PHVA

# Lowland Tapir

***Tapirus terrestris***

## Lowland Tapir (*Tapirus terrestris*) Conservation Workshop

## Population and Habitat Viability Assessment (PHVA)

**Sorocaba, São Paulo, Brazil**

**15 to 19 April 2007**

# Final Report

A contribution of the IUCN/SSC Tapir Specialist Group (TSG) and IUCN/SSC Conservation Breeding Specialist Group (CBSG) in cooperation with the Sorocaba Zoo
Lowland Tapir Population and Habitat Viability Assessment (PHVA)
Final Report. CBSG Brazil and CBSG Headquarters

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**Edited by:**

Medici, E. P.; Desbiez, A. L. J.; Gonçalves da Silva, A.; Jerusalinsky, L.; Chassot, O.; Montenegro, O. L.; Rodríguez, J. O.; Mendoza, A.; Quse, V. B.; Pedraza, C.; Gatti, A.; Oliveira-Santos, L. G. R.; Tortato, M. A.; Ramos Jr., V.; Reis, M. L.; Landau-Remy, G.; Tapia, A.; Morais, A. A.

**Compiled by the Workshop Participants**

**Translated by: da Cunha, R. G. T. &**
**da Silva, A. G. (Chapter 9)**

**Translation revised by: Medici, E. P.**

**Workshop organized by:** IUCN/SSC Tapir Specialist Group (TSG); Sorocaba Zoo, Sorocaba, São Paulo, Brazil; Houston Zoo Inc., United States; and Sorocaba Convention and Visitors Bureau, Sorocaba, São Paulo, Brazil.

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**Sponsorship for participants:** Administración de Parques Nacionales, Delegación Regional Noroeste, Argentina; American Airlines, Partnership Brookfield Zoo, United States; BIOTRÓPICOS - Instituto de Pesquisa em Vida Silvestre, Brazil; BRIT - Botanical Research Institute or Texas, United States; Brookfield Zoo, Chicago Zoological Society, United States; CAIPORA - Cooperativa para Conservação da Natureza, Brazil; Centro Tecnológico de Recursos Amazónicos - Organización de Pueblos Indígenas de Pastaza, Ecuador; Conservation International (CI), Suriname; Conservation International (CI), United States; Continental Airlines, Partnership Houston Zoo Inc., United States; Entidad Binacional Yacyretá, Paraguay; Fundação Parque Zoológico de São Paulo, Brazil; Fundação RioZOO, Brazil; Fundación Ecológica Arcoiris, Ecuador; Fundación Nacional de Parques Zoológicos and Acuários (FUNPZA) - Ministerio del Ambiente, Venezuela; Fundación Temaikén, Argentina; IF - Instituto Florestal do Estado de São Paulo, Brazil; Instituto de Ensino, Pesquisa and Preservação Ambiental Marcos Daniel (UNILINHARES), Brazil; Instituto de Investigación de Recursos Biológicos "Alexander von Humboldt", Colombia; Instituto de Pesquisas Cientificas and Tecnologicas do Estado do Amapá (IEPA), Brazil; IBAMA - Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis, Brazil; IPAM - Instituto de Pesquisa Ambiental da Amazonia, Brazil; IPÊ - Instituto de Pesquisas Ecológicas, Brazil; IUCN/SSC Conservation Breeding Specialist Group (CBSG) – Brazilian Network and United States Headquarters; IUCN/SSC TSG Conservation Fund (TSGCF); KASA - Kouprey Amigos dos Santuários de Animais, Brazil; Kwata Association, French Guyana; Michelin, Bahia, Brazil; ONCFS - Office National de la Chasse et de la Faune Sauvage, French Guyana; Parque Zoológico da Prefeitura Municipal de Bauru, Brazil; Parque Zoologico Recreacional Huachipa, Peru; Royal Zoological Society of Scotland (RZSS), Edinburgh Zoo, Scotland; Suriname Conservation Foundation - Capacity Building Support Project, Suriname; Unidad Administrativa Especial del Sistema de Parques Nacionales Naturales de Colombia (UAESPNN), Colombia; Universidad de Antioquia, Colombia; Universidad Distrital Francisco Jose de Caldas, Colombia; Universidad Nacional de Colombia (UNAL), Colombia; Wildlife Conservation Society (WCS), Bolivia; Wildlife Conservation Society (WCS), Brazil; Wildlife Conservation Society (WCS), Ecuador; Zoo Osnabrück, Germany; Zoológico de Brasília, Brazil; Zoológico de Parque Sur de la Ciudad de Maracaibo, Venezuela; Zoológico de São Bernardo do Campo, Brazil; and ZooParc de Beauval, France.

**Workshop facilitated by:** IUCN/SSC Conservation Breeding Specialist Group (CBSG) – Brazilian Network and United States Headquarters (www.cbsg.org).



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## Population and Habitat Viability Assessment (PHVA)

### Sorocaba, São Paulo, Brazil
### 15 to 19 April, 2007

# TABLE OF CONTENTS

# Lowland Tapir (*Tapirus terrestris*) Conservation Workshop

## Population and Habitat Viability Assessment (PHVA)

### Sorocaba, São Paulo, Brazil
### 15 to 19 April, 2007

# EXECUTIVE SUMMARY

# Executive Summary

## Introduction

The Brazilian Tapir, South American Tapir or lowland tapir (*Tapirus terrestris*) is a mammal of the Tapiridae Family, Perissodactyla Order, which is currently listed by the International Union for the Conservation of Nature (IUCN) as "Vulnerable to Extinction" in the categories A1cd+2c+3c (IUCN/SSC Red List Assessment 2007). In Brazil, although the species is not included in the national list of species threatened with extinction (IN do MMA - Ministério do Meio Ambiente 03, 2003 - Normative Instruction nº 03/2003 from the Ministry of Environment, Brazil), the lowland tapir is reported in six out of seven state lists. Only at the state of Pará it is not considered as threatened with extinction. In the states of Minas Gerais and Rio Grande do Sul it is listed as "Critically Endangered" and in the Paraná, São Paulo, Espírito Santo and Rio de Janeiro states it is included within the category "Endangered", being considered as "Extinct" in the Municipality of Rio de Janeiro. The current geographical distribution of the species basically encompasses the whole South America east of the Andes, from Venezuela down to northeastern Argentina and Paraguay. The species occurs in the following countries: Argentina, Bolivia, Brazil, Colombia, Ecuador, Guyana, French Guyana, Paraguay, Peru, Suriname and Venezuela. The other three species of the genus *Tapirus* are the Baird's Tapir (*T. bairdii*), which occurs in Central America, Mexico and northwestern South America (northern Colombia); the Mountain Tapir (*T. pinchaque*), which occurs in the Andean region of Colombia, Ecuador and Peru; and the Malay or Asian Tapir (*T. indicus*), which occurs in Indonesia, Malaysia, Thailand and Burma, in Southeast Asia (Brooks *et al.* 1997; Medici *et al.* 2000; Medici 2001).

As it happens with other ungulates, such as deer and peccaries, tapirs perform extremely important ecological functions (Janzen 1981; Eisenberg 1990). Tapirs play a critical role in the creation and maintenance of biological diversity, also working as indicators of the "health" of the tropical ecosystems they inhabit (Eisenberg *et al.* 1990; Jones *et al.* 1994). The local extinction or population reduction of this species can trigger a series of adverse effects in the ecosystem, causing a breakdown of some key ecological processes, such as seed dispersal and predation, nutrient recycling etc., eventually jeopardizing the ecosystem biodiversity and integrity in the long term (Dirzo & Miranda 1991; Brooks *et al.* 1997; Medici & Foerster 2002). In the Peruvian Amazon, *Tapirus terrestris* is the only ungulate which has the potential for regularly dispersing seeds, since fruits comprise approximately 33% of its diet (Bodmer 1991).

In addition, tapirs are large-bodied mammals that have a very slow reproductive cycle (13-month gestation, inter-birth interval around 24 months and only 1 offspring per litter), something that, in the absence of an adequate management intervention, lowers the chance of recovery of those populations which were reduced for whichever reason (Redford 1992; Alvard *et al.* 1997; Brooks *et al.* 1997).

