, the data needed for models of population dynamics are often very uncertain. Optimal decision-making when data are uncertain is difficult, as it involves correct assessment of probabilities that the true values fall within certain ranges, adding yet another probabilistic or chance component to the evaluation of the situation.

The difficulty of incorporating multiple, interacting, probabilistic processes into a model that can utilize uncertain data has prevented (to date) development of analytical models (mathematical equations developed from theory) which encompass more than a small subset of the processes known to affect wildlife population dynamics. It is possible that the mental models of some biologists are sufficiently complex to predict accurately population vulnerabilities to extinction under a range of conditions, but it is not possible to assess objectively the precision of such intuitive assessments, and it is difficult to transfer that knowledge to others who need also to evaluate the situation. Computer simulation models have increasingly been used to assist in PVA. Although rarely as elegant as models framed in analytical equations, computer simulation models can be well suited for the complex task of evaluating risks of extinction. Simulation models can include as many factors that influence population dynamics as the modeler and the user of the model want to assess. Interactions between processes can be modeled, if the nature of those interactions can be specified. Probabilistic events can be easily simulated by computer programs, providing output that gives both the mean expected result and the range or distribution of possible outcomes. In theory, simulation programs can be used to build models of population dynamics that include all the knowledge of the system which is available to experts. In practice, the models will be simpler, because some factors are judged unlikely to be important, and because the persons who developed the model did not have access to the full array of expert knowledge.

Although computer simulation models can be complex and confusing, they are precisely defined and all the assumptions and algorithms can be examined. Therefore, the models are objective, testable, and open to challenge and improvement. PVA models allow use of all available data on the biology of the taxon, facilitate testing of the effects of unknown or uncertain data, and expedite the comparison of the likely results of various possible management options.

PVA models also have weaknesses and limitations. A model of the population dynamics does not define the goals for conservation planning. Goals, in terms of population growth, probability of persistence, number of extant populations, genetic diversity, or other measures of population performance must be defined by the management authorities before the results of population modeling can be used. Because the models incorporate many factors, the number of possibilities to test can seem endless, and it can be difficult to determine which of the factors that were analyzed are most important to the population dynamics. PVA models are necessarily incomplete. We can model only those factors which we understand and for which we can specify the parameters. Therefore, it is important to realize that the models probably underestimate the threats facing the population. Finally, the models are used to predict the long-term effects of the processes presently acting on the population. Many aspects of the situation could change radically within the time span that is modeled. Therefore, it is important to reassess the data and model results periodically, with changes made to the conservation programs as needed.

3. DEALING WITH UNCERTAINTY

It is important to recognize that uncertainty regarding the biological parameters of a population and its consequent fate occurs at several levels and for independent reasons. Uncertainty can occur because the parameters have never been measured on the population. Uncertainty can occur because limited field data have yielded estimates with potentially large sampling error. Uncertainty can occur because independent studies have generated discordant estimates. Uncertainty can occur because environmental conditions or population status have been changing over time, and field surveys were conducted during periods which may not be representative of long-term averages. Uncertainty can occur because the environment will change in the future, so that measurements made in the past may not accurately predict future conditions.

Sensitivity testing is necessary to determine the extent to which uncertainty in input parameters results in uncertainty regarding the future fate of the pronghorn population. If alternative plausible parameter values result in divergent predictions for the population, then it is important to try to resolve the uncertainty with better data. Sensitivity of population dynamics to certain parameters also indicates that those parameters describe factors which could be critical determinants of population viability. Such factors are therefore good candidates for efficient management actions designed to ensure the persistence of the population.

The above kinds of uncertainty should be distinguished from several more sources of uncertainty about the future of the population. Even if long-term average demographic rates are known with precision, variation over time caused by fluctuating environmental conditions will cause uncertainty in the fate of the population at any given time in the future. Such environmental variation should be incorporated into the model used to assess population dynamics, and will generate a range of possible outcomes (perhaps represented as a mean and standard deviation) from the model. In addition, most biological processes are inherently stochastic, having a random component. The stochastic or probabilistic nature of survival, sex determination, transmission of genes, acquisition of mates, reproduction, and other processes preclude exact determination of the future state of a population. Such demographic stochasticity should also be incorporated into a population model, because such variability both increases our uncertainty about the future and can also change the expected or mean outcome relative to that which would result if there were no such variation. Finally, there is "uncertainty" which represents the alternative actions or interventions which might be pursued as a management strategy. The likely effectiveness of such management options can be explored by testing alternative scenarios in the model of population dynamics, in much the same way that sensitivity testing is used to explore the effects of uncertain biological parameters.

4. VORTEX POPULATION VIABILITY ANALYSIS MODEL

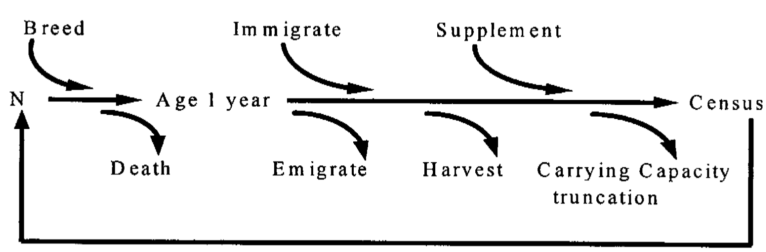
For the analyses presented here, the VORTEX computer software (Lacy 1993) for population viability analysis was used. VORTEX models demographic stochasticity (the randomness of reproduction and deaths among individuals in a population), environmental variation in the annual birth and death rates, the impacts of sporadic catastrophes, and the effects of inbreeding in small populations. VORTEX also allows analysis of the effects of losses or gains in habitat, harvest or supplementation of populations, and movement of individuals among local populations.

Density dependence in mortality is modeled by specifying a carrying capacity of the habitat. When the population size exceeds the carrying capacity, additional morality is imposed across all age classes to bring the population back down to the carrying capacity. The carrying capacity can be specified to change linearly over time, to model losses or gains in the amount or quality of habitat. Density dependence in reproduction is modeled by specifying the proportion of adult females breeding each year as a function of the population size.

VORTEX models loss of genetic variation in populations, by simulating the transmission of alleles from parents to offspring at a hypothetical genetic locus. Each animal at the start of the simulation is assigned two unique alleles at the locus. During the simulation, VORTEX monitors how many of the original alleles remain within the population, and the average heterozygosity and gene diversity (or "expect heterozygosity") relative to the starting levels. VORTEX also monitors the inbreeding coefficients for each animal, and can reduce the juvenile survival of inbred animals to model the effects of inbreeding depression.

VORTEX is an *individual-based* model. That is, VORTEX creates a representation of each animal in its memory and follows the fate of the animal through each year of its lifetime. VORTEX keeps track of the sex, age, and parentage of each animal. Demographic events (birth, sex determination, mating, dispersal, and death) are modeled by determining for each animal in each year of the simulation whether any of the events occur. Events occur according to the specified age and sex-specific probabilities. Demographic stochasticity is therefore a consequence of the uncertainty regarding whether each demographic event occurs for any given animal.

Timeline of the VORTEX simulation model



Arrows from above are events that increase N
Arrows away from the line are events that decrease N

VORTEX requires lots of population-specific data, rather than using ecological theory to generate many parameters describing population processes. For example, the user must specify the amount of annual variation in each demographic rate caused by fluctuations in the environment. In addition, the frequency of each type of catastrophe (drought, flood, epidemic disease) and the effects of the catastrophes on survival and reproduction must be specified. Rates of migration (dispersal) between each pair of local populations are specified, rather than being assumed to be a simple function of distance or other parameters. Because VORTEX requires specification of many biological parameters, it is not necessarily a good model for the examination of population dynamics that would result from some generalized life history. It is most usefully applied to the analysis of a specific population in a specified environment.

Further information on VORTEX is available in Lacy (1993) and Lindenmayer et al. (1995) and at internet site: http://www2.netcom.com/~rlacy/vortex.html

5. CHANGES MADE IN THE VORTEX PROGRAM (CREATION OF VERSION 7.41)

The previously available version of the VORTEX program (Version 7.4) does not model managed translocations among populations. The migration option in VORTEX selects migrants at random each year, whereas translocations of tamarins would more likely involve periodic movement of small groups. The harvest/supplementation options of VORTEX allow moves of specific numbers of animals at specified years, but supplemented animals are assumed to be new founders unrelated to all other animals in the populations. Therefore, several changes were made to VORTEX at the PHVA workshop in order to allow the harvest/supplementation option to model translocations of tamarins better.

First, an option was added which allows specification of a minimum population size / carrying capacity ratio for removal of animals from a population. When the population size falls below this ratio, no animals are harvested for use in translocations. Second, an option was added which allows specification of a maximum population size / carrying capacity ratio for addition of animals to a population. When the population size is above this limit, no translocations into the population are completed. Third, an option was added that allows the animals which are harvested from some populations to be placed into a pool from which animals are selected to be added to other populations. Thus, supplementation and harvest are linked, with the pedigree, age, and sex of translocated animals maintained as they are moved between populations. The mortality rate of translocated animals is also specified. If animals which have been harvested are not needed for supplementation of a population in the year that they were harvested, then it is assumed that they would remain available for supplementation in future years, but would be subjected to the species-specific mortality rates while they are being held for translocation. This mortality is in addition to the mortality resulting from the translocation itself.

6. MODEL INPUT PARAMETERS

Leontopithecus has been the focus of several fields studies since the early 1980s. Studies have been conducted in the Una Biological Reserve and surrounding areas in the state of Bahia for *L. chrysomelas* (L. Paulo Pinto and Rylands, 1997; Dietz et al. 1996) in Poço das Antas Biological Reserve and surrounding areas in Rio de Janeiro for *L. rosalia*, (Baker and Dietz, in prep.; Kierulff and Oliveira 1996; Beck et al. in prep); in privately-owned lands and in and around Morro do Diabo State Park and the Caetetes Ecological Station in São Paulo for *L. chrysopygus* (Padua and Cullen 1994). *L. caissara*, discovered in 1990, has been the focus of field studies in and around Superagüi National Park in the states of São Paulo and Paraná (Lorini and Persson 1994). Data used for the modeling included here are based on data collected from various aspects of all these field studies.

a) Life History Data

The most extensive data available on life-history characteristics of *Leontopithecus* in the wild are those of Baker and Dietz (in prep) for wild *L. rosalia* in Poço das Antas and from Beck et al. (in prep) for reintroduced *L. rosalia* in areas around Poço das Antas. Models of wild *Leontopithecus* populations were based on the Baker and Dietz data. Models of the projections of the reintroduced populations were based on the Beck et al. data.

Data collected by Baker and Dietz on wild *L. rosalia* cover the period from 1983 to 1996 and include partial or complete-life data on 614 individuals encompassing 1360 animals/years of observations. These include data on 357 births, 165 deaths and 214 disappearances, which for the purposes of this analysis have been treated as deaths. These data were entered into the software SPARKS Version 1.42 (Single Population Animal Record Keeping System; ISIS 1997) to facilitate calculation of demographic and genetic parameters needed for the VORTEX input. Additional programs were written by J. Ballou to estimate specific VORTEX parameters not otherwise obtainable by the SPARKS software.

Means and standard deviations over the 13 years were calculated for each of the basic VORTEX input parameters. Standard deviations due to environmental variation were calculated by removing average demographic variation over the 13 years (as calculated based on binomial sampling theory using annual mean values and samples sizes) from the total variation observed in each parameter.

b) Reproductive Parameters:

Female age of first reproduction (this was taken as the age at which reproduction in females began to most closely resemble adult levels of reproduction) = age 4;

Male age of first reproduction (when males began to closely resemble adult levels of reproduction) = age 4;

Proportion of females breeding each season = .757 (Standard deviation due to environmental variation = 0.382); maximum number of young/year observed was 5.

Distribution of litter sizes: (here litter size is the number of offspring produced during a full cycle of VORTEX, which is one year):

Table 1. Distribution of Annual Reproduction in *L. rosalia*

"Litter Size" (No. Of Offspring Produced/year)	Percent of Females
0	.243
1	.157
2	.438
3	.041
4	.115
5	.005

Breeding System: for the purposes of VORTEX this was defined as monogamous.

Proportion of Males breeding/season: In *L. rosalia*, more than 70% of breeding groups contain more than one adult male but social dominance usually excludes one male from participating in breeding. About 54.5% of adult males actually produce offspring. Nevertheless, from the modeling perspective, it is important to recognize that in tamarin groups, as long as there is an adult male in a group the female has a mate. Additionally, if a breeding group loses adult males, they are quickly replaced by floating males looking for breeding opportunities. Females are very rarely, if ever, prevented from breeding due to lack of breeding males. However, VORTEX does not (yet) model social groups within the context of a population. If we were to use 54.5% as the proportion of males contributing to breeding, then in some years some females would be prevented from breeding because the 54% of males are already paired with females. To avoid this problems, we ran the program using 100% of the adult males as potentially in breeding pool to ensure that adult females were always provided with the opportunity to mate.

c) Mortality Rates

Age specific mortality rates were calculated for ages 0 to 3 and adult:

Table 2. Sex/age Specific Mortality Rates in *L. rosalia*

Age Class	Males		Females	
	q_x	SD(EV)*	q_x	SD(EV)
0	.298	0.070	.328	0.087
1	.197	0.099	.196	.133
2	.239	0	.246	.076
3	.172	0.075	.21	0
Adult	.160	.082	.125	.067

* SD(EV) = Standard deviation due to environmental variation.

Maximum (reproductive) longevity was calculated as 16 years.

d) Age Structure

The age structure of the study population in Poço das Antas at the time these data were tabulated does not differ significantly from the stable age distribution defined by the mortality rates estimated above ($\chi^2 = 13.10$, df = 16; $p = 0.59$). Therefore we modeled all populations except the reintroduction population of *L. rosalia* assuming a stable age structure. For the reintroduction population, we used the exact age structure since this was known.

e) Inbreeding

Data were available on parentage for almost all of the births in the population. Paternity in dual male groups was determined through behavioral observations of dominance relationships. There was only one case where the subordinate male was observed mating with the adult female during the breeding season and this breeding did not result in a birth. There was also only one case of extra-pair copulations when a female was observed breeding with a male in another group during a territorial encounter between groups. Assuming that the dominant male was the sire of all offspring born into the group is probably for the most part accurate; only genetic analyses can verify this assumption.

These pedigree data were entered in SPARKS to calculate inbreeding coefficients using the GENES software. There were 18 cases where paternity could not be determined on the basis of behavioural observations. In these cases, assignment of paternity was always limited to one of two males. Inbreeding coefficients were calculated under all possible pairwise combinations of these unknown animals. In only one of the uncertain paternity cases did the choice of male affect levels of inbreeding in the population.

First year survival rates were calculated for individuals born with similar inbreeding coefficients, and log of survival was regressed against inbreeding coefficients. The number of lethal equivalents was estimated as 4.07 ($p=0.02$). We assumed that 50% of these were lethal alleles.

f) Other VORTEX Parameters:

Assumed sex ratio at birth was equal males and females, and there were no density dependent effects on reproduction.

We observed a negative correlation between adult mortality and fecundity for both sexes. However VORTEX can (currently) only model positive or zero correlations so we ran the model with no correlation.

g) Metapopulation Structure:

Lion tamarins populations are currently characterized by one or two relatively large populations and many small existing or potential populations located in fragmented and isolated habitat separated from the main populations. The following tables summarize these populations for *L. rosalia*, *L. chrysomelas* and *L. chrysopygus*. Data are not available for *L. caissara*.

Distribution of *L. rosalia*:

Estimates of the number of animals and the capacity in all except the reintroduced and translocated populations are based on the density of animals observed on Poço das Antas (1 individual/13.9 hectares) applied to the size of the suitable habitat area. These populations are assumed to be at capacity. Numbers of animals in reintroduced and translocated populations are based on head counts of individuals.

Table 3. Populations of *L. rosalia* with estimated numbers of animals and capacity.

Area	Estimated # Animals	Estimated Capacity
Wild *L. rosalia* Populations:		
Poço das Antas	347	347
Vicinity of Poço das Antas	71	71
Serra do Mar	74	74
Centro Hipico	29	29
Campos Novos	38	38
São João River	12	12
Emerências	10	10
Reintroduced *L. rosalia* Populations		
Iguape	115	115
Rio Vermelho	40	59
Santa Helena	25	25
Bom Retiro	4	50
Afetiva	3	6
Poço das Antas Group	11	11

Translocated *L. rosalia* Populations:		
Fazenda União	40	158
Suitable Habitat without *L. rosalia*		
São João Hill	0	53
Gaviões	0	302
Casimiro	0	79
TOTAL:	813	1433

Distribution of *L. chrysomelas*:

Unlike the other lion tamarins, the *L. chrysomelas* in and around the Una Biological Reserve are not currently in severely fragmented habitat and were therefore modeled as a single, continuous population.

The original decree creating Una Biological Reserve included 11,400ha of which 5,342ha were purchased at the time. The western (Piedade) half of that tract was invaded and largely degraded by squatters. A few families of squatters still remain in this area and will continue to degrade forest if not controlled by IBAMA. The local "Sem Terra" movement poses an additional threat to this area. The eastern (Maruim) portion remained relatively pristine. An additional 1,731ha were purchased in 1990/1993. The reserve now consists of 7,059ha of purchased lands and ca. 4,341ha remain unpurchased in the area delimited in the original decree.

Table 4. Estimated number of *L. chrysomelas* in and around Una Biological Reserve.

Area	Amount of Forest (ha)	% Degraded	Estimated # Animals
Maruim	2623*	0	140
Piedade	1612	If 100% If 0%	116 86
Area Purchased in 1990/1993	1287*	0%	68
Decreed but not Purchased	2241	50%	141
Total	**7763**		**435 to 465**

Density of tamarins likely depends on habitat type and degradation. The density of *L. chrysomelas* in the relatively pristine Maruim area is 1 GHLT/18.8ha (Dietz 1997). Density estimates for degraded areas in Una Reserve are not available. However, density of *L. rosalia* in degraded forests of Poço das Antas is 1 GLT/13.9ha. A similar figure was reported for *L. chrysomelas* in a degraded forest fragment (Rylands 1989). These densities were used to estimate numbers of GHLTs in different forest types in various modeling scenarios.