The first version of the Tapirs Action Plan, published by IUCN in 1997 (IUCN/SSC *Tapirs: Status Survey and Conservation Action Plan*) identified habitat destruction and fragmentation, with resulting population isolation, and intensive hunting as the main factors behind the decline of populations of the four tapir species in their respective range countries (Brooks *et al.* 1997). In Belize, Central America, hunting is the main factor answering for the decline of populations or local extinctions of the Baird's Tapir (Fragoso 1991). In Indonesia, habitat loss is being regarded as the major responsible for the local disappearance of the Malay Tapir, which is normally not hunted due to food restrictions imposed by the Muslim religion (Brooks *et al.* 1997). Regarding Mountain Tapirs, the main causes for the nearly complete disappearance of the species in the three countries of its geographical range are habitat loss and fragmentation and predatory hunting, conducted mainly for medicinal purposes (Downer 1997). Another quite serious aspect that was mentioned in the 1997 Action Plan is the fact that a large part of the populations of the four tapir species are found outside the boundaries of legally protected areas, something that hinders their protection.

In addition, it is clear the lack of information on tapir ecology in the wild. This fact alone substantiates the establishment of research projects and scientific events that produce, compile and discuss basic information on ecology, natural history, reproductive and behavioral questions, threats, habitat conditions etc. This lack of information, together with all the other issues that were mentioned, justifies the design and implementation of action plans for the conservation and management of tapir populations in all the regions and countries where they occur. Such action plans will undoubtedly be a key contribution for their conservation, allowing the conservation community to base and justify its efforts and convince the authorities on the need to promote rational public policies for the use of natural areas, or even about the importance to preserve and protect certain threatened habitats and species.

# IUCN/SSC Tapir Specialist Group (TSG)

The Tapir Specialist Group (TSG) is a scientific organization founded in 1980 as one of the 120 Specialist Groups of the Species Survival Commission (SSC) of the International Union for the Conservation of Nature (IUCN). The SSC works as the main advisor of IUCN and its members regarding technical aspects of species conservation. The SSC is a network comprised of Specialist Groups and Task Forces, some of which addressing conservation issues related to particular groups of plants or animals, while others focus on specific conservation issues such as species reintroduction or sustainable use of natural resources, among others. Furthermore, the SSC is responsible for the elaboration of the IUCN Red List, publication of Action Plans and informative newsletters, formulation of conservation policies etc. The Commission comprises more than 8,000 volunteer members (researchers, government officials, veterinarians, zoo employees, biologists, protected area managers etc.) working in almost every country of the world.

The Tapir Specialist Group's main goal is to contribute for the conservation of biological diversity in the planet by stimulating, developing, and carrying out practical programs to study, restore, and manage the four tapir species and their remaining habitats in Central and South America and Southeast Asia. The TSG attempts to fulfill this mission through the implementation of the following strategies: a.) Frequent revision and monitoring of the conservation status of the four tapir species, and promotion of their conservation needs; b.) Promotion and support for the research projects and the distribution of informative materials; c.) Promotion of the implementation of management and conservation programs by the appropriate organizations and governments; and, d.) Establishment of effective and strong partnerships among conservationists focused on tapirs, in order to stimulate communication and cooperation. Nowadays, the TSG has 107 members, including field researchers, environmental educators, veterinarians and geneticists, representatives of governmental agencies and non governmental organizations (NGOs), personnel of zoos and breeding centers, university professors and students etc., from 27 countries worldwide (Argentina, Australia, Belize, Bolivia, Brazil, Burma, Canada, Colombia, Costa Rica, Denmark, Ecuador, France, French Guyana, Germany, Guatemala, Honduras, Indonesia, Malaysia, Mexico, Panama, Paraguay, Peru, Thailand, The Netherlands, United Kingdom, United States, and Venezuela). Each and every one of the members is directly or indirectly involved with conservation of one or more tapir species in their respective regions, both in the wild and in captivity.

The TSG, alongside the Association of Zoos & Aquariums (AZA) Tapir TAG, European Association of Zoos & Aquaria (EAZA) Tapir TAG, Houston Zoo Inc., USA, Copenhagen Zoo, Denmark, and the Tapir Preservation Fund, USA, are the key groups working in the development and implementation of tapir conservation, management and research projects. A very important aspect of the work of these organizations is the contribution for the development of international coordinated strategies for the conservation of the four tapir species and their habitat.

# Tapir Specialist Group Action Planning Committee

During the First International Tapir Symposium, held in San José, Costa Rica, in November 2001, participants agreed that the revision and updating of the first version of the Tapirs Action Plan of IUCN – IUCN/SSC *Tapirs: Status Survey and Conservation Action Plan* (Brooks *et al.* 1997) – should be one of the priority goals for the Tapir Specialist Group in the medium term. An Action Planning Committee was formed and its first step was to discuss and select the most adequate methodology for revising the 1997 Action Plan. The chosen methodology for developing updated versions of the Action Plans for each one of the four tapir species was the Population and Habitat Viability Assessment (PHVA) Workshops, a process developed by the IUCN/SSC Conservation Breeding Specialist Group (CBSG).

The first step towards achieving the goal of carrying out one PHVA workshop for each one of the four tapir species was the "**Malayan Tapir Population and Habitat Viability Assessment (PHVA) Workshop**", held in Krau Wildlife Reserve, Malaysia, in August 2003. The workshop counted with the participation of 35 representatives of the Malayan tapir range countries in Southeast Asia, including Malaysia, Indonesia and Thailand, and also international members of the TSG. The workshop organizers were the IUCN/SSC Tapir Specialist Group (TSG); European Association of Zoos & Aquaria (EAZA) Tapir Taxon Advisory Group (TAG); IUCN/SSC Conservation Breeding Specialist Group (CBSG) and the Malaysian Department of Wildlife and National Parks (DWNP). The Copenhagen Zoo in Denmark, the DWNP, the Wildlife Conservation Society of Thailand, and the Idea Wild, in the United States, provided financial support for the event.

Some months later, during the Second International Tapir Symposium, held in Panama City, Republic of Panama, in January 2004, participants agreed that the next PHVA workshop to be carried out should focus on the Mountain Tapir. Therefore, the "**Mountain Tapir Population and Habitat Viability Assessment (PHVA) Workshop**" was carried out at the Otún-Quimbaya Sanctuary, Pereira, Risaralda, Colombia, in October 2004. A total of 66 representatives from the three mountain tapir range countries (Colombia, Ecuador, and Peru) attended the workshop, as well as international members of the TSG. The workshop organizers were the TSG and the Colombian Tapir Network (Red Danta de Colombia). Institutional support for this workshop was provided by: IUCN/SSC CBSG – Headquarters and Mexican Network; Association of Zoos & Aquariums (AZA) Tapir Taxon Advisory Group (TAG); European Association of Zoos & Aquaria (EAZA) Tapir Taxon Advisory Group (TAG); and the Houston Zoo Inc., United States. Financial support was provided by the TSG Conservation Fund (TSGCF); WWF - Colombia; Conservation International - Colombia; U.S. Fish & Wildlife Service, Division of International Conservation, Latin America & the Caribbean Initiative; Unidad Administrativa Especial del Sistema de Parques Nacionales Naturales de Colombia - UAESPNN [Special Administrative Unit of Colombia's Natural National Parks System]; Houston Zoo Inc., United States; Los Angeles Zoo, United States; Copenhagen Zoo, Denmark; and Cheyenne Mountain Zoo, United States.

The third workshop out of a series of four was the "**Baird's Tapir Population and Habitat Viability Assessment (PHVA) Workshop**", held in Belmopan, Belize, Central America, in August, 2005. A total of 70 representatives from the Baird's tapir range countries - Belize, Colombia, Costa Rica, Guatemala, Honduras, Mexico, and Panama -, as well as TSG international participants, attended the meeting. The main workshop organizers were the TSG, the Houston Zoo Inc. in the United States and The Belize Zoo and Tropical Education Center in Belize. Institutional support was provided by: IUCN/SSC Conservation Breeding Specialist Group (CBSG) Headquarters and Mexican Network; Association of Zoos & Aquariums (AZA) Tapir Taxon Advisory Group (TAG); European Association of Zoos & Aquaria (EAZA) Tapir Taxon Advisory Group (TAG). Financial support was provided by: Conservation International's Critical Ecosystem Partnership Fund (CEPF), United States; TSG Conservation Fund (TSGCF); Houston Zoo Inc., United States; U.S. Fish & Wildlife Service, Division of International Conservation, Latin America & the Caribbean Initiative, United States; Chicago Board of Trade Endangered Species Fund, Brookfield Zoo, Chicago Zoological Society, United States; Milwaukee County Zoological Gardens, United States; Parque XCARET, Mexico; Africam Safari, Mexico; World Association of Zoos and Aquariums (WAZA), Switzerland; Nashville Zoo at Grassmere, United States; Sedgwick County Zoo, United States; Virginia Zoological Gardens, United States; Bergen County Zoological Park, United States; Los Angeles Zoo, United States; San Diego Zoo, United States; Franklin Park Zoo, United States; Omaha's Henry Doorly Zoo, United States; Jacksonville Zoo and Gardens, United States; Louisiana Purchase Zoo, United States; Wuppertal Zoo, Germany; BREC's Baton Rouge Zoo, United States; Connecticut's Beardsley Zoo Conservation Fund, United States; Brevard Zoo, United States; Lee Richardson Zoo, United States, and Private Donors.

The "**Lowland Tapir Conservation Workshop: Population and Habitat Viability Assessment (PHVA)**" was held in the Sorocaba Zoo, São Paulo, Brazil, from 15 to 19 April 2007, being the milestone for the conclusion of the revision process of the Tapirs Action Plan, published in 1997. This last workshop had the active participation of around 80 representatives of the 11 lowland tapir range countries in all South America (Argentina, Bolivia, Brazil, Colombia, Ecuador, French Guyana, Guyana, Paraguay, Peru, Suriname and Venezuela).

The workshop was organized by the TSG in partnership with the Sorocaba Zoo in Brazil and the Houston Zoo Inc. in the United States. Institutional support was provided by: Municipality of Sorocaba, Brazil; Sorocaba Convention & Visitors Bureau, Brazil; IUCN/SSC Conservation Breeding Specialist Group (CBSG) - Brazilian Network and United States Headquarters; Copenhagen Zoo, Denmark; Association of Zoos & Aquariums (AZA) Tapir Taxon Advisory Group (TAG); European Association of Zoos & Aquaria (EAZA) Tapir Taxon Advisory Group (TAG); and IPÊ - Institute for Ecological Research, Brazil.

Financial support was provided by the following organizations: Alexandria Zoo, United States; Chicago Board of Trade Endangered Species Fund, Brookfield Zoo, Chicago Zoological Society, United States; Beardsley Zoo, United States; CNPq - Conselho Nacional de Desenvolvimento Científico e Tecnológico [National Counsel of Technological and Scientific Development], Brazil; Copenhagen Zoo, Denmark; Denver Zoo, United States; Dutch Foundation Zoos Help, The Netherlands; Emmen Zoo, The Netherlands; Evansville's Mesker Zoo, United States; Herberstein Zoo, Austria; Houston Zoo Inc., United States; TSG Conservation Fund (TSGCF); Los Angeles Zoo, United States; Miami Zoo, United States; Nashville Zoo at Grassmere, United States; Nature Conservation Trust, The Netherlands; Municipality of Sorocaba - FAMA PROJECT, São Paulo, Brazil; Rum Creek Preserve, United States; Safari de Peaugres, France; San Antonio Zoo and Aquarium, United States; San Diego Zoo, United States; San Francisco Zoo, United States; Sedgwick County Zoo, United States; Sorocaba Zoo, Brazil; Twycross Zoo, United Kingdom; U.S. Fish & Wildlife Service, Division of International Conservation, United States; Virginia Zoological Gardens, United States; Wildlife World Zoo, United States; World Association of Zoos and Aquariums (WAZA), Switzerland; Zoo de La Palmyre, France; Osnabrück Zoo, Germany; and Zlin-Lesna Zoo and Chateau, Czech Republic.

This very last event, as the three others which were previously carried out, was extremely successful and, from now on, we can say that the IUCN/SSC Tapir Specialist Group (TSG) has a prioritized, updated and new Action Plan for each one the four tapir species. Each one of the four plans focus on recommendations for the conservation of tapirs both in the wild and in captivity, also including capacity building and education actions, research priorities, definition of knowledge gaps and possibilities and demands for financial and human resources.

Action plans are designed to promote conservation actions in financial, technical, or logistical ways, influencing key players at the local, national, regional, and global levels. Action plans provide a common and neutral framework for a wide range of conservation professionals, providing support for decision-makers at the governmental level and for those who will actually implement the proposed actions in the field.

Scientists, natural resources managers, government officials, funding agencies, universities, zoos, community leaders and politicians, among others, use them in order to make decisions on how to allocate valuable resources. Action plans are also "snapshots in time", providing a baseline of data and information against which one can measure changes and monitor the progress of the actions, pointing where changes of emphasis or direction may be needed to conserve the species. Furthermore, Action Plans identify gaps in the research of a species and give directions for future endeavors, stimulating the acquisition of the most needed data and knowledge.

A lot of energy and hard work was necessary to raise the necessary funds for carrying out the four PHVA workshops for the four tapir species around the world. Therefore, the publication of this new Tapir Action Plan cannot be the conclusion of such efforts. The TSG will keep on working tirelessly in order to guarantee that this new plan be actively used by the professionals and organizations directly or indirectly involved with tapir conservation, and that all the actions listed as priorities be implemented.

This new Tapir Action Plan will be a **LIVING DOCUMENT**, which means it will be constantly reviewed, updated and adapted according to the changes in the conservation needs of the four species as they are identified in the coming years. To this end, the TSG has already established an Action Plan Implementation Task Force, which has an enormous responsibility. The Task Force is responsible for distributing and promoting the new Action Plan throughout all tapir range countries in Central and South America, and Southeast Asia, reaching all possible key organizations and professionals. In addition, the Task Force members will be constantly revising the Action Plan and providing technical assistance and support for the development of funding proposals, and the planning of political lobbying and negotiation. A very important outcome of these four PHVA Workshops was the creation of a network of the professionals and organizations committed to put into practice all the actions listed as priorities. Therefore, another major responsibility of the Task Force will be to keep in contact with these professionals and make sure they work on the implementation of the actions they are responsible for. Lastly, it is important to mention that the progress in implementing the Action Plan will be evaluated during the International Tapir Symposia, carried out by the TSG every three years.

# IUCN/SSC Conservation Breeding Specialist Group (CBSG)

The Conservation Breeding Specialist Group (CBSG) is also one of the 120 Specialist Groups of the Species Survival Commission (SSC) of the International Union for the Conservation of Nature (IUCN). With over a 1000 volunteer members from more than 100 countries, the CBSG is one of the largest Specialist Groups of the Commission. The CBSG has over 12 years of experience in the development, test, and implementation of tools and scientific processes for risk evaluation and decision-making in the context of species management. These tools, based on small populations and conservation biology, human demography and social learning dynamics, are used in workshops for problem-solving and the production of realistic and feasible recommendations for *in-situ* and *ex-situ* population management.

The process that is employed in the CBSG workshops produces an objective environment, providing the knowledge of specialists and a neutral facilitation with the aim to support information exchange among different stakeholders in order to reach some consensus in important issues related both to human beings and the wildlife. Through this understanding, it is possible to produce meaningful and practical recommendations. This process has been particularly successful in the compilation and integration of previously unpublished information, vital for the decision-making process.

The interactive and participatory approach of the CBSG workshops produces positive effects both on the decision-making of management issues and on the generation of social and political support for conservation actions by the members of local communities. Participants of these workshops recognize that management actions and policies need to be planned as part of a social and biological learning process. The CBSG workshops produce tools for the planning of decision-making and management programs, always based in sound science, and, at the same time, allowing new information and unexpected events to be meaningfully used for adjusting management practices. The swift production of reports from these workshops has an immediate impact in the stakeholders and decision makers.

## CBSG Regional Networks

The CBSG Headquarters is found in the United States. However, several Regional Networks were created and established in the last years. The CBSG Regional Networks use the previously created tools and processes in order to catalyze conservation actions where they are most needed. Each network adapts the tools so as they meet local demands and needs, strengthening their own practices and local experts, and creating a unique regional conservation identity. Through these networks, the CBSG tools can be used to help several countries fulfilling their commitments to the Convention on Biological Diversity. At present, the networks are established in several regions of the world, including India, South Asia, Indonesia, Japan, Central America, Mexico, Southern Africa and Europe. The CBSG Brazilian Network was founded more recently.

The CBSG Brazilian Network, the first CBSG Regional Network in South America, was formed in June 2004. The CBSG Brazilian Network is made up by a multidisciplinary group of volunteer conservationists, including a forestry engineer (Patrícia Medici) and three biologists (Leandro Jerusalinsky, Arnaud Desbiez, and Anders Gonçalves da Silva). All CBSG Brazilian Network members have been receiving training on the various aspects related to the conduction of the CBSG workshops (modeling, facilitation, disease risk assessment etc.). The Brazilian Network was created aiming to provide the Brazilian conservation organizations the access to the CBSG global network of conservation experts and to make available to them a set of unique tools for conservation action planning.