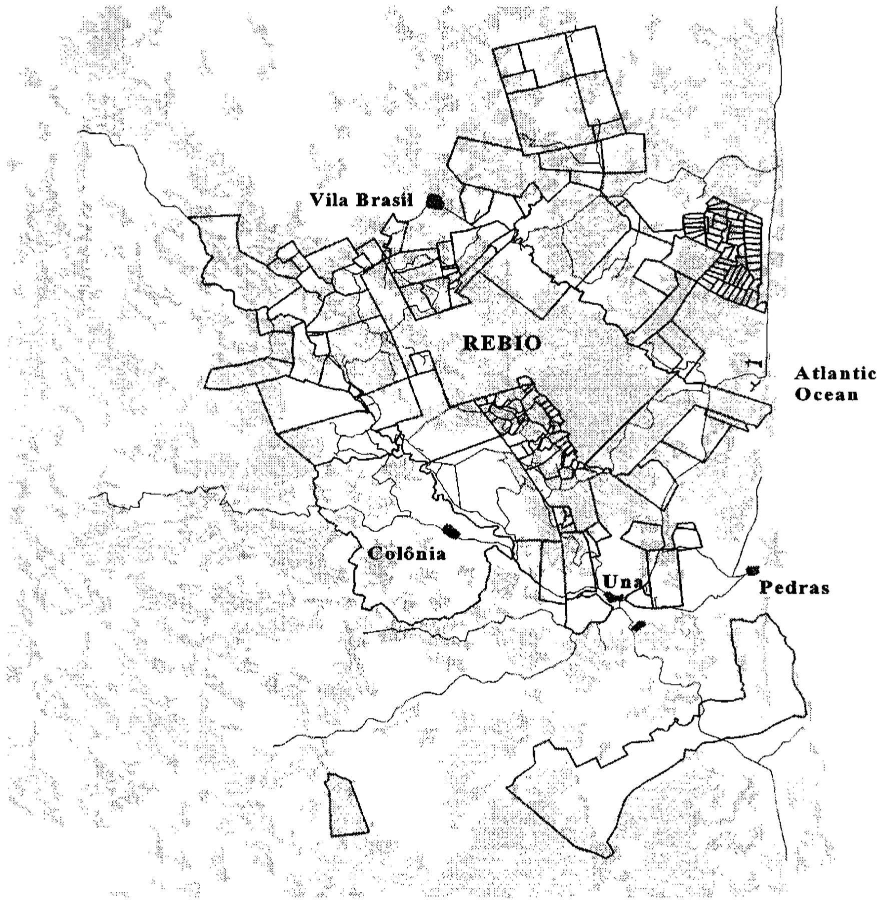


Figure 1. Una Biological Reserve (REBIO) and surrounding fazendas. Forest patches > 25 ha are shown as shaded areas (from Alger and Araujio, In press).

Distribution of *L. chrysopygus:*

Like *L. rosalia*, the distribution of *L. chrysopygus* is characterized by one large population, several small populations, and many forest fragments that theoretically could hold lion tamarins. The only density estimates available for *L. chrysopygus* are from a study on four groups (Valladares-Padua and Cullen 1994). Estimates of number of animals and capacity presented here are based on densities of 1 tamarin/30 ha.

Table 5. Populations of *L. chrysopygus* with estimated numbers of animals and capacity.

Area	Estimated No. Animals	Estimated Capacity
Existing Populations		
Morro do Diabo	820	959
Caetetus Ecological Station	25	25
Translocated *L. chrysopygus* Populations		
Duratex	52	176
Ponte Branca	10	33
Santa Maria	6	14
Tucano/Dozanella	10	57
Fazenda Mosquito	4	42

Forest Fragments Suitable for, but without, *L. chrysopygus*

Area	Estimated # Animals	Estimated Capacity	Area	Estimated # Animals	Estimated Capacity
Ipanema	0	56	F15	0	3
Brahma	0	24	F16	0	4
F1	0	38	F17	0	5
F2	0	19	F18	0	5
F3	0	24	F19	0	4
F4	0	18	F20	0	5
F5	0	14	F21	0	4
F6	0	14	F22	0	5
F7	0	38	F23	0	5
F8	0	14	F24	0	66
F9	0	19	F25	0	66
F10	0	4	F26	0	66
F11	0	5	F27	0	61
F12	0	9	F28	0	27
F13	0	9	F29	0	90
F14	0	3	F30	0	66

h) Catastrophes

L. rosalia:

Since no new data were available on quantifying the threat of various catastrophes in *L. rosalia,* we used the same threats provided in the 1990 PHVA. This included threats due to train accidents and pesticide spills within the Reserve (combined, these threats had a 7% chance of occurring each year, with a 10% reduction in survival) and a disease catastrophe (frequency was 1%/year with a 50% reduction in survival). Also considered were both minor and severe fires: minor fires occur often (1 every 3 years) and only have a minor impact on mortality (additional 1%); severe fires were modeled as occurring once every 20 years (5%/year) and reducing survival by 5%.

L. chrysomelas:

In 1990, disease threats were applied at the same rate as in *L. rosalia,* but may in fact be more of a threat since disease has actually been observed in study groups in Una. Disease threats were modeled as 3% chance of occurrence/years increasing mortality by 50%. Significant fires have occurred in Una's degraded areas. In 1993 the largest fire in the memory of Una staff burned through 1000ha (50%) in the western block degraded area. This was modeled as a 2% chance of occurring/year and reducing survival by 50% in the degraded area. This affects the overall survival in the population differently depending on what density estimates are used to calculate numbers of animals in that area.

Additionally, landless people ("Sem Terras") potentially can occupy and destroy all lion tamarin habitat in the degraded western block of Una.

L. chrysopygus:

The same rate and severity of disease applied to *L. rosalia* and *L. chrysomelas* was applied to *L. chrysopygus* (1%/years; 50% reduction in survival). Fires were considered the most significant threat and modeled at 5%/year (once every 20 years on average) with a reduction in survival of 50%.

Using the VORTEX model, we examined a number of questions and issues that were brought up by other working groups. In all cases, we modeled the population for a 100 year time period and evaluated levels of genetic diversity retained (H), observed population growth rates (r), probability of extinction (PE), average population size (N) and average level of inbreeding (F). When metapopulation scenarios were examined, we evaluated these estimates both with regard to the metapopulation as a whole as well as within each population. Each scenario was modeled with 500 simulations.

6. LEGEND FOR THE TABLES THAT FOLLOW

PS Population Structure:
Gx = a single isolated population with **x** groups of tamarins, with initially 5 animals per group and a carrying capacity of 10 animals per group
P = a single isolated population with initial numbers and carrying capacity set at N and K.
Ix = A metapopulation comprised of **x** completely isolated subpopulations.
Mx = A metapopulation comprised of **x** subpopulations, with rates of translocation as indicated for each scenario.

N Initial population size of the (meta)population

K Carrying capacity of the (meta)population

MS Migration survival: Percent of translocated animals which survive the translocation and become established in the new population.

MR Migration rate: Maximum number of animals translocated per year. Fewer are translocated whenever the source populations are below 75% of carrying capacity.

Output statistics

PE The probability of population extinction, determined by the proportion of 500 populations of that scenario which have gone extinct in the simulations. "Extinction" is defined in the model as the lack of either sex.

NP Mean number of subpopulations surviving.

N Population size, averaged across those simulated populations which are not extinct.

H Expected heterozygosity or gene diversity; the heterozygosity expected if the population were breeding at random and in Hardy-Weinberg equilibrium. Calculated from allele frequencies. If the population does breed at random (as in the models of single, isolated populations), then the inbreeding coefficient of the next generation is expected to be $F = 1 - H$.

F The mean inbreeding coefficient of the population(s). $F = 0.25$ is equivalent to a generation of parent-offspring mating, or full-sibling mating, and would result in a decrease in juvenile survival of 40%. $F = 0.0625$ is equivalent to a mating between first cousins, and would result in a decrease in juvenile survival of 12%.

r Observed average annual intrinsic rate of increase.

9. MODEL SCENARIOS, RESULTS AND IMPLICATIONS

a. Overall Genetic And Demographic Viability of The Current Number of Lion Tamarins Under Different Levels of Threats

Problem/Issue:

Ignoring for the moment the fragmented nature of the populations, are the total sizes of lion tamarin populations sufficient to meet the overall metapopulation management goals of 98% prob. survival and 98% retention of gene diversity for 100 years? This was explored by modeling the probability of extinction and maintenance of genetic diversity (gene diversity) in populations of varying size from 5 to 1000. Since different types of threats affect different lion tamarin populations, a variety of threat levels were modeled.

Results:

Table 6a, 6b and 6c present the model results at 25, 50 and 100 years. The tables represent three increasingly severe levels of threats. Smaller populations were modeled as consisting of smaller numbers of groups, with initial sizes at half capacity. Larger populations were modeled as single large populations with initial size at capacity.

Table 6a. Single isolated populations; Disease catastrophes only: 1% probability of occurrence, causing 50% mortality

Input parameters			25 years				50 years				100 years			
PS	N	K	PE	N	H	F	PE	N	H	F	PE	N	H	F
G1	5	10	83	6	60	21	98	5	42	37	100	--	--	--
G2	10	20	42	12	71	16	81	10	58	30	99	8	45	45
G3	15	30	17	19	79	12	47	16	67	24	88	14	48	44
G4	20	40	8	28	84	8	26	25	75	19	66	20	57	36
G6	30	60	1	47	89	6	6	43	82	13	26	37	69	26
G8	40	80	0	66	92	5	3	63	87	10	9	57	77	19
G10	50	100	0	84	94	4	1	83	90	8	6	78	81	16
P	75	75	0	65	94	3	1	61	88	9	9	53	76	20
P	100	100	0	89	95	2	0	86	91	7	3	80	83	15
P	150	150	0	137	97	2	0	134	94	4	0	129	88	10
P	200	200	0	185	98	1	0	181	95	3	0	178	91	7
P	250	250	0	233	98	1	0	230	96	3	0	226	93	6
P	400	400	0	376	99	1	0	373	98	2	0	366	96	4
P	700	700	0	659	99	0	0	658	99	1	0	659	98	2
P	1000	1000	0	947	100	0	0	940	99	1	0	944	98	2

Table 6b. Disease and train accident catastrophes as estimated for Poço das Anatas Reserve: Disease (1% occurrence, 50% mortality), Trains (5% occurrence, 10% mortality), and Pesticides or Fire (2% occurrence, 10% mortality).

Input parameters			25 years				50 years				100 years			
PS	N	K	PE	N	H	F	PE	N	H	F	PE	N	H	F
G1	5	10	86	6	57	25	99	6	35	49	100	--	--	--
G2	10	20	43	11	72	15	82	10	57	31	99	7	37	53
G3	15	30	20	18	79	11	54	15	66	24	92	13	46	46
G4	20	40	13	26	83	9	34	23	74	19	76	18	57	36
G6	30	60	4	42	88	7	13	39	80	14	42	33	67	29
G8	40	80	1	63	92	5	6	61	86	10	19	52	75	21
G10	50	100	1	80	93	4	3	77	89	9	11	70	80	17
P1	75	75	0	62	93	3	2	57	87	9	16	47	75	21
P1	100	100	0	88	95	3	1	81	91	7	5	73	82	15
P1	150	150	0	133	97	2	0	128	94	5	1	122	88	10
P1	200	200	0	181	98	1	0	176	95	3	0	171	91	8
P1	250	250	0	227	98	1	0	226	96	3	0	221	93	6
P1	400	400	0	371	99	1	0	369	98	2	0	362	96	4
P1	700	700	0	650	99	0	0	651	99	1	0	644	97	2
P1	1000	1000	0	928	100	0	0	929	99	1	0	919	98	2

Table 6c. Disease and fire catastrophes as estimated for Black Lion Tamarins: Disease (1% occurrence, 50% mortality), and Fire (5% occurrence, 50% mortality).

Input Parameters			25 Years				50 Years				100 Years			
PS	N	K	PE	N	H	F	PE	N	H	F	PE	N	H	F
G1	5	10	91	5	57	28	100	--	--	--	100	--	--	--
G2	10	20	65	10	70	15	93	8	52	34	100	--	--	--
G3	15	30	46	15	76	12	83	12	62	27	99	11	49	48
G4	20	40	34	20	81	10	72	17	68	22	98	14	57	31
G6	30	60	15	32	86	7	46	27	76	16	86	19	62	30
G8	40	80	11	43	88	6	39	39	81	13	78	28	68	26
G10	50	100	7	57	90	5	25	52	83	12	64	39	73	20
P1	75	75	5	46	90	4	27	38	81	13	77	28	66	27
P1	100	100	2	64	93	3	17	53	86	9	59	42	73	21
P1	150	150	0	102	95	2	8	85	90	7	39	70	80	15
P1	200	200	1	135	96	2	5	117	92	5	27	98	84	13
P1	250	250	0	177	97	1	3	153	94	4	22	129	87	10
P1	400	400	0	283	98	1	1	246	96	3	9	216	91	7
P1	700	700	0	509	99	0	1	472	98	2	4	417	95	4
P1	1000	1000	0	720	99	0	0	668	98	1	2	626	96	3

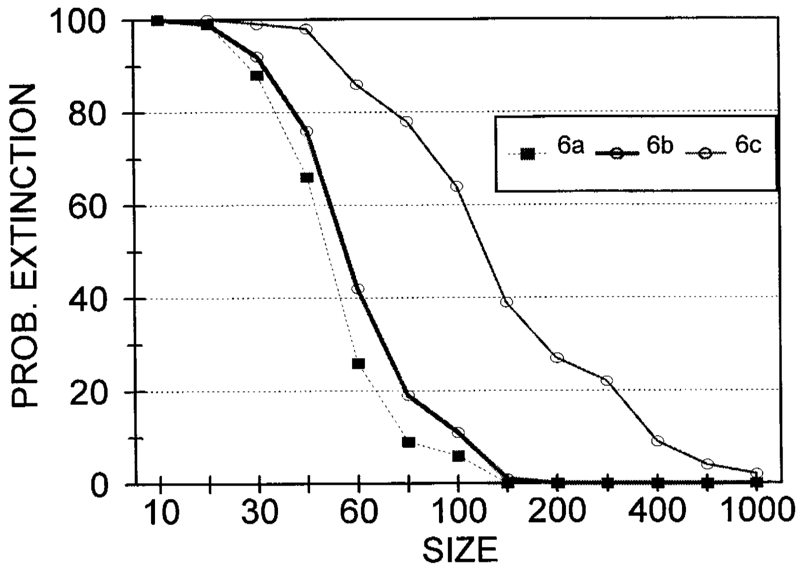


Figure 2. Prob. extinction for lion tamarin populations varying in size from 10 to 1000 under three different levels of threat. See Tables 6a, 6b, 6c.

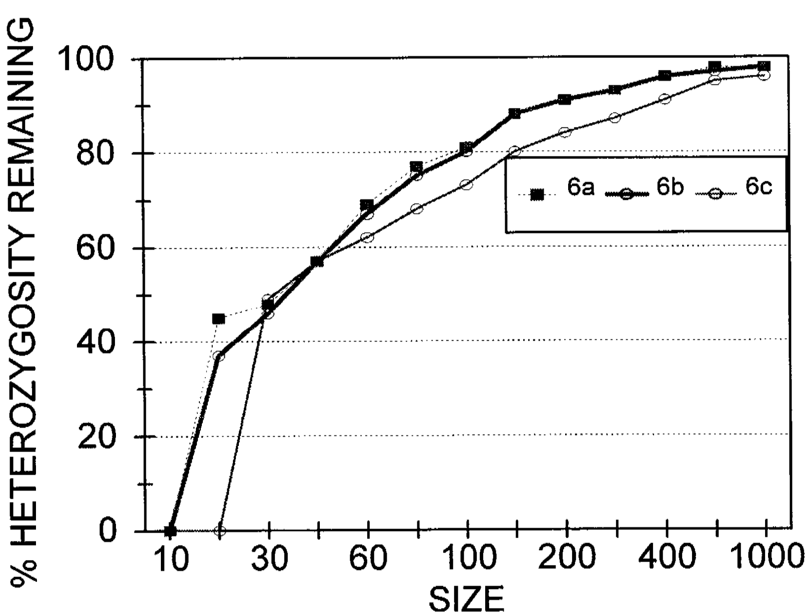


Figure 3. Percent heterozygosity remaining for populations varying in size from 10 to 1000 under the three different threat levels described in tables 6a, b, c.

Discussion:

Under the most benign threat conditions (1% chance of catastrophe affecting survival by 50%, Table 1a) only populations of size 700 or above meet the overall metapopulation objectives. While populations of size 100 or larger meet the demographic objectives, they do not meet the genetic objectives of retaining 98% gene diversity. As the levels of catastrophe increase, even the larger populations fail to meet metapopulation objectives. Under the levels of threat defined for the black lion tamarin, even a population of 1000 maintains only 96% gene diversity for 100 years. In these populations, periodic bottlenecks caused by the catastrophe (in this case fire) hamper the population's ability to retain genetic diversity.

Under the lower levels of catastrophes defined, if populations of each species were not fragmented and there were no further loss of habitat, we could marginally meet objectives defined by metapopulation management. However, this is not the case. Since fragmentation will only further increase probability of extinction and loss of genetic diversity, any degree of fragmentation or loss of habitat endangers these populations.

b. Viability of the *L. rosalia* Metapopulation

Problem/Issue:

L. rosalia are distributed among 17 fragmented populations (including the reintroduction populations) varying in size from only a few individuals to the 347 individuals in Poço das Antas Biological Reserve. We modeled a number of scenarios to gain a better understanding of the viability of these populations if not managed at all, or if managed with varying levels of intensity as a metapopulation.

We varied migration rate (MR) to reflect intensity of metapopulation management using rates of 0 (all populations isolated), 8, 16 and 24 animals per year on average. Animals used for translocation were only taken from the four populations with capacities greater than 100 and then only when the actual number of animals was within 25% of capacity. Individuals were translocated into populations only when the number of animals was less than 75% of the defined capacity of the population. Thus, while we modeled average rates of 8, 16 and 24 animals per year, these translocations only took place if needed (i.e., the source and recipient populations met the above criteria).

We also varied translocation success rate. Based on translocations to date (work by Kierulff and Oliveira), 18.5% of translocated animals either disappear from the translocation site or are lost to mortality. We therefore used 81.5% as the survival rates imposed on migrating (translocated) animals in the model. This reflects what might be expected during intensive management. We also used one-half this rate (40%) to reflect what might be expected under more relaxed management (e.g., less intensive follow up and rescue of translocated animals). These two rates are shown as MS = 40 and 81 in the following tables.

The model used two different catastrophe scenarios. Within Poço das Antas Reserve, catastrophes were: Disease (1% occurrence, 50% mortality); Trains (5% occurrence, 10% mortality); and Pesticides or Fire (2% occurrence, 10% mortality).

Under **Scenario "D"**, we used these catastrophes for Poço das Antas Reserve, but only disease catastrophes outside of the reserve.

Under **Scenario "DF"** we used the above catastrophes for the population in Poço das Antas Reserve, and disease catastrophes plus a 5% chance of 10% additional mortality due to fire or other catastrophes outside of the reserve.

Table 7. *L. rosalia* metapopulation scenarios.

Input Parameters				**25 Years**				**50 Years**				**100 Years**			
PS	Cat	MS	MR	NP	N	H	F	NP	N	H	F	NP	N	H	F
I17	D	--	0	9.9	772	99	3	8.1	730	99	6	6.1	652	98	11
M17	D	40	8	16.4	890	99	3	16.3	959	99	6	16.1	1091	98	10
			16	16.5	962	99	3	16.4	1084	99	6	16.4	1176	98	9
			24	16.4	988	99	3	16.4	1134	99	5	16.4	1144	98	8
		81	8	16.4	877	99	3	16.3	960	99	6	16.2	1083	98	10
			16	16.5	954	99	3	16.4	1091	99	6	16.4	1164	98	9
			24	16.4	982	99	3	16.4	1135	99	5	16.4	1151	98	8
I17	DF	--	0	9.6	751	99	3	7.8	702	99	6	5.6	602	97	10
M17	DF	40	8	16.4	860	99	3	16.3	926	99	6	16.1	1036	98	10
			16	16.5	941	99	3	16.4	1061	99	5	16.4	1152	98	9
			24	16.3	962	99	2	16.3	1095	99	5	16.4	1126	98	8
		81	8	16.3	857	99	3	16.2	829	99	6	16.1	1037	98	10
			16	16.5	935	99	3	16.4	1053	99	5	16.3	1130	98	9
			24	16.3	963	99	2	16.3	1086	99	5	16.4	1133	98	8

Discussion:

Without translocations (the I17 runs), many isolated populations are lost fairly soon (NP not much less than 17) and the entire metapopulation continues to decline with time. By 100 years, the overall metapopulation meets the metapopulation objectives of 98% retention of gene diversity under the lower levels of catastrophe (**D**), but fails to meet them when higher levels of catastrophes are imposed (**DF**). With translocations, almost all populations stay occupied and the metapopulation size steadily grows as those habitats which are without tamarins at the beginning of the simulations are colonized. Overall, the rates of translocation have very little effect, although the lower rate tested (about 8 animals per year) is slightly less effective than the higher rates. This might suggest that about 8/year is what is needed for ensuring stability and growth of the metapopulation as a whole. It also appears that the details of catastrophes and translocation survival have little effect on the results, at least within the range tested here.