## The PHVA Workshop

The Population and Habitat Viability Assessment (PHVA) workshop, developed by the CBSG, is an efficient and systematic process employed in the development of strategic plans for the recovery of threatened species and their habitats. Both before and during a PHVA workshop, information and data on the demography, genetics and population ecology are compiled and integrated to estimates of anthropogenic threats, such as current and predicted land use patterns. Key to this process is the use of Vortex, a computer software which models population dynamics and, through simulations, assesses the risks of current and future population decline, an analysis which is based on specific population threats and under alternative management scenarios. These models integrate biological and social data and are an excellent tool for gathering information and formulating hypotheses, providing a tangible focus for a quantitative evaluation of management options. Participants develop management recommendations based on these and other analyses.

The success of a PHVA workshop depends on the participation of a group of different professionals and sectors, allowing the interchange of knowledge and technologies, consensus-building regarding threats and solutions and the mobilization of resources. The PHVA process is based on the contributions of the different stakeholders, attempting to balance the need to integrate, or at least connect, individuals from different disciplines and backgrounds centrally concerned with the species of interest. Taken together, both the population modeling and the intense discussion among stakeholder participants, which propose and discuss feasible solutions to address the issues affecting the species, allow making better conservation decisions for the conservation of the species being considered.

# Lowland Tapir Conservation Workshop
## Population and Habitat Viability Assessment (PHVA)

The main goal of the **Lowland Tapir Conservation Workshop** was to carry out a PHVA for the species, so as to revise its conservation status and identify conservation actions for its whole geographical range, in order to produce an updated International Action Plan. To reach this goal, the workshop gathered representatives of the species range countries, including researchers, governmental institutions, conservation organizations, zoological institutions, universities, local communities etc.

During the PHVA Workshop, participants develop their activities in small Working Groups, which focus their discussions on issues that were previously identified as crucial for the conservation of the species being analyzed. All the available information on the lowland tapir (specially its demographic parameters, mortality and birth rates, age structure, dispersion, distribution, available habitat and threats over its whole range) was compiled, systematized and discussed, and this whole body of information was used for determining conservation, management, and research priorities over its whole range.

The CBSG professionals that were responsible for the design and facilitation of the workshop are listed below.

## Facilitation

**Leandro Jerusalinsky**
Instituto Chico Mendes de Conservação da Biodiversidade (ICMBio), Centro de Proteção dos Primatas Brasileiros (CPB) [Chico Mendes Institute for Biodiversity Conservation (ICMBio), Brazilian Primates Protection Center (CPB)
Ph.D. Student, Universidade Federal do Estado da Paraíba (UFPB) [Federal University of the State of Paraíba], Brazil
Facilitator, CBSG Brasil

**Onnie Byers, Ph.D.**
Executive director, CBSG Headquarters

**Luis Carrillo**
Facilitator, CBSG México

## Modeling with the *Software* VORTEX

**Arnaud Desbiez, Ph.D.**
Royal Zoological Society of Scotland (RZSS), Scotland
EMBRAPA - Pantanal, Brazil
Vortex Modeler, CBSG Brasil

**Anders Gonçalves da Silva, Ph.D.**
Coordinator, Genetics Committee, IUCN/SSC Tapir Specialist Group (TSG)
Vortex Modeler, CBSG Brasil

**Robert Lacy, Ph.D.**
President, CBSG Headquarters

The workshop was officially opened during a cocktail at the Sorocaba Park Hotel, where the participants were accommodated, on the evening of April, 14th. The master of ceremony was **Dr. Rodrigo Hidalgo Teixeira**, veterinarian of the Sorocaba Zoo. **Dr. Adauto Luis Veloso Nunes**, director of the Sorocaba Zoo, and **Dr. Luis Antonio Ferrari**, Secretary of Urban Affairs and Environment of the Municipality of Sorocaba, were the first speakers to address the participants, officially opening the event and stressing the importance of carrying it out in the city of Sorocaba, in partnership with the Sorocaba Zoo. During his speech, Dr. Nunes shared with the participants the history of participation of the Sorocaba Zoo in the lowland tapir *ex-situ* conservation and breeding efforts in Brazil. Next, the IUCN/SSC Conservation Breeding Specialist Group (CBSG) representatives, **Dr. Robert Lacy**, President, and **Dr. Onnie Byers**, Executive Director, welcomed the participants, expressing the importance of this workshop, which completes the Action Plans for the four tapir species, also addressing the potential of using of this model of action planning for other species groups. **Mr. Alberto Mendoza**, President of the Tapir Taxon Advisory Group (TAG) of the American Association of Zoos and Aquariums (AZA) also addressed some acknowledgement words to the participants, mentioning the ever stronger partnership between the Tapir Specialist Group (TSG) and the Tapir TAG, which is being used as a model for the other TAGs of the Association. **Mr. Luis Bramante**, from the Convention & Visitors Bureau of Sorocaba, key institution in the process of organizing the event logistics at Sorocaba, also addressed the participants with welcoming and acknowledgement words. Lastly, **Patrícia Medici**, Chair of the IUCN/SSC Tapir Specialist Group (TSG), welcomed the participants as well, expressing gratitude to all the institutions involved in the organization of the event through logistic, institutional and/or financial support. In addition, Patrícia Medici stressed the importance of this last PHVA workshop as a historic event of the Tapir Specialist Group.

Next morning, April 15th, the first Plenary Session of the workshop was carried out, during which each participant was asked to introduce him(her)self and to explain the other participants which are, on his(her) point of view, the main threats faced by the lowland tapir and which are the main challenges in the short, medium and long term for the conservation of the species. The opinions of all participants were registered in cards, which were stuck to a board at the front of the room.

**During this first workshop plenary session, the following presentations were also made:**

- **Presentation about the IUCN/SSC Tapir Specialist Group (TSG) - Institutional & Action Planning Committee**
  Patrícia Medici, Chair, TSG / General Coordinator, CBSG Brasil
- **Presentation about the IUCN/SSC Conservation Breeding Specialist Group (CBSG) - Institutional & CBSG Brasil**
  Leandro Jerusalinsky, Facilitator, CBSG Brasil
- **Presentation about the Population and Habitat Viability Assessment (PHVA) Process**
  Leandro Jerusalinsky, Facilitator, CBSG Brasil
- **Presentation about the VORTEX *Software***
  Arnaud Desbiez, Modeler, CBSG Brasil
  Anders Gonçalves da Silva, Modeler, CBSG Brasil

**Next, there were presentations about the conservation status of the lowland tapir on each one of the species range countries, including conservation in the wild (*in-situ*) and in captivity (*ex-situ*):**

- **Conservation Status of the lowland tapir in Argentina**
  Diego Varela & Viviana B. Quse
- **Conservation Status of the lowland tapir in Bolivia**
  Guido Ayala
- **Conservation Status of the lowland tapir in Brazil**
  Patrícia Medici & Kevin Flesher
- **Conservation Status of the lowland tapir in Colombia**
  Olga Montenegro & Juliana Rodríguez
- **Conservation Status of the lowland tapir in Ecuador**
  Victor Utreras
- **Conservation Status of the lowland tapir in the Guyanas & Suriname**
  Benoit de Thoisy
- **Conservation Status of the lowland tapir in Paraguay**
  Miguel Morales
- **Conservation Status of the lowland tapir in Peru**
  Mathias Tobler
- **Conservation Status of the lowland tapir in Venezuela**
  Luis Guillermo Añez Galban & Pilar Alexander Blanco

**Based on the challenges that were listed by the participants regarding the conservation of the species, participants and facilitators identified six (6) Working Groups and two (2) Task Forces:**

- Habitat Management in Protected Areas Working Group
- Habitat Management outside Protected Areas Working Group
- Human Conflicts Working Group
- Education, Policy and Communication Working Group
- *Ex-Situ* Conservation Working Group
- Population Biology and Simulation Modeling Working Group
- Epidemiology Task Force
- Genetics Task Force

**Each working group was given the following tasks:**

- To discuss and refine the issues/threats that are relevant to the lowland tapir;
- To prioritize the issues;
- To develop a list of short- and long-term goals for each issue;

  **Definition of GOAL:** The goal must show the way to be followed in order to ensure the population viability of the lowland tapir.
- To prioritize the goals;
- To develop and prioritize detailed action steps for each goal, most of all for the high-priority ones;
- To identify the different types of resources required to implement each action step.

Each Working Group presented the results of its deliberations in Plenary Sessions, carried out throughout the workshop, in order to guarantee that all workshop participants had the opportunity to contribute to the work of the other groups and to ensure that every issue was revised and discussed by each Working Group, incorporating the suggestions raised by members of other groups during the plenary sessions.

## Goals of the Working Groups

In a PHVA workshop, it is essential to achieve a significant consensus level among all workshop participants and all Working Groups about the conservation goals for the lowland tapir. As a result, the workshop facilitators led the group through a process where the goals of all the Working Groups were prioritized by all participants according to a single selection criterion.

## Below are the prioritized goals produced by each working group:

### Habitat Management in Protected Areas Working Group

**GOAL 1:** To have, in five (5) years, a standardized program for lowland tapir population monitoring that is implemented in at least two (2) protected areas per lowland tapir range country (Argentina, Bolivia, Brazil, Colombia, Ecuador, French Guyana, Guyana, Paraguay, Peru, Suriname and Venezuela).

**GOAL 2:** To stimulate the development of strategies and research projects aimed at ensuring the viability of lowland tapir populations living in isolated and small protected areas, until 2010. To crosscut the actions according to the Final Report of the Lowland Tapir Range-Wide Assessment made during the Workshop of the Wildlife Conservation Society (WCS), carried out in April, 2005, in Santa Cruz, Bolivia.

**GOAL 3:** To stimulate participative strategic planning of protected areas in order to decrease by 50% the intensity of conflicting practices in five (5) years.

**GOAL 4:** To promote the inclusion of the biogeographic representativeness criterion (genetic-evolutionary-ecological diversity) in the National Systems of Protected Areas of lowland tapir range countries.

**GOAL 5:** To have well-equipped protected areas that also have trained human resources in enough numbers to make supervision actions more effective.

**GOAL 6:** To produce, until December 2008, a reference document containing recommendations of the Tapir Specialist Group (TSG) for minimizing the environmental impacts of enterprises on lowland tapir populations.

## Habitat Management outside Protected Areas Working Group

**GOAL 1:** To reduce the loss of lowland tapir habitat due to fires, human settlement, large scale agriculture and cattle ranching activities and enterprises. In the case of critically endangered populations, the reduction must be of 100%.

**GOAL 2:** To ensure the connectivity of the lowland tapir habitat.

**GOAL 3:** To promote the compensation for the habitat loss caused by large scale agriculture and cattle ranching activities, unsustainable extractive activities, human settlement and enterprises.

**GOAL 4:** To control lowland tapir hunting.

**GOAL 5:** To promote the incorporation of the environmental costs of the conventional production and the evaluation of environmental services.

**GOAL 6:** To promote the development of sustainable extractive productive activities.

**GOAL 5:** To reduce the occurrence and extent of fires.

**GOAL 6:** To improve the coordination among government levels and among countries.

**GOAL 7:** To recover the degraded areas considered to be priority for lowland tapir populations.

**GOAL 8:** To avoid the contamination produced by agriculture and cattle ranching activities, enterprises, human settlement and pollution.

## Human Conflicts Working Group

**GOAL 1:** To establish a management program for subsistence hunting which allows the recovery of lowland tapir populations that were reduced due to excessive hunting, and which ensures the dietary quality of those human populations that use the species.

**GOAL 2:** To reduce the impact of commercial hunting on lowland tapir populations within the species range.

**GOAL 3:** To reduce the impact of sportive hunting on lowland tapir populations within the species range.

**GOAL 4:** To mitigate the impact of road kill on lowland tapir populations within the species range.

**GOAL 5:** To reduce the impact of infrastructure projects, such as irrigation and flood control channels, on lowland tapir populations. To reduce tapirs' deaths caused by conflicts and human activities.

**GOAL 6:** To know the impact of poisoning and diseases transmitted by several etiological agents on lowland tapir populations.

**GOAL 7:** To minimize the impact of catastrophic human actions on lowland tapir populations.

## Education, Policy and Communication Working Group

**GOAL 1:** To develop education and policy methods aimed at multiple strategic audiences in order to produce an attitude change that results in a smaller habitat loss due both to governmental programs and the activities of extractive companies.

**GOAL 2:** To develop education and policy methods aimed at multiple strategic audiences in order to produce an attitude change that results in a smaller habitat loss due to the activities of local communities.

**GOAL 3:** To develop education and policy methods aimed at multiple strategic audiences in order to produce an attitude change that results in less hunting of the lowland tapir.

**GOAL 4:** To develop education and policy methods aimed at multiple strategic audiences in order to produce an attitude change that results in better communication among conservationists.

## *Ex-Situ* Conservation Working Group

**GOAL 1:** To have *Ex-Situ* Management Plans (Collection Plans) for the lowland tapir at the regional, national and international levels.

**GOAL 2:** To increase the participation of zoological institutions (zoos and breeding centers) in the conduction of research projects about the lowland tapir in captivity.

**GOAL 3:** To advance the ecological and biological valorization of the lowland tapir at the different levels of the society (managers and visitors of zoological institutions, governmental agencies, communities).

# Epidemiology Task Force

**GOAL 1:** To disseminate the need of research projects on lowland tapir health issues and to encourage the participation of veterinarians in field projects, as well as the need for researchers to foresee the importance of research programs on health issues within their fieldwork projects.

**SUB-GOAL 1.1:** To identify professionals willing to offer training opportunities, as well as their sites and availability periods, describing the opportunities according to the following criteria:

- Distribution among countries and regions;
- Characteristics of the working method;
- Period and capacity to accommodate the candidates;
- Selection criteria.

**GOAL 2:** To build an information network on lowland tapir health issues.

**SUB-GOAL 2.1:** To identify experts in the fields of epidemiology, pathology, microbiology (bacteriology, virology etc.), parasitology, clinical pathology, toxicology, nutrition and endocrinology.

**SUB-GOAL 2.2:** To identify reference laboratories for different countries and geographical regions.

**SUB-GOAL 2.3:** To thoroughly disseminate, via Internet, the available protocols on sanitary management and collection of biological data on tapirs (TSG Tapir Field Veterinary Manual - published in June 2007).

**SUB-GOAL 2.4:** To foster the revision of contents and to evaluate the need of new protocols for tapir health issues (TSG Tapir Field Veterinary Manual - published in June 2007).

**GOAL 3:** To establish a system of compilation, interpretation and diffusion of those epidemiological data that are applicable to the Population Viability Analysis (PVA).

**SUB-GOAL 3.1:** To create a database of global *in-situ* and *ex-situ* health data of the four tapir species.

**SUB-GOAL 3.2:** To create a health data processing system which can be employed in population viability models applied to the *Outbreak* software.

**GOAL 4:** To encourage *in-situ* and *ex-situ* research projects on health issues which produce more knowledge on:

Interactions between ticks and hematozoans;
Infectious diseases and zoonoses;
Environmental stress;
Contaminant toxic agents;
Diseases affecting reproduction;
Research models in epidemiology.

**SUB-GOAL 4.1:** To identify a group of professionals specialized on laboratory techniques; to establish a discussion network on the issue of health research projects aimed at the population viability of the four tapir species and to produce a manual about these laboratory techniques.