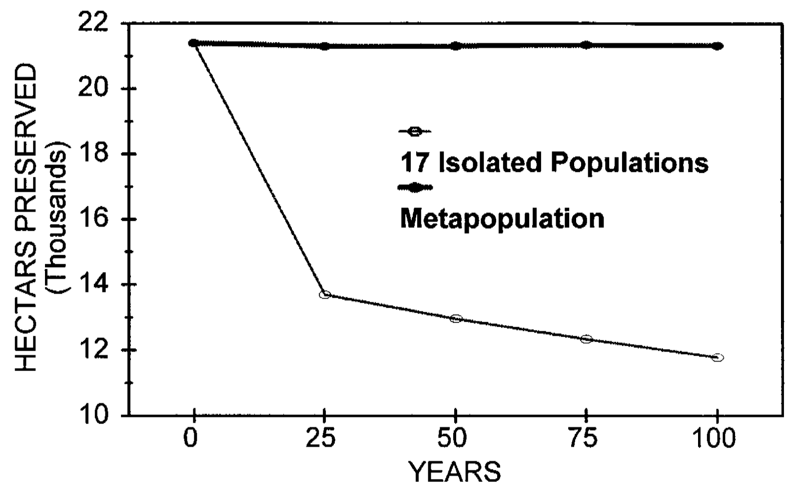


Figure 4. Total area (in thousands of hectares) occupied by *L. rosalia* under scenarios I17 (17 completely isolated populations) and M17 (all populations managed as a single metapopulation with migration survival (MS) set at 80% and migration rate (MR) set at 24. Areas were calculated as weighted sum of areas occupied where weights are probability of population surviving at 25, 50, 75 and 100 years.

c. Viability of *L. chrysomelas* Population in Una Biological Reserve

Problem/Issue:

We modeled the viability of the *L. chrysomelas* population in and around the Una Biological Reserve under a variety of assumptions.

Scenario A: Viability test of the population in Maruim and Piedade (assuming no degradation).This gives a total population of 294, capacity is also assumed to be 294. Catastrophes include 3% probability of disease, causing 50% increase in mortality; plus 2% probability of fire causing 50% increase in mortality in degraded area (causing 18% mortality).

Scenario B: Same as above except assuming Piedade is 100% degraded, giving a total N and capacity of 324. Catastrophes the same as in A, but since 43% of population is in degraded forest and subject to 50% loss during a fire catastrophe, this catastrophe is modeled as having an overall mortality of 21%.

Scenario C: Total population within the 7,763 ha originally defined as Una assuming Piedade is degraded. This gives a total population and capacity of 465. Catastrophes as in A, with 49% of the forest degraded and subject to 50% loss during a fire catastrophe. Modeled as having an overall mortality of 25%.

Scenario D: What is the viability of the population if all tamarins were lost from areas outside the existing reserve and in the degraded habitats within the reserve? This leaves tamarins only in the 3910 ha of Maruim and the area purchased in 90/93, with a population and capacity of 208. Fire catastrophes are not included.

Table 8. GHLT scenarios A-D

Input Parameters				25 Years				50 Years				100 Years			
	PS	N	K	PE	N	H	F	PE	N	H	F	PE	N	H	F
A	P1	294	294	0	274	99	1	0	276	98	2	0	276	95	4
B		324	324	0	306	99	1	0	303	98	2	0	304	96	4
C		465	465	0	439	99	0	0	439	99	1	0	434	97	2
D		208	208	0	198	98	1	0	195	96	3	0	195	93	6

Discussion:

In all cases, the population appears to be demographically viable. Even the population of 208 GHLTs restricted to the non-degraded habitat had no extinctions over the 100 years. Genetically, however, none of the scenarios meet the metapopulation objectives of 98% gene diversity retained over 100 years. The population of 465 individuals almost meets this objective. These results illustrate the importance of including *at a minimum* the entire 11,400 ha area in and around Una for the conservation of *L. chrysomelas*.

d. Viability of the *L. chrysopygus* Metapopulation

Problem/Issue:

L. chrysopygus are currently distributed among 7 populations ranging in size from 4 to 820 individuals. Five of these populations (Duratex, Ponte Branca, Santa Maria, Iucano/Dozanella and Mosquito Fazenda) were recently established through translocations and the populations have not yet expanded to fill carrying capacity.

There exists another 32 forest patches varying in size from about 100 ha to 2700 ha, which could hold groups of tamarins (Table 5). These populations could potentially become part of the managed metapopulation through translocations. We therefore modeled the following scenarios:

I7 = The seven existing populations in isolation (no managed translocations or recolonizations of patches that go extinct) starting with current numbers of individuals and allowing the model to expand the population to the areas' capacities.

M7 = The seven existing populations managed as a metapopulation with varying rates of translocations and two different survival rates for translocated animals. The rates used were the same as was used for the *L. rosalia* metapopulation models above (8, 16, 24 individuals/year translocated; 81% and 40% survival rates of translocated animals).

M25= A metapopulation management plan which includes the seven existing populations, and any habitat with capacity greater than 10 individuals (for a total of 25 populations).

Currently unoccupied habitat could be colonized through translocations. Translocation and translocation survival rates as above.

M39= Includes all existing and potential populations for a total of 39 populations.

As in the *L. rosalia* model, animals used for translocation were only taken from the two populations with capacities greater than 100 and then only when the actual number of animals was within 25% of capacity. Individuals were translocated into populations only when the number of animals was less than 75% of the defined capacity of the population.

Catastrophes used in this model included a 1% chance of disease causing 50% mortality, and for fire, a 5% occurrence increasing mortality by 50%.

Results:

Table 9. *L. chrysopygus* metapopulation scenarios

Input Parameters			**25 Years**				**50 Years**				**100 Years**			
PS	MS	MR	NP	N	H	F	NP	N	H	F	NP	N	H	F
I7	--	0	3.6	699	99	1	2.2	636	98	2	1.5	535	96	4
M7	40	8	5.4	757	99	1	5.1	679	98	3	4.1	570	96	6
		16	6.1	787	99	1	6.0	734	99	3	5.4	632	96	6
		24	6.2	776	99	1	6.2	726	99	3	5.5	630	96	6
	81	8	6.5	789	99	1	6.2	737	99	3	5.5	658	96	5
		16	6.7	824	99	1	6.6	744	99	3	6.1	688	97	5
		24	6.7	838	99	1	6.6	756	99	2	6.2	677	96	5
M25	40	8	6.7	720	99	1	5.6	653	98	3	4.4	569	96	5
		16	8.9	779	99	1	8.5	716	98	3	7.2	597	96	6
		24	10.1	804	99	1	10.2	754	99	3	8.8	640	96	6
	81	8	11.7	786	99	2	10.8	709	98	3	9.0	630	96	6
		16	15.5	856	99	2	15.8	846	99	4	13.7	736	96	7
		24	18.0	937	99	2	18.1	936	99	4	16.0	831	96	7
M39	40	8	6.7	722	99	1	5.4	653	98	3	3.9	564	96	5
		16	9.4	760	99	2	8.5	683	98	3	7.0	587	96	6
		24	11.4	787	99	2	11.0	751	99	3	9.0	632	96	6
	81	8	11.3	763	99	2	9.8	669	98	3	7.9	587	96	5
		16	15.9	821	99	2	15.1	749	98	4	12.1	631	96	6
		24	18.1	856	99	2	16.9	787	98	4	15.2	708	96	7

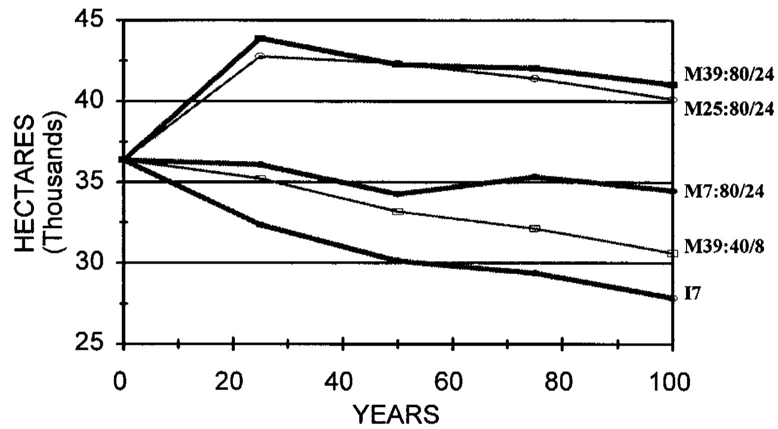


Figure 5. Total area (in thousands of hectares) occupied by *L. chrysopygus* under scenarios I7, M7, M25 and M39. Area calculated as in figure 3.

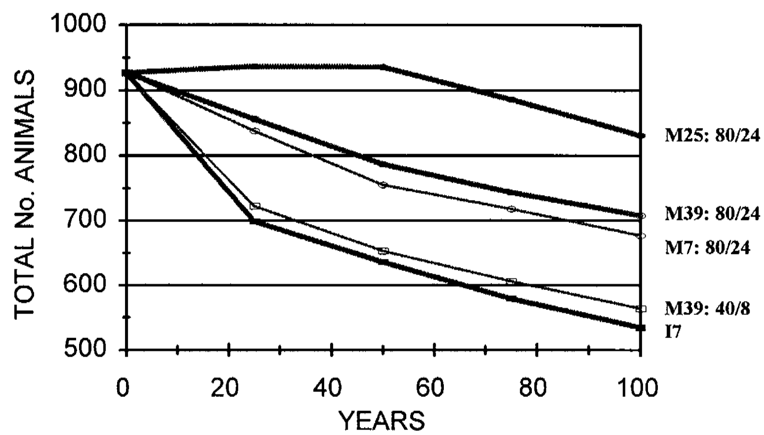


Figure 6. Numbers of L. chrysopygus remaining over 100 years under five different management scenarios.

Discussion:

As isolated populations without metapopulation management (I7), the system fails to meet metapopulation objectives (98% survival, 98% gene diversity). Only 96% gene diversity is retained and extinction is 1.7% (not shown in table). Note also that although there are 7 populations initially, on the average fewer than 2 survive (NP) and even within 25 years, over three populations, on average, are lost.

Managing the seven existing populations as a metapopulation keeps almost all patches inhabited under the higher rates of translocation (scenario M7, MS=80, MR=16 or 24) with the higher success rate. However, the metapopulation still fails to meet the overall genetic metapopulation objectives. Increasing the number of populations does little to change this. The differences between the 25 population metapopulation and the 39 population metapopulation are very minor (figure 5) and neither meet the genetic metapopulation goals of 98% retention over 100 years (Table 9). Under both these scenarios, and even under the highest translocation rate, only 15-16 of the populations remain inhabited at 100 years

Figure 6 shows the total number of animals remaining in the population over 100 years in the metapopulation under five of the scenarios. An interesting result is that more animals remain over time when only 25 populations are managed as a metapopulation compared to when all 39 populations are included in the metapopulation. This reflects the cost of maintaining these additional 14 small populations. The smaller populations are continuously going extinct and being recolonized by the larger populations, causing a drain on the larger populations. This causes a decline in the total number of animals in the metapopulation. The benefits of managing a metapopulation of 39 populations in terms of the additional area preserved (figure 5) are accomplished only through the loss of animals needed to keep these forest fragments inhabited.

These results suggest that inclusion of the numerous small patches in the metapopulation management plan will likely have little effect on increasing the overall genetic viability of the *L. chrysopygus* metapopulation and in fact may cause an overall decline in the number of *L. chrysopygus*. The priority should be on the larger forest patches.

e. Current viability of the reintroduced *l. rosalia* population without further reintroductions or management.

Problem/Issue:

The Metapopulation Management Group discussed the need to evaluate periodically the status of reintroduction and translocation programs. To address this issue partially, we asked the following question: Without any further reintroductions or management, is the current reintroduced population of *L. rosalia* sufficiently genetically diverse and demographically capable of expanding to fill its estimated carrying capacity and remain viable over a 100 year period? This question was examined by modeling the six separate populations of reintroduced tamarins assuming that there would be no further addition of animals to these populations through reintroduction or any further management (i.e., no recolonization through translocation of populations that go extinct). The populations were allowed to grow to capacity at a rate determined from the life-history parameters defined above. The model was run under two levels of catastrophes. Scenarios in Table 10a include were based on disease catastrophes only; 1% probability of occurrence, causing 50% mortality. Table 10b included catastrophes as estimated for *L. rosalia* in Poço das Antas Reserve: disease (1% occurrence, 50% mortality), threats from trains (5% occurrence, 10% mortality), and pesticides or fire (2% occurrence, 10% mortality).

Results:

Table 10a. Model results examining viability of reintroduced *L. rosalia* populations and the overall (total) reintroduced metapopulation if there were no further reintroductions nor management (i.e., no further translocations between populations). Results are at year 100. Disease catastrophes only; 1% probability of occurrence, causing 50% mortality.

Area/Population	Input			Results at 100 Years				
	PS	N	K	PE	N	H	F	r
Rio Vermelho	P	40	59	4	56	76	21	.085
Afetiva	P	3	6	100	0	---	---	---
Santa Helena	P	25	25	22	19	52	43	.052
Bon Retiro	P	4	50	72	42	55	42	.037
Iguape	P	115	115	0	111	87	12	.104
Poço das Antas Group	P	11	11	97	7	29	63	.020
Total Metapopulation				0	194	93	19	.093

(from file REINT5a.out)

Table 10b. Same as Table 10a but includes catastrophes as estimated for *L. rosalia* in Poço das Antas Reserve: disease (1% occurrence, 50% mortality), trains (5% occurrence, 10% mortality), and pesticides or fire (2% occurrence, 10% mortality).

Area/Population	Input			Results at 100 Years				
	PS	N	K	PE	N	H	F	r
Rio Vermelho	P	40	59	2	54	75	23	.079
Afetiva	P	3	6	100	0	---	---	---
Santa Helena	P	25	25	29	18	51	43	.043
Bon Retiro	P	4	50	75	41	55	42	.031
Iguape	P	115	115	0	111	87	12	.096
Poço das Antas Group	P	11	11	98	6	28	65	.071
Total Metapopulation				0	188	93	18	.086

(from file REINT5b.out)

Discussion:

The results for the two levels of catastrophes were similar. Only the two largest populations (Rio Vermelho and Iguape) had high probabilities of surviving for 100 years (Table

10a). However, these were still likely to become quite inbred and lose substantial levels of genetic diversity over this time period. While their life-history seems to provide them with the demographic potential for long-term survival (see the r values in these tables), the limits to these population sizes restrains their ability to maintain high levels of genetic variability. While the level of gene diversity retained in the metapopulation overall is as much as 93%, each population is becoming quite inbred (F values on the average approaching 20%). Overall, although the reintroduction population has a high probability of surviving if left on its own at this point, inbreeding will be high over the long term.

f. Viability of *L. rosalia* reintroduced populations under continued management but no further reintroductions

Problem/Issue:

The previous model simulations indicated that if the current populations were left as they are, the overall metapopulation is likely to survive for 100 years, but they will become inbred and lose genetic diversity. In this simulation, we examine the survival and gene diversity in a population of 200 tamarins with a carrying capacity of 255. This represents the total N and total capacity of all reintroduction populations combined, and reflects the maximum effect of intensive management: high rates of translocation and recolonization would act to merge the populations into one genetic and demographic unit. This population was modeled under two threat levels: A) 1% probability of occurrence, causing 50% mortality; and B) catastrophes as estimated for *L. rosalia* in Poço das Antas Reserve: disease (1% occurrence, 50% mortality), trains (5% occurrence, 10% mortality), and pesticides or fire (2% occurrence, 10% mortality).

Results:

Table 11. Model results examining viability of reintroduced populations and overall (total) metapopulation if there were intensive management but no further reintroductions. Results are at year 100. Lower threat level: Disease catastrophes only; 1% probability of occurrence, causing 50% mortality. Higher threat level: disease (1% occurrence, 50% mortality), trains (5% occurrence, 10% mortality), and pesticides or fire (2% occurrence, 10% mortality).

Threat Level	PS	N	K	PE	H	F	N	r
Lower	P1	200	255	0	94	5	251	.113
Higher	P1	200	255	0	94	6	247	.100

(from file REINT6.out & REINT6a.out)

Discussion:

Probability of extinction remains extremely low, as expected, and inbreeding has dropped from almost 20% to about 5%. The two different threat levels show similar results.

g. Effect of additional reintroductions on level of gene diversity in the *l. rosalia* reintroduced populations

Problem/Issue:

With no further reintroductions and intensive management at a level sufficient to cause the reintroduced populations to perform demographically and genetically as one large population, levels of inbreeding still accumulate in the population (Table 11). What affect would further reintroductions have on reducing the accumulation of inbreeding?

VORTEX models reintroduction by supplementing a population with unrelated (i.e., founder) individuals. A complication in modeling reintroduction in *L. rosalia* using VORTEX is that the source of reintroduced animals (the captive population) is genetically related to the reintroduced population. We should therefore not model the introduction of new, unrelated animals, but must take into consideration the level of relatedness between these two populations. Over the last several years, the reintroduction program has reintroduced about 6 individuals/year. Pedigree analysis of the captive and reintroduced populations indicates that the reintroduction of the next 6 "best" captive individuals (those 6 individuals that would increase the level of gene diversity in the reintroduction population the most), increases the founder genome equivalents (fge) of the reintroduced population by only 0.20. On the other hand, reintroducing 6 purely unrelated founders to the reintroduced population increases the fge by 0.67. Thus, reintroduction of captive animals is only 30% as effective as reintroducing wild, unrelated animals. To model the genetic effects of further reintroductions from the captive population using VORTEX, we modeled the reintroduction of 1/3 the number of animals reintroduced to reflect this difference. For example, to model the genetic effects of 6 reintroduced animals, we actually only supplemented the population with 2 unrelated individuals.

We examined the following scenarios. A) reintroduction of 6 individuals each year for the next 5 years; B) reintroduction of 6 individuals/year for the next 10 years; C) reintroduce 6 individuals per year for the next 30 years; and D) translocate 6 unrelated individuals into the reintroduced population each year for the next 30 years. These were run on a population of 200 animals with a K of 255, again reflecting an intensely managed population.

Results:

Table 12. Effect of further reintroduction on levels of gene diversity in the reintroduced population of *L. rosalia.*

Reintro Level	PS	N	K	PE	H	F	N	r
A) 6 next 5 years	P1	200	255	0	94	6	251	.113
B) 6 next 10 years	P1	200	255	0	94	6	250	.114
C) 6 next 30 years	P1	200	255	0	94	5	250	.117
D) 6 unrelated next 30 years	P1	200	255	0	94	5	251	.121

(from file REINT7.OUT through REINT10.OUT)

Discussion:

Addition of even 6 unrelated animals each year for the next 30 years is insufficient to reduce inbreeding below about 5 to 6%. Clearly, reducing the level of inbreeding any further will require substantial genetic supplementation.

WORKING GROUP SUMMARY

1) Overall, for each of the taxa (except *L. caissara*, for which we have no data), if populations were not fragmented and there were no further loss of habitat, they would marginally meet objectives defined by metapopulation management plan (98% chance of survival and 98% maintenance of gene diversity for 100 years). However, this is not the case, and therefore any degree of fragmentation or loss of habitat endangers these populations.

2) Effects of fragmentation can be reduced by movement of animals between populations. However, there needs to be enough movement to ensure that small populations contribute to overall metapopulation viability.

REFERENCES

Alger, K., and M. Araujo. In prep. Remanescentes florestais na região da Reserva Biologica de Una: priorizando conservação usando um sistema de informação geografica.

Dietz, J. M.; S. N. Sousa, and R. Billerbeck. 1996. Population dynamics of golden-headed lion tamarins *Leontopithecus chrysomelas* in Una reserve. Dodo, J. Wildl. Preserv. Trust 32:115-122.

Gilpin, M. E., and M. E. Soulé. 1986. Minimum viable populations: processes of species extinction. Pages 19-34 in Soulé, M. E., Conservation Biology: The Science of Scarcity and Diversity. Sinauer Assoc., Sunderland, Mass.

ISIS. 1997. SPARKS (Single Species Animal Record Keeping System). International Species Information System, Apple Valley, MN.

Kierulff, M. C. M., and P. P. Oliveira. 1996. Re-assessing the status of conservation of the golden lion tamarin *Leontopithecus rosalia* in the wild. Dodo, J. Wildl. Preserv. Trust 32: 89-115

Lacy, R. C. 1993. VORTEX: A computer simulation model for population viability analysis. Wildlife Research 20:45-65.

Lindenmayer, D.B., M.A. Burgman, H.R. Akcakaya, R.C. Lacy, and H.P. Possingham. 1995. A review of the generic computer programs ALEX, RAMAS/space and VORTEX for modeling the viability of wildlife populations. Ecological Modeling 82:161-174.

Lorini, M. L., and V. G. Persson. 1994. Status of field research on *Leontopithecus caissara*: the black-faced lion tamarin project. Neotropical Primates 2 (suppl):52-55.

Pinto, L. P., and A. B. Rylands. In Press, 1997. Geographic distribution of the golden-headed lion tamarin, *Leontopithecus chrysomelas*: implications for its management and conservation. Folia Primatologica

Shaffer, M. L. 1981. Minimum population sizes for species conservation. BioScience 31:131-134.

Valladares-Padua, C., and L. Cullen. 1994. Distribution, abundance and minimum viable metapopulation of the black lion tamarin *Leontopithecus* chrysopygus. Dodo, J. Wildl. Preserv. Trust 30:80-8.

LEONTOPITHECUS II

The Second
Population and Habitat Viability Assessment
for Lion Tamarins
(Leontopithecus)

Belo Horizonte, Brazil
20-22 May 1997

Final Report
May 1998

Edited by
Jonathan D. Ballou, Robert C. Lacy, Devra Kleiman, Anthony Rylands and Susie Ellis

Section 6

Infrastructure and Funding Working Group Report

THE INFRASTRUCTURE, FUNDING AND EVALUATION OF LION TAMARIN CONSERVATION EFFORTS

Denise Rambaldi and Devra Kleiman

There is a consensus that fund raising strategies are crucial to maintain and improve the infrastructure of all groups working towards the conservation of the genus *Leontopithecus* and its habitat, the Atlantic Forest (Mata Atlantica). Another problem is the lack of funds in Brazil to support research. Most funding agencies set priorities within the Amazon Forest rather than the Atlantic Forest. Groups working with the tamarins should pressure these funding agencies to include the Atlantic Forest as high priority. Suggestions for actions on these issues are described below:

1. RESEARCH AND CONSERVATION INFRASTRUCTURE FUNDING

1) The zoos using lion tamarins as flagship species should "pay" or invest in the Lion Tamarins of Brazil Fund to support the field activities, based on priorities in Brazil. The connection between zoos and Brazilian organizations should be tighter through periodical reports about what is occurring with wild tamarins and their habitats.

2) The group could jointly lobby research funding organizations such as CNPq (National Council of Research) and the state organizations with the same goals, to increase their support for research on lion tamarins and their habitat. Other sources that support research include Fundação O Boticário de Proteção à Natureza for small projects up to US $15,000. The recently created FUNBIO - Fundo Brasileiro para a Biodiversidade supports projects in a range over US $100,000.

3) There are agencies supporting large projects with considerable resources. To optimize efforts and increase the possibilities of receiving support from these agencies, the four groups working on tamarins should develop joint proposals involving research, education and institutional support.

4) The four groups working with lion tamarins could collaborate in the creation of marketable items and the development of a distribution network for such products in (and outside) Brazil.

5) Participants from the four species' Committees could create a subgroup to approach large companies and potential donors within and outside Brazil, taking care to avoid companies whose reputation could compromise the credibility of the *Leontopithecus* conservation efforts.

2. METHODS TO MEASURE CONSERVATION IMPACT

There is a lack of methodology to estimate and measure the impact of socio-economic, legislative, and educational activities on the conservation of the lion tamarins and their habitats.

We recommend that the CBSG and other conservation organizations begin to develop techniques to evaluate and compare jointly the impact of biological and non-biological activities so that non-biological activities are completely incorporated into current methodologies.

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Section 7

Updates on Lion Tamarin Captive Breeding Program

Golden Lion Tamarin Captive Breeding Program

1996 Annual Report to the Golden Lion Tamarin International Cooperative Research and Management Committee

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&
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Introduction

The global captive population of golden lion tamarins is managed as a single population with one set of overall genetic and demographic goals. The management of the captive population is overseen by the International Cooperative Research and Management Committee, established in 1981, and administered by the Studbook Keeper. A of 1990, the government of Brazil also gave the Committee jurisdiction over the management of the wild populations of golden lion tamarins. The Committee established policy for the management of both the wild and captive populations, provides advice to the government of Brazil (the Brazilian Institute for the Environment and Renewable resources, IBAMA), and reviews all research proposals relative to these populations. The Committee also reviews applications form institutions wishing to obtain golden lion tamarins as part of the captive breeding program.

Status of the Captive Population

The following table summarizes that status of the captive population as of 31 December, 1995:

No. Living Animals	485
% Growth Rate Since 1994	0.0%
No. Participating Institutions	143
No. Founders	44
No. Living Founders	7
No. Founder Genome Equivalents	13.87
% Expected Heterozygosity Retained	96.4%
Average Mean Kinship	0.0360

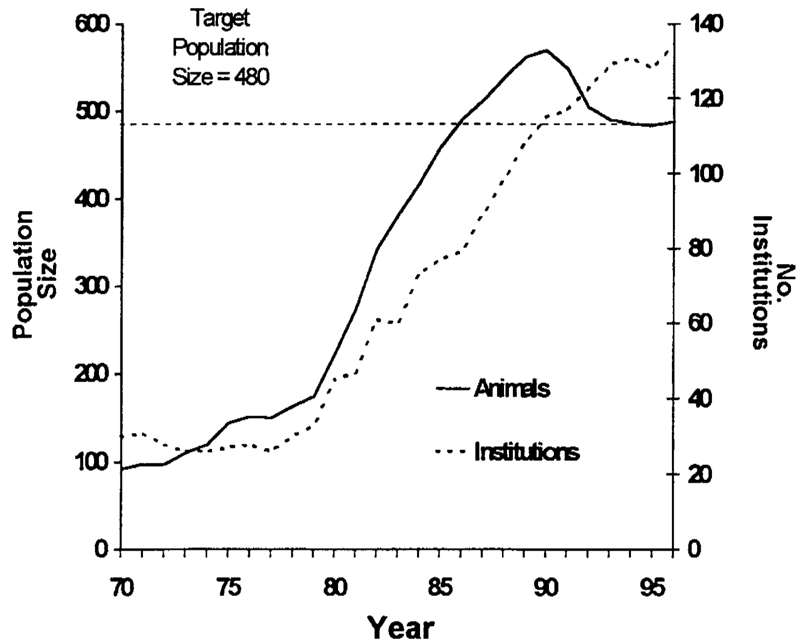
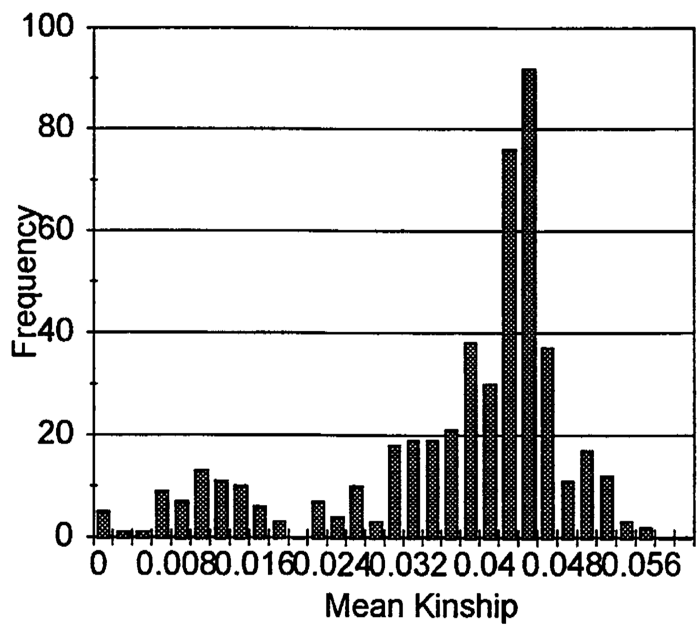


Figure 1 shows the growth of the captive population in terms of number of animals and number of institutions since 1970. The demographic objectives outlined in the 1995 Masterplan state that the population should remain at about 470-480 animals to retain 90% of the gene diversity for 100 years. The population is now being managed for zero population growth, with annual production slightly in excess of that to supply animals for the reintroduction program.

In golden lion tamarins, determination of which animals are to breed, and with whom is determined by kinship values. Kinship values measure the genetic value of individuals relative to gene diversity taking into consideration the age structure and reproductive potential of the living members of the population. Low kinship values are more valuable. The distribution of kinship values of the captive population is show in Figure 2. The animals in the left side of the distribution are valuable animals primarily in Brazil.



The management and distribution of the captive golden lion tamarin population is administered by an internationally elected Management Committee. Zoos holding golden lion tamarins are asked to sign and adhere to the Cooperative Research and Management Agreement, a series of management protocols developed by the committee. Zoos wishing to join the Conservation Program as holders of breeding or non-breeding golden lion tamarins must sign the Agreement and be approved by the Management Committee. The golden lion tamarin is also a designated species in the Species Survival Plan (SSP) program of the American Zoo and Aquarium Association (AZA).

1995-1996 Activities

Publication of the 1995 International Studbook

The International Studbook for Golden Lion Tamarins is a chronology of the captive population of golden lion tamarins (*Leontopithecus rosalia*), beginning with animals living as of January 1, 1960. The current studbook database lists information on 2736 individual tamarins.

The Studbook includes information on animal identities and locations, sex, parentage, ownership, and genetic relationships. In addition, data are presented on juveniles' parental care experience, proven breeders, hand rearing, and evidence for diaphragmatic hernias or other medical conditions. Information (unpublished) concerning causes of death is maintained by the Studbook Keeper.

Information for the Studbook is collected at the beginning of each year by sending Update Requests to all participating zoos (all institutions known to hold golden lion tamarins are included in the Studbook). For the 1995 Studbook, we received responses from all 143 zoos except the following: ZooParc de Beauval, France; Perth Zoological Gardens, Australia; Rio de Janeiro Zoological Gardens, Brazil; Riyadh Zoological Gardens, Saudi Arabia; Szegedi Vadaspark, Hungary; and Twycross Zoo, England,

The 1995 International Studbook contains:

a) a list of all specimens, alive on 31 December 1995, sorted by holding institution;
b) a list of all births which occurred during 1995;
c) a list of all deaths which occurred during 1995; and
d) a list of all transactions which occurred during 1995.

Other reports available through the Studbook Keeper include the Husbandry Protocol for golden lion tamarins (in English and Portuguese) and a lion tamarin bibliography. . Additional information on the captive population or the Golden Lion Tamarin Conservation Program can be obtained by contacting the Studbook Keeper directly:

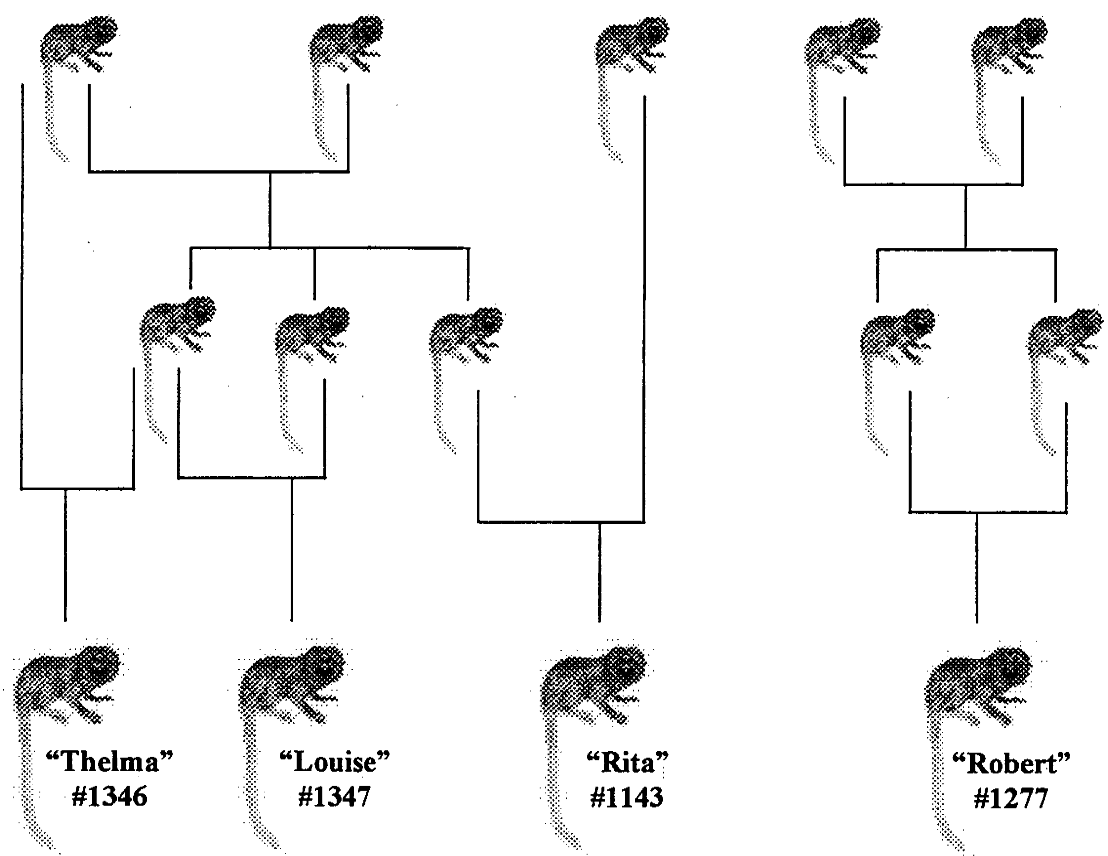
Construction of the Official Golden Lion Tamarin Conservation Program World Wide Web Page

Abigail Sherr has constructed the first Official Golden Lion Tamarin Conservation Program World Wide Web Page. We have used the National Zoo's server to host the Page. It contains information on the various aspects of the GLT Conservation Program including captive breeding, reintroduction, conservation education, ecology and behavioral studies of the wild population, reforestation. Some nice GLT pictures are included, and Abigail is now in the process of adding a *Leontopithecus* bibliography. Check out the new Page at: **http://www.si.edu/glt**

Smithsonian Institution's Folklife Festival

In August, 1996, we participated in the Smithsonian Institution's annual Folklife Festival. This year there was an exhibit on Research at the Smithsonian, and we set up a booth on the Science of Population Management. We used golden lion tamarins as a way to describe how captive breeding programs make breeding decisions based on pedigrees. We presented the visitors with a simple pedigree of golden lion tamarins and challenged them to identify the genetically most valuable animal in the pedigree if our objective was to retain genetic diversity. The exhibit worked very well and we intend to use it in other similar exhibits (including one on Research here at the National Zoo).

Take a look at the pedigree. The living animals are those at the bottom with names and numbers - **Can you find the genetically most valuable animal?** .



Answer: Robert, then Rita.

Status of the GHLT Captive Population
Jan 1, 1997

Kristin Leus, Studbook Keeper
Royal Zool. Society of Antwerp

Region	Size	#Institutions
Europe	117.105.8 (230)	42
N.America	62.42.0 (104)	25
Brazil	103.96.47 (246)	12
Asia	24.20.4 (48)	5
Total	306.263.59 (628)	84

The drop in the number of Brazilian animals compared to 1995 is mainly due to the confiscation of the Leocan animals by the police in May after which their whereabouts are unknown --> lost to follow up.

Growth of the Captive Population over the Last 11 years

Year	Total Population	Europe	N. America	Brazil
1996	303.259.57 (619)	117.105.8 (230)	62.42.0 (104)	100.92.45 (237)
1995	314.273.46 (633)	122.103.2 (227)	59.41.0 (100)	110.112.40 (262)
1994	306.265.34 (605)	127.103.2 (232)	59.41.0 (100)	99.103.32 (234)
1993	291.253.28 (572)	119.93.0 (212)	57.42.0 (99)	96.100.28 (224)
1992	269.216.22 (507)	101.71.0 (172)	57.42.0 (99)	95.89.22 (206)
1991	241.206.25 (472)	85.64.0 (149)	57.42.0 (99)	96.94.25 (215)
1990	185.165.28 (378)	65.52.0 (117)	53.37.0 (90)	62.72.28 (162)
1989	150.138.18 (306)	34.37.0 (71)	46.29.0 (75)	67.68.18 (153)
1988	123.117.7 (247)	22.28.0 (50)	36.23.0 (59)	63.62.7 (132)
1987	94.100.3 (197)	18.21.0 (39)	21.15.0 (36)	53.62.3 (118)
1986	79.77.1 (157)	10.13.0 (23)	14.10.0 (24)	53.53.1 (107)

THE INTERNATIONAL RECOVERY AND
MANAGEMENT COMMITTEE FOR
GOLDEN-HEADED LION TAMARIN
Leontopithecus chrysomelas

under the auspices of:
Secretary of the Environment —
Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis — IBAMA
Edict Portaria No. 1. 204 / 18.07.90

APP. 3

PROGRESS REPORT ON THE CAPTIVE POPULATION OF GOLDEN-HEADED LION TAMARINS - L.chrysomelas - May 1995.

Demographic status of the captive population

On 31 Dec 1994, the living IRMC-managed captive population of golden-headed lion tamarins consisted of 616 animals, distributed over 59 institutions in Brazil, Asia, North-America and Europe. Compared to the status on 31 Dec 1993, the population increased with seven percent. For 1994, 118 births and 79 deaths were reported. Three wildborn animals entered the program. In total, 1180 golden-headed lion tamarins are recorded in the International Studbook No.7.

Demographic control of the captive population

Management for zero population growth is recommended for the North American, the European and the Brazilian subpopulation.

At the moment, this objective is only achieved for the North American population.

In Europe the growth rate decreased significantly compared to 1993, although there was still a population increase of ten percent (24% in 1993). The slower growth is caused by a lower number of offspring produced per female, combined with a higher export rate. The lower reproductive output was achieved through the use of social and hormonal contraception, sterilization, and the forming of unisex groups.