**SUB-GOAL 4.2:** To answer the demand of field researchers about poisoning episodes of the four tapir species.

# Prioritization of the Goals of all Working Groups

| GOAL | Species | AR | BR | BO | CO | EC | FG | GU | PA | PE | SU | VE | TOT |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| To reduce the loss of lowland tapir habitat due to fires, human settlement, large scale agriculture and cattle ranching activities and enterprises. In the cases of critically endangered populations the reduction must be of 100%. | **47** | **3** | **20** | **2** | **7** | **4** | **1** | **1** | **3** | | **3** | | **91** |
| To establish a management program for subsistence hunting which allows the recovery of lowland tapir populations that were reduced due to excessive hunting, and which ensures the dietary quality of those human populations that use the species. | **35** | **1** | **6** | **2** | **5** | **3** | **3** | **2** | **3** | **3** | **2** | **5** | **70** |
| To have *Ex-Situ* Management Plans (Collection Plans) for the lowland tapir at the international, national and regional levels. | **20** | **1** | **18** | | | **2** | | | **1** | | | | **42** |
| To ensure the connectivity of the lowland tapir habitat. | **20** | **2** | **9** | | **1** | | | | **2** | | | | **34** |
| To have, in five (5) years, a standardized program for lowland tapir population monitoring that is implemented in at least two (2) protected areas per lowland tapir range country (Argentina, Bolivia, Brazil, Colombia, Ecuador, French Guyana, Guyana, Paraguay, Peru, Suriname and Venezuela). | **20** | | **10** | **1** | **1** | **1** | | | | | | | **33** |
| To develop education and policy methods aimed at multiple strategic audiences in order to produce an attitude change that results in a smaller habitat loss due both to governmental programs and the activities of extractive companies. | **16** | | **3** | | **1** | **4** | **1** | | **2** | | **2** | | **29** |
| To stimulate the development of strategies and research projects aimed at ensuring the viability of lowland tapir populations living in isolated and small protected areas, until 2010. To crosscut the actions according to the Final Report of the Lowland Tapir Range-Wide Assessment made during the Workshop of the Wildlife Conservation Society (WCS), carried out in April, 2005, in Santa Cruz, Bolivia. | **13** | | **17** | | | **2** | | | | | | | **32** |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| To stimulate participative strategic planning of protected areas in order to decrease by 50% the intensity of conflicting practices in five (5) years. | **12** | **1** | **2** | | | **1** | | | **1** | | | | **17** |
| To promote the inclusion of the biogeographic representativeness criterion (genetic-evolutionary-ecological diversity) in the National Systems of Protected Areas of lowland tapir range countries. | **11** | | **10** | | | | | **2** | | | | | **23** |
| To reduce the impact of commercial hunting on lowland tapir populations within the species range. | **11** | | | | **1** | | **3** | | | | | | **15** |
| To develop education and policy methods aimed at multiple strategic audiences in order to produce an attitude change that results in less hunting of the lowland tapir. | **10** | | **2** | | | **2** | | | | **1** | | | **15** |
| To reduce the impact of sportive hunting on lowland tapir populations within the species range. | **10** | **3** | | | | | **1** | | **4** | | **2** | | **20** |
| To have well-equipped protected areas that also have trained human resources in enough numbers to make supervision actions more effective. | **9** | | **8** | | | **1** | | | **1** | | | | **19** |
| To produce, until December 2008, a reference document containing recommendations of the Tapir Specialist Group (TSG) for minimizing the environmental impacts of enterprises on lowland tapir populations. | **9** | | **6** | | | | | | | | | | **15** |
| To increase the participation of zoological institutions (zoos and breeding centers) in the conduction of research projects about the lowland tapir in captivity. | **9** | **1** | **8** | | | **1** | | | | | | | **19** |
| To promote the compensation for the habitat loss caused by large scale agriculture and cattle ranching activities, unsustainable extractive activities, human settlement and enterprises. | **8** | **4** | **4** | | **1** | **2** | | | **1** | | | | **20** |
| To control lowland tapir hunting. | **8** | | **2** | | | | **1** | | | **1** | | | **12** |
| To promote the development of sustainable extractive productive activities. | **6** | **3** | | | **1** | | | | | | | | **10** |
| To promote the incorporation of the environmental costs of the conventional production and the evaluation of the environmental services. | **6** | **1** | **1** | | **1** | **1** | | | | | | | **10** |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| To know the impact of poisoning and diseases transmitted by several etiological agents on lowland tapir populations. | **5** | | **3** | | **1** | | | | | | | | **9** |
| To reduce the occurrence and extent of fires. | **5** | | **5** | | | | | | | | | | **10** |
| To improve the coordination among government levels and among countries. | **5** | | | | **2** | | | | | | | | **7** |
| To develop education and policy methods aimed at multiple strategic audiences in order to produce an attitude change that results in a smaller habitat loss due to the activities of local communities. | **4** | | **5** | | | | | | | | **1** | | **10** |
| To recover the degraded areas considered to be priority for lowland tapir populations. | **4** | | **5** | | **1** | | | | | | | | **10** |
| To advance the ecological and biological valorization of the lowland tapir at the different levels of the society (managers and visitors of zoological institutions, governmental agencies, communities). | **3** | | **3** | | **1** | | | | | | | | **7** |
| To develop education and policy methods aimed at multiple strategic audiences in order to produce an attitude change that results in better communication among these audiences. | **3** | | **3** | | | **2** | | | | | | | **8** |
| To minimize the impact of catastrophic human actions on the lowland tapir populations. | **3** | | **5** | | **1** | | | | **1** | | | | **10** |
| To reduce the impact of infrastructure projects, such as irrigation and flood control channels, on lowland tapir populations. To reduce tapirs' deaths caused by conflicts and human activities. | **3** | | | | | | | | **1** | | | | **4** |
| To mitigate the impact of road kill on lowland tapir populations within the species range. | | | **5** | | | | | | | | | | **5** |
| To avoid the contamination produced by agriculture and cattle ranching activities, enterprises, human settlement and pollution. | | | | | | | | | | | | | **0** |
| **TOTAL** | **315** | **20** | **160** | **5** | **25** | **25** | **10** | **5** | **20** | **5** | **10** | **5** | |

# Prioritization of Goals for each Country

| Priority Goals ARGENTINA |
|---|
| **1.** To promote the compensation for the habitat loss caused by large scale agriculture and cattle ranching activities, unsustainable extractive activities, human settlement and enterprises. |
| **2.** To reduce the loss of lowland tapir habitat due to fires, human settlement, large scale agriculture and cattle ranching activities and enterprises. In the cases of critically endangered populations the reduction must be of 100%. |
| **3.** To reduce the impact of sportive hunting on lowland tapir populations within the species range. |

| Priority Goals BOLIVIA |
|---|
| **1.** To reduce the loss of lowland tapir habitat due to fires, human settlement, large scale agriculture and cattle ranching activities and enterprises. In the cases of critically endangered populations the reduction must be of 100%. |
| **2.** To establish a management program for subsistence hunting which allows the recovery of lowland tapir populations that were reduced due to excessive hunting, and which ensures the dietary quality of those human populations that use the species. |
| **3.** To have, in five (5) years, a standardized program for lowland tapir population monitoring that is implemented in at least two (2) protected areas per lowland tapir range country (Argentina, Bolivia, Brazil, Colombia, Ecuador, French Guyana, Guyana, Paraguay, Peru, Suriname and Venezuela). |

| Priority Goals BRAZIL |
|---|
| **1.** To reduce the loss of lowland tapir habitat due to fires, human settlement, large scale agriculture and cattle ranching activities and enterprises. In the cases of critically endangered populations the reduction must be of 100%. |
| **2.** To have *Ex-Situ* Management Plans (Collection Plans) for the lowland tapir at the international, national and regional levels. |
| **3.** To stimulate the development of strategies and research projects aimed at ensuring the viability of the lowland tapir populations living in isolated and small protected areas, until 2010. To crosscut the actions according to the Final Report of the Lowland Tapir Range-Wide Assessment made during the Workshop of the Wildlife Conservation Society (WCS), carried out in April, 2005, in Santa Cruz, Bolivia. |

| Priority Goals COLOMBIA |
|---|
| **1.** To reduce the loss of lowland tapir habitat due to fires, human settlement, large scale agriculture and cattle ranching activities and enterprises. In the cases of critically endangered populations the reduction must be of 100%. |
| **2.** To establish a management program for subsistence hunting which allows the recovery of lowland tapir populations that were reduced due to excessive hunting, and which ensures the dietary quality of those human populations that use the species. |
| **3.** To improve the coordination among government levels and among countries. |

| Priority Goals ECUADOR |
|---|
| **1.** To reduce the loss of lowland tapir habitat due to fires, human settlement, large scale agriculture and cattle ranching activities and enterprises. In the cases of critically endangered populations the reduction must be of 100%. |
| **2.** To develop education and policy methods aimed at multiple strategic audiences in order to produce an attitude change that results in a smaller habitat loss due both to governmental programs and the activities of extractive companies. |
| **3.** To establish a management program for subsistence hunting which allows the recovery of lowland tapir populations that were reduced due to excessive hunting, and which ensures the dietary quality of those human populations that use the species. |

| Priority Goals FRENCH GUYANA |
|---|
| **1.** To establish a management program for subsistence hunting which allows the recovery of lowland tapir populations that were reduced due to excessive hunting, and which ensures the dietary quality of those human populations that use the species. |
| **2.** To reduce the impact of commercial hunting on lowland tapir populations within the species range**.** |
| **3.** To reduce the loss of lowland tapir habitat due to fires, human settlement, large scale agriculture and cattle ranching activities and enterprises. In the cases of critically endangered populations the reduction must be of 100%. |

| Priority Goals GUYANA |
|---|
| **1.** To establish a management program for subsistence hunting which allows the recovery of lowland tapir populations that were reduced due to excessive hunting, and which ensures the dietary quality of those human populations that use the species. |
| **2.** To promote the inclusion of the biogeographical representativeness criterion (genetic-evolutionary-ecological diversity) in the National Systems of Protected Areas of lowland tapir range countries. |
| **3.** To reduce the loss of lowland tapir habitat due to fires, human settlement, large scale agriculture and cattle ranching activities and enterprises. In the cases of critically endangered populations the reduction must be of 100%. |