The registered Brazilian population increased with four percent in 1994, which is also significantly less than in 1993. However, it is impossible to determine in detail the population dynamics behind this lower growthrate, because of the incomplete data (arrival dates and origin unknown in many animals).

Genetic status of the captive population

The total captive population has at least about one hundred represented founders. However, foundernumbers differ strongly between the subpopulations. Management towards a larger founderpopulation in Asia (11 repres.founders), and to a lesser

International Studbook Keeper
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extent in North-America (21 repres.founders), seems desirable. In the meantime, efforts should be continued to decrease variation in founderrepresentations within the different subpopulations.

The Brazilian registered population includes a high number of animals with unknown parentage/origin. This makes it impossible to do a reliable analysis on the genetic status of this subpopulation. Still, even the minimum values for number of founders and genetic diversity, indicate a genetically healthy subpopulation.

Regional management

The Asian subpopulation is growing and the number of participating institutions in this region will increase in the near future. Therefore, the possibility to have a regional coordinator for this region should be investigated.

In a first stage, regional management of the Brazilian population will have to concentrate on the collection of missing basic data, to make the development of detailed genetic and demographic management plans possible.

Research

* Dystocia/birth problems in golden-headed lion tamarins:

In 1994, five new cases of dystocia, causing the death of the breeding female, were reported. Dr.Vet.James Kirkwood, of the London Zoological Society, started a veterinary research project on this problem.

* Hormonal contraception:

The research project at the Antwerp University on the behavioural and physiological effects of hormonal implants, will be continued in 1994/1995, thanks to a PhD grant paid by the Royal Zoological Society of Antwerp (US $ 20,000).

* Collection of morphological data:

A data sheet for processing immobilized or dead golden-headed lion tamarins in zoos has been developed, in cooperation with Dr.J.Dietz. The objective is to collect comparable morphological data on both wild and captive animals. The data sheet will be distributed by the studbookkeeper within the next months.

Helga De Bois, International Studbookkeeper
Royal Zoological Society of Antwerp

Census Report

Restricted to: BLACK-LION-TAMARIN Studbook

Dates: As of End of date <= 31/12/1995

Taxon Name: **LEONTOPITHECUS CHRYSOPYGUS**

Year as of 31 Dec	Specimen Counts		Observed Lambda Annual	Geometric Mean
1995	53.47.7	(107)	1.18	
1994	45.42.4	(91)	1.10	1.14 (last 2 yrs)
1993	44.34.5	(83)	1.00	1.09 (last 3 yrs)
1992	44.38.1	(83)	1.09	1.09 (last 4 yrs)
1991	39.36.1	(76)	1.06	1.08 (last 5 yrs)
1990	38.33.1	(72)	1.04	1.08 (last 6 yrs)
1989	37.32.0	(69)	1.01	1.07 (last 7 yrs)
1988	38.30.0	(68)	1.17	1.08 (last 8 yrs)
1987	30.28.0	(58)	1.16	1.09 (last 9 yrs)
1986	26.24.0	(50)	1.61	1.13 (last 10 yrs)
1985	15.16.0	(31)	1.11	1.13 (last 11 yrs)
1984	15.13.0	(28)	1.12	1.13 (last 12 yrs)
1983	13.12.0	(25)	1.09	1.13 (last 13 yrs)
1982	12.11.0	(23)	0.92	1.11 (last 14 yrs)
1981	15.10.0	(25)	1.47	1.13 (last 15 yrs)
1980	9.8.0	(17)	1.06	1.13 (last 16 yrs)
1979	7.9.0	(16)	0.84	1.11 (last 17 yrs)
1978	9.10.0	(19)	0.95	1.10 (last 18 yrs)
1977	10.10.0	(20)	1.11	1.10 (last 19 yrs)
1976	9.9.0	(18)	1.29	1.11 (last 20 yrs)
1975	8.6.0	(14)	1.56	1.13 (last 21 yrs)
1974	4.5.0	(9)	1.29	1.13 (last 22 yrs)
1973	3.4.0	(7)	1.00	1.13 (last 23 yrs)

Note: Lambda values include Imports and Exports...

ZOO	Males	Females	Unknown	Total
São Paulo Zoo	12	9	6	27
Rio Primate Center	18	17	0	35
Bauru Zoo	1	1	0	2
Sorocaba Zoo	1	1	1	3
Brasilia Zoo	2	2	0	4
Jersey Zoo	9	9	0	18
Zoo Magdeburg	3	1	0	4
Krefeld Zoo	1	1	0	2
Central Park Zoo	2	2	0	4
Zoo Ft. Worth	2	2	0	4
Adelaide Zoo	2	2	0	4
TOTAL				107

Compiled by: Claudio V. Padua thru National Zoological Park, Wash. D.C.
Data current thru: 31 Dec 1995

SPARKS v1.2
17 Jan 1997

LEONTOPITHECUS II

The Second
Population and Habitat Viability Assessment
for Lion Tamarins
(Leontopithecus)

Belo Horizonte, Brazil
20-22 May 1997

Final Report
May 1998

Edited by
Jonathan D. Ballou, Robert C. Lacy, Devra Kleiman, Anthony Rylands and Susie Ellis

Section 8

Appendices

APPENDIX A: Participant List

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APPENDIX B.

Leontopithecus chrysopygus Metapopulation Management Action Plan

5/9/97 DRAFT

Prepared by C. Padua & J. Ballou

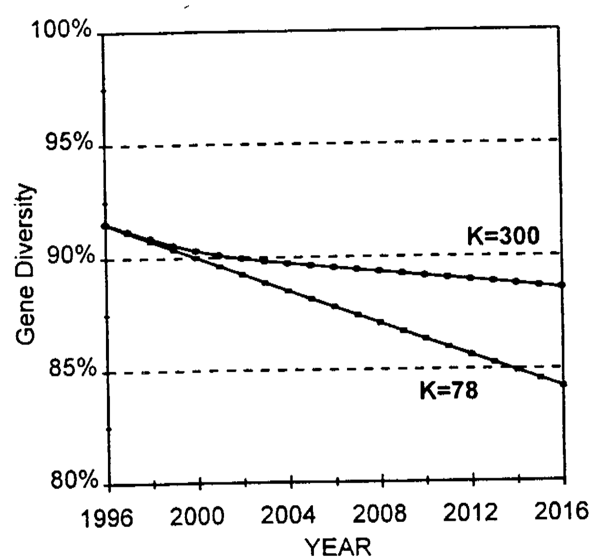
Introduction: Metapopulation Management

The black lion tamarin (BLT; *Leontopithecus chrysopygus*) is one of the most endangered primates in Brazil. The total estimated number of BLTs is approximately 950 individuals, located in seven geographically separated and isolated populations in the state of São Paulo, Brazil.(Tab 1).

Table 1. Estimated number of black lion tamarins in the wild by sub-population.

Location	Public/Private	Area	Population
Morro do Diabo	Public	34000	820
Caetetus	Public	2000	40
Duratex	Private	1600	70
Ponte Branca	Private	1200	10
Santa Maria	Private	400	4
Tucano/Rosanella	Private	2000	10
Mosquito	Private	2000	4
Total		43200	958

In addition to these seven wild populations, the captive population consists of 108 individuals in 10 zoos. Most of the animals are at the Rio de Janeiro Primate Center (CPRJ), São Paulo Zoo and Jersey Wildlife Preservation Trust. Zoos involved are in South America (4) North America (2), Europe (3), and Australia (1). Based on the 1994 studbook, the population has 92.3% of the wild population's gene diversity. This is equivalent to the amount of gene diversity "captured" by 6.5 wild-caught individuals. It is also approximately equal to an average level of relatedness of about 8% (higher than first-cousins).



The genetic goal of most captive populations is to establish a population size sufficient to retain 90% of gene diversity for 100 years without the addition of any new founders. Under this strategy the captive population retains a substantial amount of the species' total genetic variation over the long-term, regardless of what might happen to any existing wild population.

The captive BLT population as it now stands can not achieve these standard objectives because of its small size and high level of relatedness among individuals. Although over 90% gene diversity is currently retained, this will erode over a relatively short time frame if the population is kept at its current size (Figure 1). Even if the population were to grow to 300 individuals, gene diversity would still drop below 90% within 10 years. A population of about 6000 animals would be needed to retain 90% for 100 years, and even then under very optimistic population growth conditions. In summary, the captive BLT population can not be considered contributing to the conservation of BLTs under currently accepted captive breeding standards.

Ranging in size from four to 820 individuals, these eight populations (seven in the wild and the captive population) form the core of the conservation program for this species. Yet because of their fragmented nature and their generally small size, these isolated populations by themselves lack the ecological, demographic and genetic potential to ensure the survival of the species. However, interactively managing these separate populations as a metapopulation under a shared conservation goal substantially increases their conservation value. Under this strategy (the BLT Metapopulation Management Plan, for MMP) each population, including the captive population, would be routinely monitored to evaluate the overall state of viability of the total species' metapopulation. Individuals would be translocated between populations as needed to ensure the health and viability of each of the populations. In addition, as suitable habitat currently unoccupied by BLTs is identified, individuals could be translocated to these areas to increase the number and sizes of the populations in the metapopulation.

The BLT Metapopulation Management Plan should specify the goals and objectives for each population in the metapopulation and define under which conditions animals would need to be translocated between populations. The action plan proposed here addresses these conditions relative only to the captive population. This is an appropriate first step in the MMP because there is more flexibility in defining such factors as population size, number of individuals and even population location in the captive population than there is for the wild populations.

Goals and Objectives of the Captive Population: The Nucleus Population Strategy

The role of the captive population in the conservation of BLTs needs to be clearly defined. As the population currently stands, it has little value beyond simply providing exhibit animals to a small number of zoos. However, zoological institutions have shown an interest in holding BLTs, and we have the opportunity to take advantage of this to provide additional conservation security to the BLT species. The vast majority of BLTs in the wild are in the Morro de Diabo Biological Reserve. While currently secure, prudent conservation strategies dictate that additional populations be established in the case of catastrophic threats (biological or otherwise) to that population. The captive population can, if managed correctly, serve as a significant demographic and genetic reserve for the wild BLT populations. In addition, the captive population can provide public conservation education, public relations and fund raising opportunities for the BLT conservation program.

Typically, genetic and demographic goals for captive populations are developed under the assumption that the captive population should be of sufficient size, stability and genetic constitution to preserve the survival of the species if the wild population were to go extinct. Under the MMP, the responsibility of the conservation of BLTs is shared among the populations within the metapopulation. The captive population therefore need not be self-sufficient with regards to its conservation goals, but can rely on and provide genetic and demographic input to and from other members of the metapopulation. This strategy allows us to maintain a smaller captive population (150-200 individuals), which continuously retains a higher level of gene diversity (say 95%) than standard strategies call for. This has been termed the *nucleus population* strategy and is designed so that the captive population contains at any one time a fairly high proportion of the wild gene diversity so that, if needed, a fully self-sufficient captive population can be developed from the nucleus population at any time.

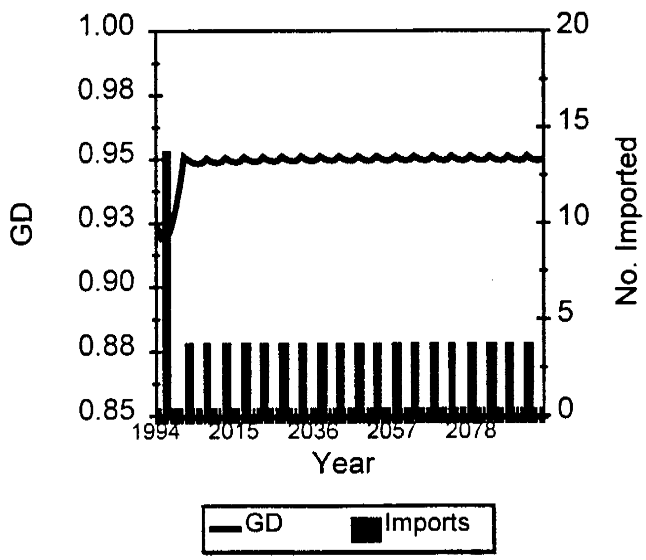
Maintaining a small population with high levels of gene diversity requires frequent gene flow into the population. The rate of gene flow required depends on how much gene diversity we wish to continuously retain in the population, the size of the population, and how frequently we move animals as well as the effects of removing animals from the wild populations.

The number of initial imports (the number of animals it takes to bring gene diversity to the target level in one generation) and the number of "maintenance" imports (the number needed to keep gene diversity at the desired level) for 98% and 95% gene diversity for different population sizes are shown in Table 2. For example, to maintain 98% of the wild population's gene diversity in a population of size 100 requires an initial import of about 60 animals and 44 imports every 5 years thereafter.

Table 2. Number of imports (initial and every 5 years) needed to maintain different levels of wild gene diversity in populations of different size.

% Gene Diversity		Population Size		
		100	**150**	**200**
98%	**Initial Imports**	59	56	56
	Every 5 Years	44	30	23
95%	**Initial Imports**	13.9	13.4	13.4
	Every 5 Years	7.3	4.9	3.7

A graphic demonstration of the K=200 strategy is shown in the figure on the left: the initial import brings the genes diversity to 95%, while the periodic imports maintains it at about 95% throughout the period.



NOTE: The results of these analysis depends heavily on the assumption that each founder will make a genetic contribution equivalent to 0.4 fge. If this is not possible, the number of founders needed to maintain levels of variation will be increased. For example, if the fge is actually 0.2, then the number of founders to maintain 95% diversity in a population of 200 is: Initial import of 27 followed by 10 every 5 years. This is almost twice as many initial imports than if fge =.4, and almost 3 times the level of periodic import. An fge of 0.4 seems to be appropriate for tamarins, although in a large population, it is more difficult to achieve a given fge than in a small population.

Based on the above estimates, we recommend that the goals of the captive population be to increase to and then continuously retain approximately **95% of the wild gene diversity** in a population size between **150 and 200 animals**, and that we try to increase the gene diversity of the captive population to 95% within the next 5 to 10 years. This will require an initial importation into the captive population of importation of 13 to 14 new founders over this period (the sooner the better), and an addition of 4 or 5 new founders every 5 years.

95% gene diversity is selected as a goal because it represents a high level of gene retention without incurring a high and continuous drain on the wild population(s). The population size of 150-200 is selected because populations much smaller than this require a significantly higher levels of genetic supplementation. In addition, there are logistical difficulties with managing a smaller population. Finding compatible mates within geographic regions is at times problematic with smaller numbers. We don't feel that it is necessary to maintain a population larger than 200 animals. To do so would occupy space required by other species (including other *Leontopithecus*). Even at 200 individuals, a large proportion of the population would consist of non-breeding individuals. We estimate that only 15 to 20 pairs (30 to 40 individuals) at any one time would be breeding. The remaining animals would be pre-reproductive, post-reproductive, or in holding waiting for a breeding opportunity.

Participating Zoological Institutions

We recommend that at least initially breeding animals be distributed among as few zoos as necessary to maximize utilization of newly imported founders. Ideally, we would like to see a few institutions commit large numbers of cage spaces for breeders (***core*** institutions), and other institutions commit to long-term holding of non-breeding animals (***participating*** institutions). As the program develops, breeding can be spread out among more zoos.

Currently holding BLTs are three zoos in Europe (Jersey, Krefeld, Magdeburg), two in the US (Central Park, Fort Worth), one in Australia (Adelaide), and four in Brazil (CPRJ, São Paulo, Bauru and Brasilia). Zoos that have been approved by the Management Committee but have not yet received animals include: Bristol, La Palmyre, Belfast, Lisbon, Rio de Janeiro and Marwell Several other zoos in Europe have shown interest in applying: Dresden, Dortmund, Berlin. Thus, there are enough zoos currently interested to expand the captive population. ***However, before the captive population is expanded, we need to define the location, characteristics, experience, level of commitment from and facilities required of the institutions participating in the program.***

Because of logistic considerations, it makes more sense to build the majority of the population in Europe, where permit and shipping constraints are less of a problem than in the US or Australia or if the population were spread out among several regions.

Experience with GLTs and GHLTs, which are maintained for zero population growth, show that the population can be managed with an average group size of about 2.8 and that about 15-20% of the population needs to be established as breeders to maintain zero population growth. Based on this experience, we estimate that about 50-55 groups of *L. chrysopygus* will be needed to maintain a population of 150 animals, with about 15 to 20 pairs set up as breeders. The remaining 30 - 35 groups would consist of non-breeding animals.

The number of zoos involved will depend on the number of groups each zoos can hold. To simplify logistics of transferring animals, it would be preferential for participating zoos to hold several groups, both breeding and non-breeding. For example, the following table shows how 15 zoos holding varying sized groups might hold the total of 55 groups needed:

# Groups/Zoo	# Zoos	Total # Groups
1	0	0
2	4	8
3	7	21
4	0	0
5	0	0
6	2	12
7	2	14
TOTAL:	15	55

This strategy uses 11 zoos to hold small number of groups and four zoos to establish major breeding colonies.

Selection of Participating Zoos

Zoos selected to participate in the program must meet the following criteria:

a. For Core institutions, available facilities for multiple breeding groups with corresponding holding facilities and a willingness to join the program on a long-term basis (minimum of 10 years);
b. Proven breeding experience with Callitrichids (preferably with other *Leontopithecus*);
c. Proven experience with other cooperative breeding programs (e.g, extensive EEP involvement);
d. Quarantine facilities suitable for importation of wild-caught primates and export of captive-bred animals to the wild;
e. For Core institutions;
f. Willingness to participate in funding or fund raising activities for BLT conservation in the wild.

***TASK**: Define minimum quarantine facilities/standards for import of wild BLTs. Montali/Cristiana Martins/Catào and Doug Pernikoff?*

All participating institutions will be required to sign a Cooperative Management Agreement similar to those that currently exist for the GLT and GHLT captive programs with the following stipulations:

a. Agree to abide by the recommendations from the studbook keeper (or "species coordinator") recognizing that the nucleus population management strategy requires frequent movement of animals, including receiving wild-caught animals and that keeping the population at 150-200 animals means strict regulation of breeding;
b. Agree to cover costs of shipping animals between institutions and to and from Brazil;
c. Agree to contribute to cover the costs of moving animals between populations in the wild.

***TASK**: Using the cooperative agreements from GLT and/or GHLTs, draft a BLT Agreement with any modifications necessary to meet the above objectives.*

Some number (2?) of elected representatives from the zoos would sit on the BLT Management Committee. Applications from zoos interesting in receiving BLTs would be reviewed by the IRMC as well as by a veterinarian experienced with quarantine needs for import and export of wild-caught primates. The BLT IRMC would continue to be responsible for developing all policy with regards to the captive and wild populations on behalf of IBAMA.

The captive population would be owned entirely by IBAMA and be managed by an International Species Coordinator, who would also maintain the International Studbook. The Coordinator would be a permanent member of the IRMC and would preferably be employed by one of the core institutions.

***TASK**: Identify 3-5 zoos in Europe with the above criteria to invite to participate in the BLT captive breeding program as core institutions and to receive initial imports. DK and JM offered to make initial contact with these zoos. Institutions which agree to participate as core institutions will be asked to have representative on the BLT IRMC*

Establishing and Supplementing the Existing Captive Population

The model presented above estimates that about 13 "unrelated" animals need to imported into the captive population within next 5 years, and about 4-5 individuals every five years after that. The actual number of periodic imports will ultimately be determined by adaptive management; periodic analysis of captive population's pedigree data (e.g., every five years) will indicate the need to import more BLTs if the level of gene diversity drops below 95%.

The initial shipment of about 13 individuals to increase the existing population's gene diversity to 95% should consist of three separate shipments consisting of 4 animals each for a total of 12 animals. Each transfer would consist of 2 pairs with animals coming from each of the three largest populations (MD, C, FRC) to minimize likelihood of collecting related animals. These 3 transfers should be done within the next 5 years.

***TASK**: Develop a captive population Masterplan to identify exactly which animals these new founders will be paired with, and at which zoos will receive these initial shipments.*

During this same 5-year time period, experiments will be conducted to test methods for transferring captive-reared animals into wild populations (reintroduction) and transferring wild born animals between wild populations (translocations). Initial experiments could focus on methods to introduce single captive animals into existing wild groups. Groups at FMo, FSR, FPB would be ideal for these studies. This work would be conducted in consultation with B. Beck and C. Kierluff based on their experience with reintroduction and translocation of GLTs.

Extended Management of the Captive Population

As the captive population expands, the growth needs to be carefully monitored and projected. Additional zoos should be enrolled to meet these demands well in advance of the growth of the population to ensure that zoos are not left holding animals in unsuitable situations (e.g., alone). Suggest that zoos apply to the BLT IRMC at least 18 months prior to the time animals are expected to be available.

The genetic goal should be to retain the maximum level of gene diversity possible using the mean kinship management strategy under the constraints of maintaining the population size between 150 and 200 individuals.

Imports of wild-caught animals will be determined on the basis of pedigree analysis every five years. If levels of gene diversity fall below 95%, the necessary number of imports needed will be determined as the number it takes to increase gene diversity to a value that over the next five years will decline to no less the 95%.

Strategies for Translocations Among Populations

More detailed modeling needs to be conducted to develop a strategy for moving animals among the multiple populations of the metapopulation. This includes transfers between the captive population and wild populations, as well as among wild populations.

What needs to be addressed:

a. Define conditions that would indicate a need for transfers. These could be based on both demographic and genetic criteria (i.e., population size or level of genetic diversity falls below some critical level). Genetic criteria can be based on theoretical, molecular, and/or physical evidence of loss of genetic variation;
b. Logistical considerations of translocations;
    b1. Behavioral issues relative to removing/adding individuals to populations;
    b2. Ecological implications;
    b3. Disease/health and quarantine concerns
c. Under what conditions would the management of the captive population change from a nucleus population strategy to a self-sufficient population objective.

***TASK**: Develop the details of a translocation strategy addressing all the above issues*
SOME HYPOTHESES:
a. Swap entire groups or place entire groups in an empty territory;
b. Take out a male from a group and introduce a male duo in its place;
c. Artificially create a pair and release after a cage experience in the translocation area.

The Costs of a BLT MMP

The costs of various components of the BLT MMP need to be estimated to provide objectives to fund raising activities. Funding considerations that need to be addressed include:

a . Metapopulation Management in the field
    a1. Periodic monitoring of all populations
    a2. Capturing animals for monitoring, research and translocation needs
    a3. Pre and post translocation monitoring
    a4. Animal shipments
    a5. Travel for annual BLT IRMC meeting
b. Captive population management needs
    b1. Studbook keeper or part/time assistant
    b2. Travel and workshop (to launch captive breeding program)

At a point soon after identifying key players in the captive breeding community, we propose a BLT Metapopulation Management Program Workshop. The purpose of the workshop is bring together all major stake-holders in the world of BLT conservation and formally initiate the BLT MMP program. At the workshop the cooperative management agreement would be finalized and presented to IBAMA, and the details of the comprehensive MMP program formalized.

TIME SCHEDULE: QUARTERLY

May 1997 Action plan draft
Start transfer monitoring program
PHVA (May)
Review and approve Action Plan

Jun 1997 DK & JM begin contacting European zoos for interest
Identify key players in captive community - add to Management Committee, get their input on action plan

Jul 1997 Prepare draft captive MMP agreement
Develop models, strategies and recommendations for MMP of wild populations

Oct 1997 Launch workshop
Captive Masterplan (identify re-location of captive animals to participating zoos, where new founders will be sent).
Sign agreements (zoos, IBAMA, studbook keeper, Committee)
Permits, funds

Jan 1998 Initial transfer of animals to zoos and transfer of captive-born back to wild

Apr 1998 Start translocation monitoring for second shipment

Jul 1998 Review and revise status of program at Committee Meetings

Oct 1998 Initiate second shipments (zoos « wild)

APPENDIX C

Symposium

The Lion Tamarins of Brazil: Twenty-Five Years of Research and Conservation

20th May 1997

Ângelo B. M. Machado - President - Fundação Biodiversitas
Ilmar Santos - Director, Fundação Biodiversitas
Devra Kleiman - National Zoological Park, Washington, D. C.
Anthony B. Rylands - Conservation International do Brasil
Célio Valle - Director - State Forestry Institute, Minas Gerais

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0830 - 0900 Welcome and Introductory Remarks

0900 - 0930 Evolution and genetics of *Leontopithecus*
Hector Seuánez (National Institute of Cancer)

0930 - 1000 Distribution and status of *Leontopithecus*
Anthony B. Rylands (Conservarion International do Brasil)

1000 - 1030 Ranging and feeding behavior of *Leontopithecus*
James M. Dietz (University of Maryland)

1030 - 1100 Coffee Break

1100 - 1130 Mating systems , demography and social organization of lion tamarins
Andrew Baker (Philadelphia Zoo)

1130 - 1200 History of lion tamarin research and conservation
Jeremy J. C. Mallinson (Jersey Wildlife Preservation Trust)

1200 - 1400 Lunch

1400 - 1430 Reintroduction of zoo-born lion tamarins - influence of variable environments on development and behavior
Benjamin Beck (National Zoological Park)

1430 - 1500 Genetic and demographic management of zoo populations
Jon Ballou (National Zoological Park)

1500 - 1530 Metapopulation Management
Claudio Valladares Padua (University of Brasília)

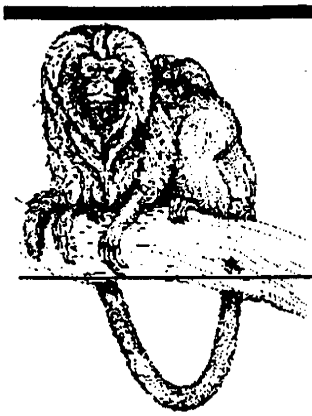
1500 - 1600 Coffee Break

1600 - 1630 Management, restoration and augmentation of protected areas
Keith Alger (Instituto Socioambiental do Sul da Bahia - IESB)

1630 - 1700 The role of NGO's in *Leontopithecus* conservation
Denise Rambaldi (Associação do Mico-Leão Dourado)

1700 - 1800 Poster Session

APPENDIX C. (MISSING!)



Tamarin Tales

Volume 1, 1997

Newsletter of the International Committees for Recovery and Management of Leontopithecus rosalia, L. chrysopygus, L. chrysomelas, and L. caissara

The Lion Tamarin Committees

The conservation and management of both the *in situ* and *ex situ* populations of the endangered lion tamarin, *Leontopithecus,* is overseen by the four International Recovery and Management Committees (IRMCs). These Committees act as official technical advisors to the Brazilian federal environmental agency IBAMA (Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis) with respect to *Leontopithecus* conservation planning. The committees promote lion tamarins as "flagship" species, the ultimate intent being the preservation of the unique Atlantic Rainforest (Mata Atlântica) ecosystem and its many endemic plants and animals. The Committees are international in composition, with members from diverse disciplines and background, including conservationists, field biologists, zoo biologists, educators, administrators, and staff from IBAMA. All directors of federal conservation units in Brazil (e.g., reserves and national parks) for a lion tamarin species are permanent voting members of the relevant IRMC. The IRMCs are more than 50% Brazilian in composition. Traditionally, there have been two co-chairs for each committee, one Brazilian and one non-Brazilian. Each of the IRMCs also has appointed technical advisors who provide information, participate in meetings, but are not voting members. Elections to IRMC membership and to the co-chair positions occur every three years.

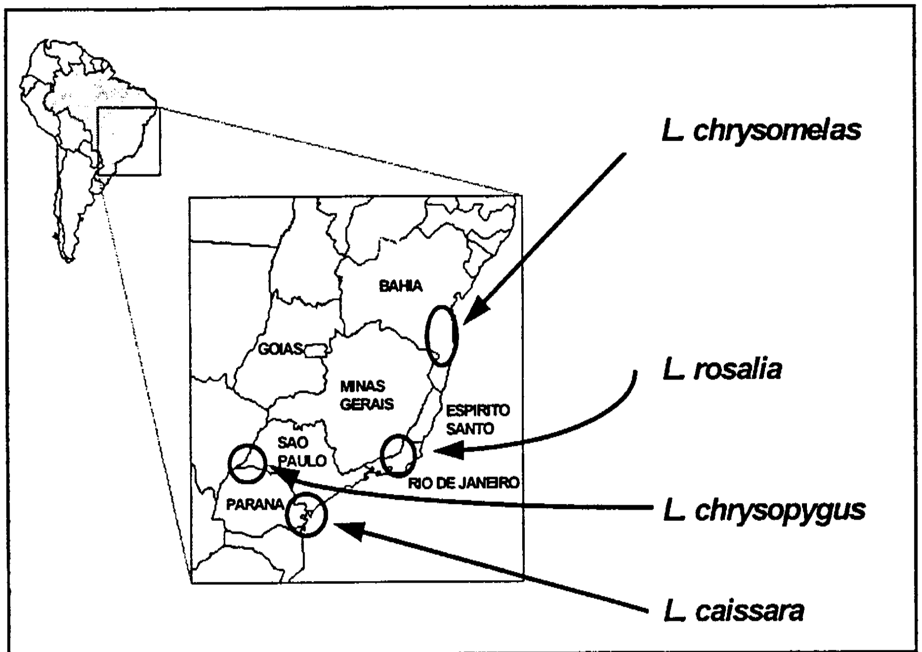
The IRMCs see their joint responsibility as metapopulation (*in situ* and *ex situ*) management for the four species. Priorities currently focus more on the need for habitat preservation and the survival of the wild populations. The ultimate purpose of the IRMCs is to direct, unify, guide and motivate individuals and teams in setting and implementing science-based objectives to turn conservation goals into policy. The IRMCs provide IBAMA with recommendations concerning:

- management of the captive populations; e.g., approval of new zoos to receive specimens, transfer of specimens between zoos for demographic and genetic management, and regional management plans (nearly 100% of the tamarins that come under the Committees' jurisdiction are the property of the Brazilian people through IBAMA);
- research proposals for both captive and wild populations;
- major new conservation initiatives that might affect the wild or captive populations (e.g., translocation, education or reforestation projects);
- community conservation education programs; and
- expansion of protected areas through land acquisition, enlargement of existing conservation units or establishment of new conservation units (e.g., national parks and reserves).

The Committees also send letters and lobby appropriate agencies to support new legislation, increase habitat protection, and eliminate threats to the viability of the habitat or species, e.g., removal of squatters. Finally, they may gather support and request outside lobbying for conservation initiatives from overseas organizations and agencies, a technique which occasionally provides momentum in resolving issues being considered by government agencies.

The benefits of this particular species recovery process include the collaborative partnerships between the Brazilian government and a multitude of donors and NGOs and the use of multi disciplinary semi-autonomous high performance teams to implement conservation activities.

Contributed by D. G. Kleiman, National Zool. Park & J. J. C. Mallinson, Jersey Wildlife Preservation Trust



THEIR CURRENT STATUS

The four species of lion tamarins inhabit the last remaining fragments of the once majestic Atlantic Rainforest on Brazil's southeastern coast. This forest, with its unique and little known flora and fauna, differs significantly from the better known Amazon forest due to its higher elevation, cooler temperatures, soil composition, and proximity to the ocean. It is the home to numerous rare and endangered species, some among the most spectacular species in the New World. This forest is also significantly more threatened than its northern counterpart. Located in the heart of Brazil's agricultural and industrial development center, the original continuous forest, once nearly 16,000 kilometers long, has been extensively fragmented. Only 2% of its original area remains. No other tropical rainforest in the world has been devastated to as great an extent. This is the home of the golden, golden-headed, black and black-faced lion tamarin, among the most endangered primates in the world.

The Golden Lion Tamarin - *L. rosalia*

The golden-lion tamarin is a small squirrel sized monkey with striking, fiery orange-gold fur. Its historical distribution included most of the Atlantic coastal rainforest northeast of city of Rio de Janeiro but has been reduced to a small fraction of its original range. Those patches that do exist consist of remnant and scattered forests within the state of Rio de Janeiro; few exceed 1000 hectares in size and fewer still contain golden lion tamarins. The number of golden lion tamarins has decreased not only as a result of declining habitat but also because, until the late 1960s, they were regularly captured for use as pets and exhibit animals in zoos. The only officially protected area containing golden lion tamarins is the Poço das Antas Biological Reserve. Established in 1973, the Reserve is located only 90 kilometers northeast of the city of Rio de Janeiro. Although totaling almost 6000 hectares in area, only about 60% of the reserve contains suitable tamarin habitat. The Reserve currently supports approximately 290 animals.

During 1991-1992, a major survey was carried out to examine the status and distribution of golden lion tamarins outside the Reserve. Using satellite images to locate remnant forests and tape-recorded playbacks of tamarin long-calls, Maria Cecília Kierulff and Paula P. de Oliveira (students from the Federal University of Minas Gerais) located 12 single and isolated groups of tamarins in very small and very degraded forest patches. These isolated groups have been incorporated into the conservation planning for golden lion tamarins and efforts are now underway to translocate tamarins from the most threatened patches to more protected areas (see translocation article below). The total wild population is now estimated at nearly 600 animals, including the reintroduced population. The stable captive population, consisting of 480 individuals in 140 zoos world-wide provides additional security for the species.

The conservation efforts for golden lion tamarins were initiated in the early 1970s by a collaborative program between the National Zoological Park, Smithsonian Institution, and the Rio de Janeiro Primate Center. The program has expanded since then to cover multiple aspects of golden lion tamarin conservation including: habitat management and restoration; vegetation analysis; studies on the ecology, genetics, behavior and natural history of wild tamarins; an international captive breeding program; reintroduction of captive-born tamarins into previously unoccupied forests; translocation of wild-born animals; and both local and international conservation education programs. The conservation priorities and objectives for this program are set forth in the Golden Lion Tamarin Conservation Program's Mission Statement, developed as a result of the 1990 Population and Viability Analysis for *Leontopithecus*. The Conservation Program is now coordinated in Brazil by the newly formed Golden Lion Tamarin Association (Associação Mico-Leão-Dourado, or AMLD) and employs nearly 30 people.

The GLT Conservation Program has received financial support from many organizations over the years, including the World Wildlife Fund, Smithsonian Institution, Jersey Wildlife Preservation Trust, Frankfurt Zoological Society, Wildlife Preservation Trust International, Lion Tamarins of Brazil Fund, National Geographic Society, and the Friends of the National Zoo. The program works in close collaboration with IBAMA's Dionizio M. Pessamilio, Director of the Poço das Antas Biological Reserve. Our program is described in more detail on the World Wide Web at: **http://www.si.edu/glt**.

Contributed by J. Ballou, National Zool. Park.

The Black Lion Tamarin - *L. chrysopygus*

Like the other lion tamarins, the black or golden-rumped lion tamarin *Leontopithecus chrysopygus* is one of the most endangered species of New World primates. Until recently, these primates were only known to inhabit two protected areas in the southwestern reaches of the state of São Paulo, Brazil (Morro do Diabo State Park, and the Caetetus Ecological Station). The species total estimated wild population size was 100 individuals.

More recent studies have provided us with more accurate information on the status of black lion tamarin. The black lion tamarin conservation biology project is coordinated by the Instituto de Pesquisas Ecológicas (IPÊ), a Brazilian NGO based in Nazaré Paulista, São Paulo. The research on black lion tamarins began in 1984 at the Morro do Diabo State Park, located in the western region of the state of São Paulo. From there, the project expanded to other areas and became one of the few long term research studies on a Brazilian endangered species. The project's expansion resulted in the increase of researchers and field assistants: from one researcher, Claudio Pádua, and one field assistant, Sr. José de Sousa, IPÊ's Project now counts on ten full time researchers and three field assistants.

Photo: Maurilo Clareto

The first years of this study furnished information about the genetics, behavior, ecology, demography, and habitat of the black lion tamarin. As a result of the more recent studies, four new sub-populations of *L. chrysopygus* were found. The density of black lion tamarins in the wild is calculated to be 3.72 individuals per km^2. Based on this density, we now estimate a metapopulation size of about 900 individuals in seven different populations varying in size from 821 (Morro do Diabo Park) to 4 animals (Ponte Braca Farm). In captivity the sub-population was only 107 (in 11 zoos) by the end of 1995. These results suggest that if treated individually, all black lion tamarin sub-populations, with the possible exception of the largest population in the Morro do Diabo State Park, have a low chance of survival.

The *L. chrysopygus* IRMC recognizes that if all sub-populations are managed as a metapopulation, which may include reintroduction, translocation, and/or managed dispersal of individuals among its sub-populations, there will be a higher probability of long-term survival of this species. We have begun to implement this strategy through the efforts of IPÊ and have been working on the following:

- A study of the potential translocation habitats for the species to verify whether the habitat is significantly similar to the habitat found in the areas occupied by other black lion tamarin sub-populations;
- Long term monitoring of a series of neighboring groups in one of the black lion tamarin's sub-population areas; and
- Translocation of one of these monitored groups to a protected and uninhabited pre-selected habitat.

Cláudio Pádua continues to coordinate the Project. Eduardo Ditt helps administer the project but each study site is coordinated by a field researcher. Patricia Medici is collecting the data on the translocated group and also on the other populations of *L. chrysopygus* inhabiting the Pontal do Paranapanema region. Marilene Silva coordinates the study of the Central region of São Paulo (at the DURATEX Farm, see article below) and Maria das Graças de Souza is the environmental educator for the Black Lion Tamarin Project and is based at the Caetetus Ecological Station.

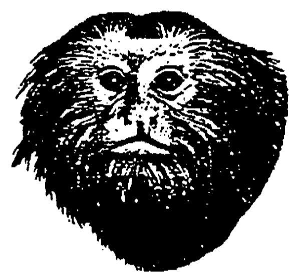
In addition to the protection and survival of black lion tamarins, IPÊ's Black Lion Tamarin Project has provided additional benefits such as:

1. **The protection of forest fragments** belonging to private landowners. Farmers' involvement in this species conservation has become crucial for the protection of these fragments in the black lion tamarin's original range. The conservation of habitat remnants has protected not only this primate, but all other species found in the same ecosystems.
2. **The training of several field professionals.** Many Brazilian university students and field assistants, as well as a few foreign students, have been trained and absorbed in this or other of IPÊ's conservation projects. Training is particularly important in Brazil, where there are few opportunities for practical experience.
3. The implementation of **conservation education programs**, organized by S. Pádua, in many areas where black lion tamarins are found. Public awareness has been a critical aspect of the conservation project for this species. Education has reached students as well as adults in many regions, making the protection of existing natural habitats more effective by building up the pride of local people in this and other regional species.

Check out the World Wide Web site "The Wild Ones" for more on the black lion tamarin conservation program: **http://www.cc.columbia.edu/cu/cerc/WildOnes**.

Contributed by C. Pádua, IPÊ.