| Priority Goals PARAGUAY |
|---|
| **1.** To reduce the loss of lowland tapir habitat due to fires, human settlement, large scale agriculture and cattle ranching activities and enterprises. In the cases of critically endangered populations the reduction must be of 100%. |
| **2.** To establish a management program for subsistence hunting which allows the recovery of lowland tapir populations that were reduced due to excessive hunting, and which ensures the dietary quality of those human populations that use the species. |
| **3.** To ensure the connectivity of the lowland tapir habitat. |

| Priority Goals PERU |
|---|
| **1.** To establish a management program for subsistence hunting which allows the recovery of lowland tapir populations that were reduced due to excessive hunting, and which ensures the dietary quality of those human populations that use the species. |
| **2.** To develop education and policy methods aimed at multiple strategic audiences in order to produce an attitude change that results in less hunting of the lowland tapir. |
| **3.** To control lowland tapir hunting. |

| Priority Goals SURINAME |
|---|
| **1.** To reduce the loss of lowland tapir habitat due to fires, human settlement, large scale agriculture and cattle ranching activities and enterprises. In the cases of critically endangered populations the reduction must be of 100%. |
| **2.** To establish a management program for subsistence hunting which allows the recovery of lowland tapir populations that were reduced due to excessive hunting, and which ensures the dietary quality of those human populations that use the species. |
| **3.** To develop education and policy methods aimed at multiple strategic audiences in order to produce an attitude change that results in a smaller habitat loss due both to governmental programs and the activities of extractive companies. |

| Priority Goals VENEZUELA |
|---|
| **1.** To establish a management program for subsistence hunting which allows the recovery of lowland tapir populations that were reduced due to excessive hunting, and which ensures the dietary quality of those human populations that use the species. |

# Lowland Tapir (*Tapirus terrestris*) Conservation Workshop

## Population and Habitat Viability Assessment (PHVA)

**Sorocaba, São Paulo, Brazil**
**15 to 19 April, 2007**

# WORKING GROUP

# Habitat Management in Protected Areas

# Habitat Management in Protected Areas

## PARTICIPANTS

Adriane Aparecida de Morais – Brazil

Alexandre de Matos Martins Pereira – Brazil

Andréa Soares Pires – Brazil

Andressa Gatti – Brazil

Claudine Sakimin – Suriname

Daniel Brito – Brazil

Edsel Amorim Moraes Jr. – Brazil

Eduardo Venticinque – Brazil

Elias Sadalla Filho – Brazil

José Sinisterra Santana – Colombia

Leandro M. Scoss – Brazil

Marcos Adriano Tortato – Brazil

Mathias Tobler – Peru

Maurício Talebi Gomes – Brazil

Miguel A. Morales – Paraguay

Renato de Oliveira Affonso – Brazil

# PROBLEMS

For the start of the discussions of this Working Group, we considered the conservation challenges that were identified in the plenary session of the previous day, during which all participants expressed their opinions regarding the major challenges for the conservation of the lowland tapir in the short, medium and long-term. Several of these challenges were tied to habitat loss in protected areas, a topic which led to the creation of this Working Group. The listed challenges were discussed, grouped and revised, something that produced the following list of issues:

- Lack of regional initiatives for conservation of the lowland tapir and its habitat;
- Lack of broad and effective National Systems of Protected Areas;
- Lack of identification and maintenance of viable populations in protected areas;
- Lack of management plans for the protected areas: identification of priority action steps for the conservation of the lowland tapir on each area;
- Lack of creation of protected areas;
- Lack of effective patrolling of protected areas;
- Lack of connectivity among protected areas.

After this grouping, we carried out a brainstorming with the aim to raise the main threats to the protected areas containing lowland tapir populations.

## IDENTIFICATION OF THREATS

- Hunting
- Land ownership issues
- Logging
- Lack of control/patrolling
- Non-delimited indigenous areas
- Lack of biological information
- Presence of cattle and other domestic animals
- Agriculture
- Lack of planning and monitoring
- Deficiency and inefficiency of human resources
- Proximity to urban areas and agricultural areas
- Fire / Fires
- Isolation
- Roads / Highways
- Road kill
- Lack of information dissemination
- Infra structure projects
- Size and shape of Conservation Units

- Identification and regularization of RPPNs (Private Reserve of Natural Heritage)
- Invasion of exotic species
- Representativeness by region
- Lack of Management Plans
- Poorly planned tourism and public use
- Lack of economic alternatives
- Lack of articulation with neighboring communities
- Growth of the human population
- Mining
- Lack of involvement of universities
- Lack of training of human resources
- Degradation of the hydric system
- Problems of management and skills
- Lack of continuity of processes
- Lack of financial resources
- Lack of standard management protocols

We carried out a discussion in order to define the indirect and direct threats to the Conservation Units:

| DIRECT THREATS | INDIRECT THREATS |
|---|---|
| Hunting | Land ownership issues |
| Logging | Logging |
| Presence of cattle and other domestic animals | Lack of control/patrolling |
| Fire / Fires | Non-delimited indigenous areas |
| Isolation | Lack of biological information |
| Road kill | Agriculture |
| Infra structure projects | Lack of planning and monitoring |
| Size and shape of Conservation Units | Deficiency and inefficiency of human resources |
| Representativeness by region | Proximity to urban areas and agricultural areas |
| | Roads / Highways |
| | Lack of information dissemination |
| | Infra structure projects |
| | Invasion of exotic species |
| | Identification and regularization of RPPNs (Private Reserve of Natural Heritage) |
| | Lack of Management Plans |
| | Poorly planned tourism and public use |
| | Lack of economic alternatives |
| | Lack of articulation with neighboring communities |
| | Growth of the human population |
| | Mining |
| | Lack of involvement of universities |
| | Lack of training of human resources |
| | Degradation of the hydric system |
| | Problems of management and skills |
| | Lack of continuity of processes |
| | Lack of financial resources |
| | Lack of standard management protocols |

Subsequently, the Working Group started to discuss the effects of the lack of creation, implementation and effectiveness of protected areas on the conservation of lowland tapir populations in its whole geographical range.

Given the diversity of professionals and, above all, countries which were represented in the Working Group, there was no agreement among group members regarding different categories of protected areas and basic features of National Systems of Conservation Units, since these are different for each country. Therefore, the Working Group decided to use as a base the IUCN Protected Area Management Categories I and II (1994), common to all countries. These categories are the following ones:

**Category I** Areas for Strict Protection
Strict Nature Reserves and Wilderness Areas

**Category II** Areas for Ecosystem Protection and Recreation
National Parks

**IUCN (1994).** *Guidelines for Protected Area Management Categories*. IUCN Commission on National Parks and Protected Areas with the assistance of the World Conservation Monitoring Centre. IUCN, Gland, Switzerland.