The Golden-headed Lion Tamarin - *L. chrysomelas*



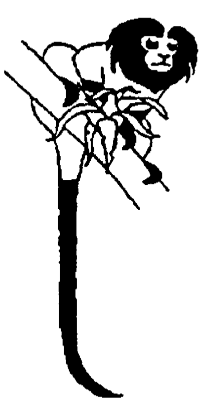
The endangered status of the golden-headed lion tamarin has been recognized since the early 1970s. Like the other lion tamarins, this species has suffered the consequences of substantial deforestation in its natural geographic range, which is in the southern part of the state of Bahia, as well as a small part of the northeastern state of Minas Gerais. However, only in the last ten years has *L. chrysomelas* been the focus of considerable attention regarding its conservation. The principal stimulus for this arose as a result of concern over the illegal export of 50-60 animals to Belgium and Japan in 1983/84. Due to this, IBAMA established the IRMC which ultimately resulted in many of the confiscated animals being returned to the ownership of Brazil. The recovery was highly successful and the IRMC established a captive breeding program and studbook for the species. The captive breeding program now consists of over 640 individuals in 73 institutions world-wide and is organized through the Antwerp Zoo (Kristin Leus, Studbook Keeper).

The natural population of *L. chrysomelas* exists primarily in the Una Biological Reserve (Saturnino de Souza, Director) located in the state of Bahia. Extensive surveys by Luiz Paulo de S. Pinto and Luciano I. Tavares (from the Federal University of Minas Gerais) between 1991 and 1993 found golden-headed lion tamarins throughout their geographic range. The geographic distribution, based on this study, was estimated at 19,462 km^2. The range consists of two distinct regions in terms of land use. Cattle ranching predominates in the western part, which has resulted in highly fragmented forest. The eastern part corresponds to the principal cocoa growing region in Brazil, where forests are intermixed with cocoa plantations. Cocoa is frequently grown under a system referred to as *cabruca*, where a small number of the forest canopy trees are left standing to provide shade. This provides marginal habitat for numerous vertebrates, including the lion tamarins.

Within the 7059 ha Una Biological Reserve, James Dietz (University of Maryland) and his students have been conducting extensive studies of tamarin behavior, ecology and life-history to try to improve our knowledge of the viability of golden-headed lion tamarins. Dietz estimates 416 individuals within Una itself. The number of tamarins outside the protected area of Una is not known, but may be as many as several thousand.

*Extracted partially from the report by L. P. de S. Pinto and L. I. Tavares in **Neotropical Primates** 2(suppl.), December, 1994 and material contributed by J. Dietz, Univ. of Maryland.*

The Black-faced Lion Tamarin - *L. caissara*



The black-faced lion tamarin was discovered in 1990 by two researchers (Maria Lúcia Lorini and Vanessa Guerra Persson) from the National Museum of the Federal University of Rio de Janeiro and the "Capão da Imbuia" Museum of Natural History. While conducting a fauna survey at the Superagüi National Park in Paraná state, Brazil, they followed up persistent rumors of the existence of a tamarin on the Island of Superagüi. The Park is one of the last remnants of Atlantic Forest in this state, for, unfortunately, very little of the original coverage is left. The discovery of a new species of primate in an ecosystem that was believed to have been carefully studied shows how little we known about Brazil's biodiversity.

Immediately after its discovery in 1990, the IRMC for this species was formed and five main conservation strategies for the species were proposed: (1) studies of the geographic distribution and population size; (2) research on the species' ecology and behavior; (3) measures for habitat protection; (4) initiation of an environmental education program; and (5) develop plans for the role of captive breeding.

Some studies have already been conducted and the results show that the area of distribution of *L. caissara* is of 300 km^2, between the Island of Superagüi and adjacent parts of the continent in the states of Paraná and São Paulo. The total population is estimated to be 260 individuals, divided in three sub-populations, of which 120 individuals inhabit Superagüi.

In 1995 a comprehensive action plan for protection and management of the species was prepared by the IRMC and delivered to the government agency IBAMA.

Funds for research/protection of *L. caissara* have been provided by the Fundação o Boticário de Proteção à Natureza, the Lion Tamarins of Brazil Fund, Jersey Wildlife Preservation Trust, Wildlife Preservation Trust International, Wildlife Preservation Trust Canada, Brazilian Institute for Environment (IBAMA) and IPÊ.

Contributed by I. Camara, Soc. Bras. Protecão Ambiental, and C. Pádua, IPÊ.

PHVA, *Leontopithecus* Symposium Planned For 1997

A week-long series of workshops will be hosted by the Fundação Biodiversitas in Belo Horizonte, Minas Gerais, Brazil during the third week of May, 1997. The week will begin with a two-day *Leontopithecus* Silver Anniversary Symposium to celebrate the past 25 years of research and conservation activities for *Leontopithecus*. The objectives of the symposium are to: (1) synthesize and compare the evolution, ecology and conservation of the four lion tamarin species; and (2) solicit and present the data and information needed to conduct the *Leontopithecus* Population and Habitat Viability Analysis workshop (PHVA) that will immediately follow the symposium. The proceedings of the symposium will be published in a volume co-edited by D. Kleiman and A. Rylands.

The PHVA will be organized by IBAMA and the Fundação Biodiversitas and facilitated by Dr. Ulysses Seal of the Conservation Breeding Specialist Group (CBSG) and Dr. Robert Lacy of the Brookfield Zoological Society. The aim of the PHVA is to review and update the data available for each species in order to evaluate progress since the first highly successful *Leontopithecus* PHVA held in Belo Horizonte in 1990. Finally, the week will end with two days for meetings of the four IRMCs.

Contributed by J. Ballou, National Zool. Park

Report from the Field: Golden-headed lion Tamarins in Una.

During the past 12 months José Renato, our Brazilian Research Assistant, worked full-time systematically collecting behavioral data on five groups of tamarins in Una Reserve, Bahia. I spent six weeks in the Reserve and Becky Raboy, Univ. of Maryland doctoral candidate advised by me, worked 12 weeks in Una.

One of our objectives is to improve the data used in population viability assessments (PVAs) for golden-headed lion tamarins (GHLTs) in Una Reserve. In previous PVAs I used data on birth and death rates taken from long-term studies of golden lion tamarins (GLTs) in Poço das Antas Reserve. Our studies on GHLTs in Una Reserve during the past year suggest that these rates differ between the two species. Fecundity, which we define as the number of offspring weaned/reproductive female/breeding season appears to be greater for GLTs than for GHLTs. Two factors may explain the observed difference. First, whereas about 15% of GLT study groups are polygynous at any point in time, we observed only one case of polygyny in GHLT study groups since the beginning of our study. Second, although about one-third of GLT reproductive females produce two litter per year, we have not observed any GHLT reproductive females produce more than one litter per year. At this point we don't know why this is the case.

Mortality, defined as the percent of study animals that disappear during a given period of time, appears to be greater for GHLTs than for GLTs. One hypothesis to explain the greater mortality in Una is that the predator community in Una is more complete than in the highly degraded forests of Poço das Antas. During the past year several tamarins in Una study groups were known to have been killed by mammalian and avian predators. Indeed, Becky Raboy was fortunate enough to watch as a group of GHLTs and a group of Wied's marmosets (*Callithrix kuhli*) simultaneously mobbed an ocelot in the Reserve.

A second hypothesis to explain the high incidence of tamarin mortality in Una is disease. Two individuals in one study group (The Prince's Group) were seen behaving as though they were sick. Both individuals died within a few days. Predation of two other members of the same group resulted in the dissolution of the group and takeover of its territory by adjacent groups. The is the first reported case of disease causing the extinction of a reproductive group of lion tamarins in the wild.

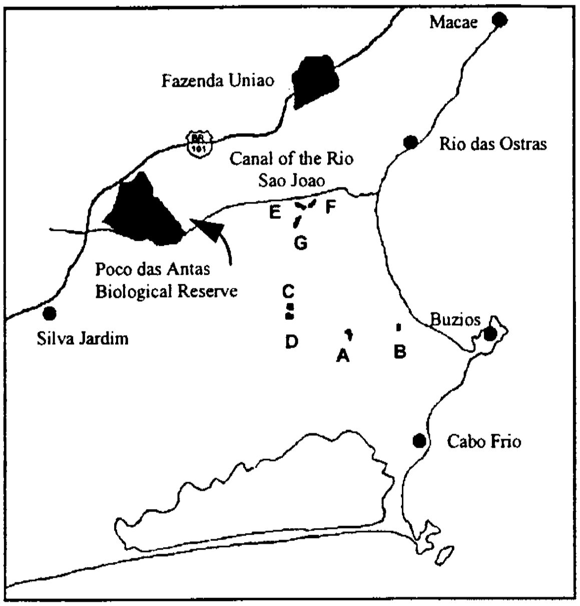
In summary, it appears that the GHLT population in Una Reserve is smaller, grows (births minus deaths) at a slower rate and might be more susceptible to environmental variation and diseases than we estimated in previous PVA models. We have just begun comparative work but it's already clear that GLT and GHLTs are very different monkeys!

I would like to take this opportunity to thank the contributors to the Lion Tamarins of Brazil Fund and the Jersey Wildlife Preservation Trust for supporting our important conservation and research activities in Una Reserve. We also great fully acknowledge the support of Saturnino de Souza, Director of Una Reserve.

Contributed by Dr. J. Dietz, Univ. of Maryland.

Update on Golden Lion Tamarin Conservation Activities

Translocation: Cecilía Kierulff began the translocation of golden lion tamarins from endangered habitat fragments to Fazenda União, a ranch with over 2800 ha. of unoccupied forest. The Associação Mico Leão Dourado (AMLD) signed an agreement for the use of these 2800 ha of lowland Mata Atlântica with RFFSA (Federal Railroad Network). The Association will pursue the development of an agreement with Fazenda



Letters show locations of isolated groups of lion tamarins that will be translocated to Fazenda União.

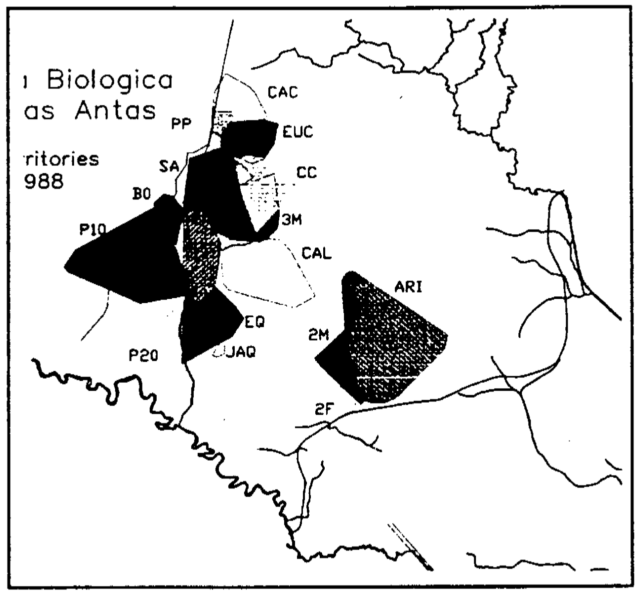
União to establish a private reserve to ensure the continued legal protection of the Fazenda's forest. There will also be re-emphasized efforts to encourage fazenda owners to protect their remaining forest patches legally. The AMLD will work with local municipalities to pass laws to support GLT conservation.

Kierulff and Oliveira will capture and translocate to Fazenda União six additional GLT groups and will begin baiting and following an additional five groups. Kierulff intends to determine whether translocation is a more cost-effective method of increasing numbers and genetic diversity than reintroduction.

Reintroduction: Initiated in 1984, the Reintroduction Program has added 2300 ha. to the total area protected for GLTs in Brazil through its program of releasing GLTs on private fazendas.

By the end of 1996, Benjamin Beck reported that there were 200 tamarins surviving as a result of the reintroduction program. This is due to explosive reproduction (38 births in 1996) in the reintroduced population. These animals live in 26 social groups on 13 ranches. The proportion of the reintroduced population comprising of wild-born tamarins is now 88% and will continue to increase. Survival of offspring remains at 65%. These trends suggest that the reintroduced population will continue to grow without further reintroductions of captive-born animals. However, further reintroduction may be necessary to provide genetic diversity in the reintroduction population, improve the genetic and demographic status of the captive population, promote conservation education, and maintain support for the program by the zoo community.

Beck and Jon Ballou (GLT Studbook Keeper) have organized the shipment of up to 24 GLTs from 13 zoos (many coming to North America from Europe) to be housed at six "Pipeline" zoos in free-ranging exhibits in preparation for future reintroduction to Brazil.



GLT territories studied in the Reserva Biologica Poço das Antas, 1987-1988

Ecology: James Dietz (Univ. of Maryland) and Andy Baker (Philadelphia Zool. Gardens) continued the semi-annual physical examination of 34 groups of wild GLTs as part of the genetic-demographic studies of the wild population. They have logged nearly 4000 hours of direct observations on 17 habituated groups. One female, originally trapped in 1983, still survives!

We intend to continue ongoing field research in the following areas: sociobiology, communication, ecology, medical studies, locomotion and functional morphology, reproductive physiology, reintroduction, and social organization.

The new Associação Mico Leão Dourado (AMLD) (formed in January 1993 - Executive Director, Denise

Rambaldi; President, Alcides Pissinatti) assumed responsibility (from the Brazil Foundation for the Conservation of Nature, FBCN) for all 26 staff members working for the Golden Lion Tamarin Conservation Program as well as all equipment and vehicles.

Contributed by Dr. D. G. Kleiman, National Zool. Park

Assessment Planned for Golden Lion Tamarin Conservation Program

The Golden Lion Tamarin Conservation Program (GLTCP), a recovery effort for Golden Lion Tamarins (GLTs) and their habitat, has been active since 1982. Project objectives include integration of *in situ* and *ex situ* GLT populations and conservation of sufficient habitat for the long-term survival of the species in the wild. We expect that specific objectives will be re-evaluated and updated with the upcoming PHVA in May, 1997. However, it is unlikely that the PHVA will provide much guidance regarding the organizational mechanisms to achieve new objectives.

Photo: Jessie Cohen, National Zoological Park

Therefore, in addition to the PHVA, the members of the GLTCP are requesting a detailed independent evaluation of our conservation, education and research activities during the past 14 years. We believe that recovery efforts not only need to be evaluated quantitatively relative to their achievements, but also qualitatively relative to organizational structure and function and the process used to achieve defined goals.

Thus, the purpose of the proposed evaluation would be to provide us with a constructive review of the degree to which we achieved our goals, whether the goals were achieved in a cost effective manner and finally whether the structure and functioning of the GLTCP and the newly-formed Brazilian NGO, the Associação Mico Leão Dourado (AMLD), are appropriate to meet PHVA priorities set for the future.

There have been few evaluations of recovery programs for endangered species or habitats. The GLTCP hopes to use this evaluation both to provide us with guidance in meeting our goals in the years ahead, but also to provide a model for developing criteria for the evaluation of species recovery programs. We have asked Ross Simons, Special Assistant to the Director, Museum of Natural History at the Smithsonian Institution, to chair the evaluation committee.

We have just begun organizing our ideas and working on a schedule for the process; hopefully, in late May or early June, the evaluation panel can start interviewing GLTCP scientists, staff, collaborators, etc. A site visit to Brazil will occur in early September. The whole evaluation process is expected to be completed by the end of the calendar year.

Contributed by D. G. Kleiman, National Zoological Park.

Effect of Translocations on Resident Groups of Black Lion Tamarins

IPÊ

In its fifth year, IPÊ's Primate Project at the Rio Claro Farm, which belongs to DURATEX, the largest reforestation company in Brazil, continues to provide important results on the effects of translocating tamarins from one area to another. This year's goals were the following:

- to study how the neighboring groups of black lion tamarins occupied the vacant territory, left by a translocated group.
- to continue studying the primate community found at the farm.
- to keep up with the research and conservation work at the farm despite the meager financial support IPÊ received.

One of the most important aspects of this year's studies was to observe how neighboring groups of tamarins move into a new territory. The first translocation occurred in May of 1995, from the Rio Claro Farm to an area belonging to the King Ranch, located farther west in the state of São Paulo. The group was composed of four individuals: a pair, an older male, and a younger male. Their adaptation was very smooth and they did not show any difficulty in finding food and new tree holes for protection. Data have been systematically collected both from the newly translocated group and from the groups at the Fazenda Rio Claro that used to be their neighbors.

The results show that the groups adjacent to the translocated one did not occupy the vacant territory. The two neighboring groups seem to be cautious and have very slowly invested in entering the newly emptied territory. We are not sure what is keeping them from expanding, whether they do not yet need the space, or whether they still feel the presence of the ex-dwellers of that area. The continuation of this study will furnish more information on habitat selection among lion tamarins, which is very important as little has been known in that respect, especially among neotropical primates.

Another important aspect of this study is the information gathered on the minimum and maximum home range sizes needed for the survival of *L. chrysopygus*. This study will also allow us to calculate the carrying capacity of a given area and will furnish information on the minimum viable habitat size for the species.

The results of the studies with the Primate Project have already been partially published in scientific journals, while other data are becoming the focus of two Masters' thesis, both of which are almost completed. IPÊ's work, however, is much more than an academic exercise. By introducing this endangered species into a new forest in its former range, we have decreased the chances that a disease or other disasters may wipe out the black lion tamarins. We also believe that we have increased the prospects for population growth and recovery.

Contributed by M. Silva, IPÊ

Landowners' Environmental Education Program for Una and Surrounding Areas

An environmental education program for the area surrounding Una Biological Reserve, Bahia, (REBIO-UNA area) commenced in November 1995. It is specifically aimed at landowners and farm workers in order to develop their support for the protection of the forest in the Reserve and on their farms. The long term project goal is to influence farm owners and workers to make responsible decisions regarding their land-use practices, i.e., those which are economically and ecologically sustainable.

J&B Rare Scotch Whiskey's Care for the Rare fund has provided the Jersey Wildlife Preservation Trust (JWPT) with a grant over a three-year period in support of the above program. The JWPT has established a contract with Dr. Keith Alger, Executive Director of the Instituto de Estudos Socio-Ambientais do Sul da Bahia (IESB), concerning this program and an Advisory Group has also been established. Joaquim Blanes is the Project Officer and Gabriel Santos has been appointed as the Assistant Project Officer. Dr. Saturnino de Sousa, Director of the Una Biological Reserve, represents the 'gatekeeper' of this program to provide a consistent liaison between the sponsor, J&B, and the project officers.

During 1996 more contacts were made with local land-owners and the interaction process with the farmers from the REBIO-UNA surrounding continued. Thirty-six farms have now been visited. Five meetings with rural workers took place in the farms, reaching 60 rural workers directly. This activity required a great effort, because it was necessary to obtain the landowner permission and then to reconcile with project agents' timetable with the worker's availability. The subject discussed in these meetings was: What is the Una Biological Reserve, and its importance?

Work with the IBAMA agents also improved during this past period due to the PRA (Participatory and Rapid Appraisal) which was carried out by IBAMA and IESB in September, 1996. The PRA objective was a self-evaluation made by the agents to identify activities which should be change or improved, and pressures on the conservation unit. As a result of this activity, the following problems were identified:

- Squatters pressure on the REBIO-UNA area (17 squatters are in the Reserve, preparing land for agriculture, hunting, burning, logging, raising cattle);
- Labor shortage (presently only 4 agents survey the Reserve);
- Lack of appropriate resources for basic activities (fuel for vehicles, vehicle maintenance, REBIO building maintenance, equipment); and
- Lack of improvement of the REBIO-UNA agents knowledge (courses to teach how to apply the laws, how to use rifles and guns, first-aid);

During the first year of the program in the REBIO-UNA surroundings, only one recorded incident related to hunting occurred. In June 1996, four hunters were detected in the reserve. Twenty-eight signs have already been given to 10 farmers, containing the sentence: "It is forbidden to hunt and cut trees." All the farmers were very enthusiastic and gave permission to put the signs in their farms. 52 signs are being painted and will soon be distributed.

As it was decided by Mr. Saturnino de Souza, the REBIO-UNA manager, and the program team, signs will be fixed on strategic places along the access roads to the Reserve, informing about the laws:

ATTENTION!
YOU ARE NEAR THE REBIO-UNA
THIS AREA IS UNDER IBAMA SUPERVISION
IT IS FORBIDDEN TO HUNT, LAW No....
IT IS FORBIDDEN TO CUT TREES, LAW No....

Many hunters within the REBIO-UNA surroundings say that they know it is forbidden to hunt in the Reserve, but they thought they could do it outside the Reserve.

In 1996, squatters invaded three areas in farms located in the REBIO-UNA surroundings. IESB has been in contact with INCRA to ensure that new settlements do not occur anymore in the Reserve surroundings area. These three areas are under risk of being burnt during this summer, due to the vegetation already cut.

The same strategy and action lines of the first year of this program will be adopted for the next stage, trying to finish goals that could not be completely achieved. Priority will be given to the maintenance of a good relationship with the landowners through periodic visits, information about the program activities and, especially, meetings with the rural workers of the farms.

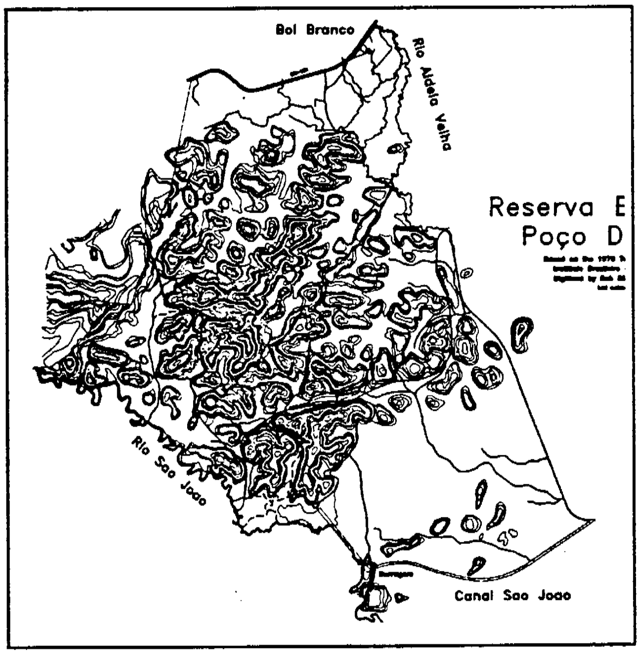
Extracted from the 1996 Annual Report by J. Blanes and submitted by J. Mallinson, Jersey Wildlife Preservation Trust.

Forest Rehabilitation Program in Poço das Antas Biological Reserve.

The principle aim of this ongoing project is to conduct a vegetation and seed bank survey to gain information for developing an action plan to rehabilitate degraded areas in the Biological Reserve of Poço das Antas.

The vegetation mapping shows four distinct types of vegetation for lowland and hillside geomorphological compartments of the Reserve: mature and secondary forests, early secondary vegetation (*capoeira*) and old pastures (grassland). The Reserve is composed of a mosaic of these fragmented vegetation types.

In the last 25 years, the area covered by mature forests increased more than 200 ha, an indication that mature forest fragments are naturally merging, creating more extensive areas and probably decreasing the edge effects. At the same time the area covered by grasslands increased more than 100 ha due to fire events and the hydrological changes in the southern region of the Reserve caused by the construction of the Juturnaiba dam at the beginning of 80's. Most remarkable, however, has been the increase, between 30-40%, in secondary vegetation in the last 25 years. Early secondary (*capoeira*) and old pastures vegetation types cover 2167 ha of the Reserve's total area (about 6000 ha). Analysis of the seed banks in these different vegetation types indicate that in the secondary and early secondary forest and old fields, acceleration of the natural process of regeneration can only be accomplished through habitat manipulation. Regeneration in these areas is hampered by low germination and high mortality rates, water stress, low dispersal of seeds by wind, difficulty of seed penetration through the thick dead grass layer, and intense competition with grass plants.



Topography of the Poço das Antas Biological Reserve (R. Billerbeck and K. Wolfe)

These studies show that a management plan to rehabilitate degraded areas in Poço das Antas Biological Reserve should target activities in specific locations, focusing on lowlands, hillsides areas covered by old pasture (grassland) and hillsides areas covered by early secondary vegetation. The vegetation mapping shows that the degraded areas represent 42.8% of the total area of the Reserve, however the seed bank study indicates that only 28.1% (grasslands) of the Reserve must be prioritized for recuperation. However, creation of only 76 ha of vegetation corridors at strategic locations within the Reserve can have a significant impact within only a few years, mainly because these would impede the progress of fires into the Reserve's interior.

With this in mind, the reforestation program at Poço das Antas Biological Reserve needs to:

1) plan vegetation corridors in association with fire breaks while avoiding flooded areas;
2) give priority to rehabilitation of degraded lowland areas since these areas are the most extensive and unknown in the Reserve and the vegetation remnants of this system provides an important food resources for the golden lion tamarin;
3) improve the Reserve's road system by building a new dirt road outside the northern part of the Reserve to help control that area against hunters and fires;
4) establish a permanent team of workers to install and maintain the vegetation corridors; and
5) develop a budget to implement this action plan over the next 3 to 5 years

This project was funded by WWF-US and WWF - Brasil and the Smithsonian Institutions International Environmental Sciences Program..

Contributed by José Luis Campana Camargo

Seasonal Variation in Behavior and Ecology of Black Lion Tamarin

I have been studying the black lion tamarins since 1988 when I saw this wonderful primate for the first time. Since then, I have come to know the black lion tamarins very well. Their beauty is extraordinary, like the other Brazilian lion tamarin species. This last year, I observed four groups of black lion tamarins (a total of 14 animals) in the 2187 ha. Caetetus Ecological Station. Since my studies began, I have found that the black lion tamarin is an important seed disperser for plants used in their diet, and that they form a foraging association with the olivaceous woodcreepers in the tropical forest at Caetetus Ecological Station in southeastern Brazil. This association seems to be a case of commensalism. The olivaceous woodcreepers seem to benefit from black lion tamarin foraging activity by obtaining more food items during periods of foraging by the tamarins.

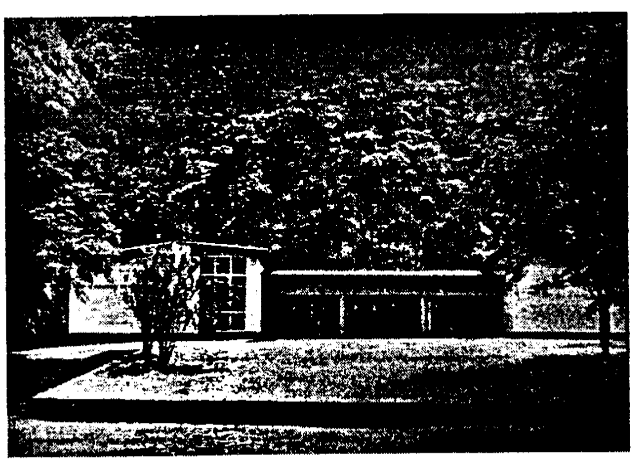
My observations also provide important information on their diet. There seems to be highly seasonal variation with high percentages of exudates in the diet during the dry season and high consumption of fruits in the wet season, and a high percentage of time spent foraging for prey in both seasons. I observed that in humid habitats, such as swamps, foraging for animal prey and exudates occurs more in tree cavities and the palm ***Euterpe***, whereas in drier habitats foraging occurs in tree cavities, ***Syagrus*** palms, "jequitibás" ***Cariniana estrellensis***, and bamboos. Frequently the adults were observed sharing their prey with the infants, especially with large prey such as anurans.

Conservation for this wonderful species depends on collaboration between researches, local human populations, the Brazilian government, zoos, universities and more funding sources to support research in ecology in their natural habitats, to locate new populations, and to assist with the captive breeding program. Funding for this project has come from: WWF - Fundo Mundial Para a Natureza/Brasil; Fundação O Boticário de Proteção a Natureza/Brasil; Jersey Wildlife Preservation Trust/UK; and the Lincoln Park Zoo Scott Neotropical Fund/Chicago-USA.

Contributed by Fernando de Camargo Passos, Universidade Federal de São Carlos & IPÊ

The Rio de Janeiro Primate Center (CPRJ)

The Rio de Janeiro Primate Center, created in November of 1979 as a division of the State Foundation for Environmental Engineering (FEEMA), has the objectives of conducting research on and preserving primates and their forest habitat within Brazil, with an emphasis in the Atlantic Forest region. Located about 100 km from the city of Rio de Janeiro, the Center covers an area of some 260 hectares in the beautiful foothills of the Serra dos Órgãos. This site is marvelously well suited for the kinds of scientific and conservation activities being carried out, and a large part of the area is still covered with forests rich in species diversity.



Main Building at CPRJ

Directed by Dr. Alcides Pissinatti, the Center maintains a staff of 10 and has resources and facilities to provide services in animal management and nutrition, veterinary medicine and habitat restoration. The Center also houses library and museum facilities.

Current Inventory at CPRJ

SPECIES		♂/♀/?
Callithrix	*Callithrix jacchus*	**1/1/4**
	C. kuhli	**7/5/9**
	C. geoffroyi	**17/17/6**
	C. aurita	**2/1/0**
	C. flaviceps	**0/1/0**
	C. humeralifer	**1/0/0**
Leontopithecus	*Leontopithecus rosalia*	**11/2/0**
	L. chrysomelas	**35/18/9**
	L. chrysopygus	**12/11/2**
Saguinus	*Saguinus bicolor bicolor*	**10/10/10**
	S. b. martinsi	**5/3/0**
	S. b. mistax	**1/1/0**
	S. midas midas	**2/1/0**
	S. m. niger	**2/1/0**
Cebus	*Cebus apella xanthosternos*	**4/9/0**
	C. a. robustus	**1/0/0**
Callicebus	*C. personatus nigrifrons*	**1/1/0**
	C. p. personatus	**0/1/0**
	C. moloch	**1/0/0**
Allouatta	*Allouatta fusca clamitans*	**1/0/0**
Brachyteles	*Brachyteles arachnoides*	**4/3/1**
	TOTAL	**118/84/41**

Since its inauguration, CPRJ has been a critical component of the conservation and captive breeding programs for *Leontopithecus* (*L. rosalia*, *L. chrysomelas*, and *L. chrysopygus*). In addition, the Center has developed captive propagation programs for *Callithrix*, *Saguinus*, *Cebus*, *Callicebus*, *Alouatta*, *Brachyteles* and other species of Brazilian primates. These projects, conducted by CPRJ's staff in partnership with numerous Universities and other national and international institutions, have been successful in breeding and enhancing the scientific knowledge of the above species. Currently there are 11 projects conducted in collaboration with national institutions, and nine ongoing projects with international collaborators.

Animal facilities at CPRJ

Animals bred at CPRJ are used in programs aimed at repopulating the species and in the formation of new satellite colonies in Brazil and elsewhere. CPRJ currently holds 250 individuals distributed in 90 enclosures around its campus.

Contributed by A. Pissinatti, CPRJ.

Studies of the Natural History of the Black-Faced Lion Tamarin

IPÊ's studies on the natural history of black-faced lion tamarins began in 1995, after the approval of the IRMC for the species. It took us around three months to radio collar a group of these lion tamarins and another three months to get them habituated to our presence. After that, we have been collecting data systematically, which will be the first concrete information on the ecology and behavior for the species. The study shows that *L. caissara* sleeps mainly in tree dens, has a diet composed of fruits, insects, and small vertebrates, and is more active in the early morning and late afternoon, spending the mid day hours resting or moving at a slower pace. These results do not demonstrate any major behavioral and ecological differences between *L. caissara* and the other three species of *Leontopithecus*. This study is critical as the first step in designing conservation management strategies for the black-faced lion tamarin.

We are receiving a great deal of local support, from the IBAMA's park director and staff, as well as from the community. It seems that by sharing our findings with the local community, we are gradually gaining their confidence and support. Our field researcher in this region is Fabiana Prado, who besides conducting the field study is also sharing her findings with the local communities to increase public awareness of conservation and raise interest and pride on the region's rich biodiversity.

The financial support for this project has been obtained from the "O Boticarió" Foundation and from the Lion Tamarins of Brazil Fund. We are still trying to raise additional funds to be able to continue the project. This study is of great importance and is worth our effort.

Contributed by Cláudio Pádua and Fabiana Prado, IPÊ

Photo: Fábio Olmos

Environmental and Conservation Education

The conservation of species and habitats ultimately depends on long-term public support, particularly the public living in close proximity to the habitat as well as the public influencing financial support or policies important for project implementation or continuation. This support results from an increase in public awareness of conservation issues, increasing the value of conservation, and developing avenues for positive action. This process of social change required a continued long-term education effort. For these reasons, environmental education programs are considered a vital component of all the lion tamarins conservation programs.

Golden Lion Tamarin Conservation Education Program

The mission of the GLT Conservation Education Program has been to increase public awareness and involvement in conservation of the golden lion tamarin and its habitat. Initiated in 1984, the program has focused on developing support for GLT habitat management, support for the management of GLT populations, and developing a stable infrastructure for the conservation program to assure long-term stability. The Conservation Education Program of the Associação Mico-Leão-Dourado (AMLD) is located at the Education Center at the Poço das Antas Biological Reserve.

Over the last year, the Conservation Education Program conducted various activities with groups that visited the Education Center. Some groups also visited other project sites of the AMLD, such as the farms where captive-born GLTs have been reintroduced, the Translocation Project, Reforestation Project, the Mata Atlântica Program and local communities.

The team dedicated part of its time to assist teachers who participated in the education course conducted on November, 1995, and pledged to implement new projects in their local schools. It was not possible to make the planned visits to all the AMLD projects since the Education Project staff consists of only two permanent members. In addition, the number of new AMLD projects was higher than previously foreseen by this administration, making it even more difficult for the Education staff to schedule their visits.

Schools have visited the Education Center regularly on Mondays, Wednesdays, Fridays and Saturdays, when we also receive students from universities and special groups.

Due to lack of funds, we were unable to accomplish several activities that we had proposed for this year. These include developing a new set of audiovisual material emphasizing activities conducted by the Education Program, the production of a new panel for mobile exhibits with updated information about all AMLD projects, and the production of certain educational materials. The Education Program is planning to prepare a proposal to request funding for these and many other activities.

Contributed by D. Rambaldi,, AMLD

Environmental Education Activities of IPÊ

Environmental education has long been one of IPÊ's main missions. Throughout the years, IPÊ's programs and research studies have intensified in this area, for we understand that conservation cannot be effective without the support of local people.

One of our main areas of activity has been at the Caetetus Ecological Station in the state of São Paulo. For many months of the year, the program is busy with students visiting from local schools. For some months, however, teachers were on strike so Maria das Graças de Souza (Gracinha), IPÊ's local education coordinator, took advantage of this time to raise awareness among other sectors of the local community.

IPÊ's Gracinha interpreting nature trails at the Caetetus Ecological Station

While schools were on, she divided her time between the program at the Ecological Station and outreach activities with the students. Gracinha met teachers and school directors to design activities months in advance. As transportation for a whole class is not always available, she often visited the surrounding schools to give slide talks about several conservation topics, especially about the Ecological Station and the endangered animals inhabiting the area. The symbol species for this program is the black lion tamarin, which has become a regional source of pride and is now associated with the forest at the Station. The Education group also organized a course for 15 employees of the Forestry Institute who work in natural areas. This was the first experience of this kind and it became evident that the participants benefited a great deal from the course. The course lasted four days and many local professionals gave talks on specific issues, a strategy that has two objectives: value local professionals and their work; and straighten the links between the Station and the surrounding community.

To broaden regional conservation awareness, the education staff also contacted many local leaders to invest in new links and possible future support. As this Station's history is associated to that of the surrounding farmers (the area belonged to an ancestor), the idea of protecting and turning it into a source of pride has received support from many neighbors. Help has come in many ways: they have lent their tractor to open a service road, for example, or they have dropped by to leave a message they received (the Station does not have a phone). Overall, the education program for the Caetetus Ecological Station has expanded well and is now receiving much more support.

IPÊ also has established environmental education programs associated with its black-faced lion tamarin research. Fabiana Prado, an IPÊ researcher studying behavior and ecology of *L. caissara*, is now developing several education activities for the local communities. She managed to show a video on the species that had been produced by TV Globo, the largest Brazilian network. This is one of the most popular programs in the country but the local community has not been able to watch the program because of lack of electricity. The presentation was a success, especially because many of the local people saw themselves on air! Fabiana has also talked to local students about the tamarin and other local species. Children then produced beautiful drawings that were exhibited in the local bar, the most population gathering place in the community. Fabiana is now contacting the local women's group to suggest to them, among other conservation and funding alternatives, the production of artifacts using the tamarin as their main focus.

Contributed by S. Padua,, IPÊ

The Lion Tamarins of Brazil Fund

The ***Lion Tamarins of Brazil Fund*** was initiated in 1991 by Dr. Gerald Durrell of the Jersey Wildlife Preservation Trust on behalf of the *Leontopithecus* International Recovery and Management Committees to help support important *Leontopithecus* conservation projects currently underway in Brazil. The fund was established to assist the four different lion tamarins projects according to their needs for field personnel and equipment in Brazil. Each year invitations are mailed to all institutions participating in *Leontopithecus* captive breeding or conservation programs requesting contributions to the fund. To date, over US$66,000 has been raised.
Contributed by J. C. Mallinson, JWPT.

Donations Received 1995-1996 (US$)

Jersey Wildlife Preservation Trust, UK ($1,287.23)
Sedgewick Zoo, USA ($500)
Arizona Zool. Society, Arizona, USA ($1000)
Abigail Haywood, New York, USA ($25)
Twycross Zoo, Warwickshire, UK ($152.75)
Marwell Zoo, Herts, UK ($152.75)
Copenhagen Zoo, Denmark ($985.18)
Howletts, UK ($381.87)
Colchester Zoo, Essex, UK ($152)
Jardin Zool.de Aclimação em Portugal, SA ($98.70)
Zoo La Palmyre, France ($986.90)
Whipsnade Wild Animal Park, UK ($228)
Belfast Zoo, UK ($1,067.50)
Acacia Zoo, ME, USA ($92.59)
Paignton Zoo, Devon, UK ($381.25)
Racine Zoological Society, Wisconsin, USA ($92.59)
Zoopark Beauval, France ($862.33)
National Aquarium in Baltimore, USA ($97.59)
Memphis Zoo & Aquarium, USA ($487.95)
Dublin Zoo, Ireland ($1,515)
Tulsa Zoo, Oklahoma, USA ($91.62)
P Watt, Vancouver, Canada ($68.48)
Taronga Zoo, Sydney, Australia ($2,485.28)
Noorder Dierpark, Netherlands ($570.97)
Columbus Zoo, Ohio, USA ($485.07)
Adelaide Zoo, Australia ($3000)
Singapore Zoo, Singapore ($2000)

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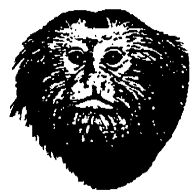

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