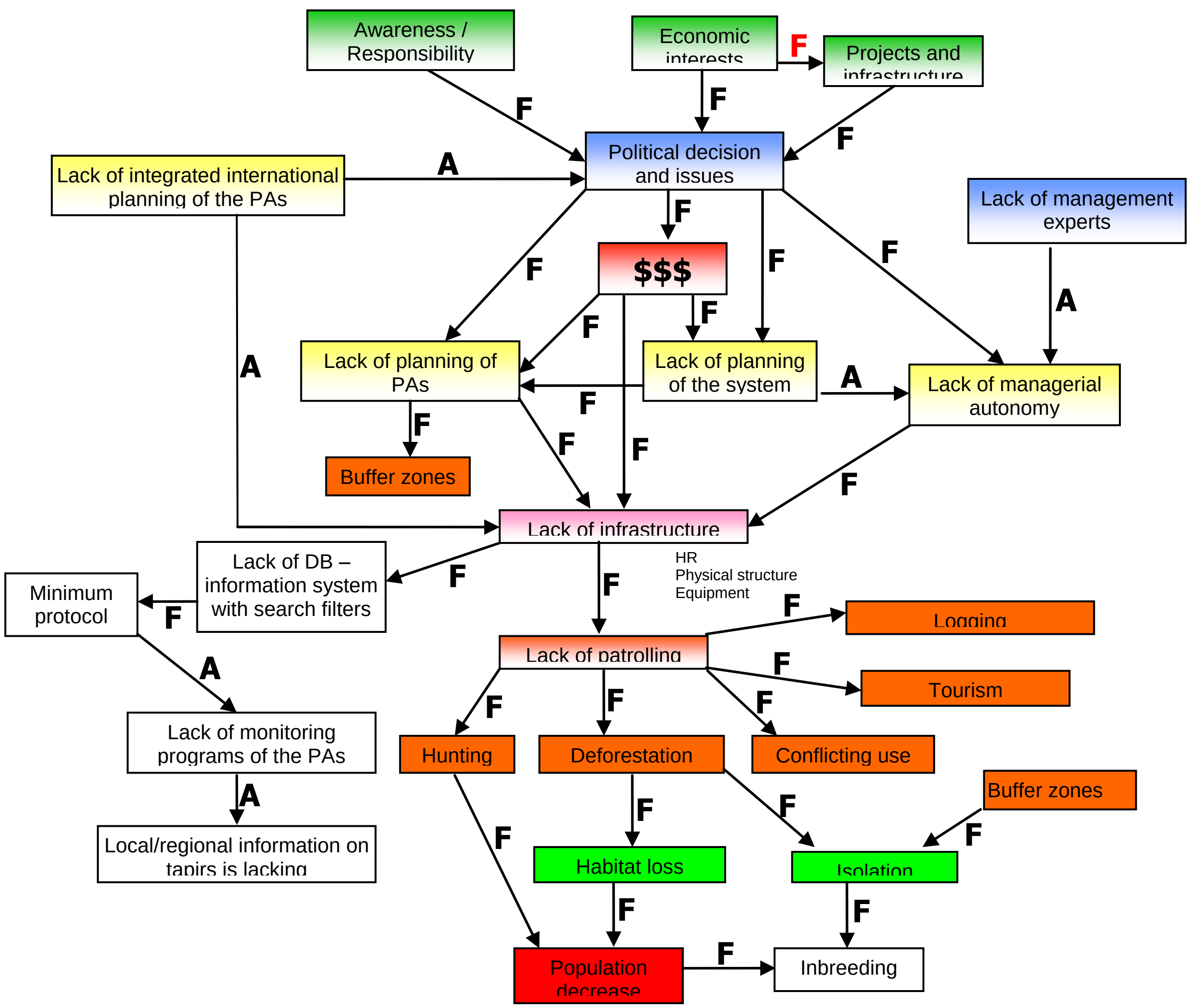
**Davey, A.G. (1998).** *National System Planning for Protected Areas.* IUCN, Gland, Switzerland and Cambridge, UK. x + 71pp.

## CLASSIFICATION OF FACTS (F) AND ASSUMPTIONS (A)

The following step was an extensive analysis of the flowchart, to define which problems were a Fact **(F)** and which were an Assumption **(A)**.

- The lack of information dissemination  determines the lack of knowledge: **(F)**
- Economic interests determine political decisions: **(F)**
- Economic interests influence the execution of construction/infrastructure projects: **(F)**
- Political decisions influence the execution of construction/infrastructure projects: **(F)**
- Politics *versus* infrastructure projects: **(F)**
- Expertise *versus* managerial autonomy: **(A)**
- Political decisions X managerial autonomy: **(F)**
- Political decisions and issues *versus* lack of planning of the PAs Systems: **(F)**
- Policy *versus* financial resources: **(F)**
- Political decisions *versus* planning: **(F)**
- International planning *versus* lack of political decisions: **(A)**
- Lack of managerial autonomy *versus* lack of infrastructure: **(F)**
- Lack of planning of the PAs Systems *versus* lack of planning of the PA: **(F)**
- Lack of planning of the PAs Systems *versus* managerial autonomy: **(A)**
- PA planning *versus* influence in the infrastructure: **(F)**
- Lack of integrated international planning *versus* infrastructure: **(A)**
- Lack of planning of the PAs Systems *versus* infrastructure: **(F)**
- Lack of resources *versus* infrastructure: **(F)**
- Infrastructure *versus* patrolling: **(F)**
- Infrastructure *versus* local and regional information on lowland tapir populations: **(F)**
- Information on the lowland tapir *versus* dissemination: **(F)**
- Lack of infrastructure *versus* lack of monitoring programs: **(F)**
- Lack of monitoring programs *versus* lack of regional information *versus* local: **(A)**
- Lack of minimum protocols: **(F)**
- Lack of a database *versus* lack of monitoring programs: **(A)**
- Patrolling *versus* illegal hunting: **(F)**
- Patrolling *versus* tourism, logging, conflicting use: **(F)**
- Patrolling *versus* deforestation: **(F)**
- Patrolling *versus* logging: **(F)**
- Patrolling worsen the conflicting use: **(F)**
- Deforestation *versus* isolation of lowland tapir populations: **(F)**
- Deforestation *versus* habitat loss: **(F)**
- Isolation *versus* inbreeding: **(F)**
- Habitat loss *versus* decline of lowland tapir populations: **(F)**
- Decline of lowland tapir populations *versus* inbreeding: **(F)**
- Illegal hunting *versus* decline of lowland tapir populations: **(F)**
- Lack of comprehensive planning *versus* influence in the buffer zones: **(F)**

# PROBLEMS FLOWCHART



# PROBLEM STATEMENTS

**PROBLEM 1:** The deficiency in the dissemination of information on the lowland tapir hinders political decision making and economical investments in the planning of protected areas within the distribution range of the species.

**PROBLEM 2:** The lack of financial resources hinders the planning and implementation of programs in protected areas and their effective protection for lowland tapir conservation.

**PROBLEM 3:** The lack of a minimum monitoring protocol hinders fundraising for the creation and implementation of lowland tapir monitoring programs in protected areas.

> **Note:** Definition of **MONITORING**: the systematic repetition of a parameter with a defined timeframe.

**PROBLEM 4:** The lack of an adequate infrastructure in those protected areas in which the lowland tapir occurs, due to the lack of National Systems of Protected Areas, management plans, managerial autonomy and financial support, leads to a deficient patrolling and conflicting use.

**PROBLEM 5:** Political and economical interests favor the implementation of works and infrastructure which affect the protected areas within the species distribution range.

**PROBLEM 6:** The lack of an integrated planning among the protected areas and their buffer zones results in conflicts which threatens lowland tapir population viability.

# PROBLEM PRIORITIZATION

When the process of problem prioritization began, this Working Group felt the need to include additional problems which tackled small and isolated areas and biogeographical representativeness. Based on such group demand, the main problems directly affecting lowland tapir populations were listed:

1. Conflicting use
2. Inadequate management
3. Infrastructure works
4. Areas with inadequate size
5. Representativeness of the areas
6. Isolation

Next, it was carried out a discussion on how to improve the description of some of the problems and, after that, prioritize them.

**PROBLEM 5:** Political and economical interests favor the implementation of works and infrastructure which affect the protected areas within lowland tapir distribution range.

a) The works should have more scientific data both in order to propose mitigatory actions which could minimize the impact and to have negotiation power to increase their implementation chances.
b) The inclusion of environmental variables in the political and economical decisions will favor lowland tapir populations in protected areas. To detail the environmental variables.

**<u>NEW DESCRIPTION OF THE PROBLEM</u>:** The process of implementation of works and infrastructure does not include environmental impact studies, hindering the development of mitigation proposals, and directly and negatively affecting the protected areas.

**PROBLEM 6:** The lack of an integrated planning among the protected areas and their buffer zones results in conflicts which threaten lowland tapir population viability.

a) To list the conflicting uses which lead to a decrease in the viability. To detail the problems.

**<u>NEW DESCRIPTION OF THE PROBLEM</u>:** The lack of an integrated planning among the protected areas and their buffer zones results in conflicting uses, such as deforestation, mining, agriculture, cattle, change in the hydrological regime, hunting, fire, among others, all of which cause habitat loss and changes, and isolation and reduction of lowland tapir populations.

# PRIORITIZED PROBLEMS

**PROBLEM 1:** Low population viability of the lowland tapir in small and isolated protected areas.

**PROBLEM 2:** Low representativeness of the biogeographic variation of the lowland tapir in the National Systems of Protected Areas of the different range countries, something that affects the species conservation in the long term.

**PROBLEM 3:** The lack of a minimum protocol hinders fundraising for the creation and implementation of lowland tapir monitoring programs in protected areas.

**PROBLEM 4:** The lack of an integrated planning among the protected areas and their buffer zones results in conflicting uses, such as deforestation, mining, agriculture, cattle, change in the hydrological regime, hunting, fire, among others, all of which cause habitat loss and alteration, and isolation and reduction of lowland tapir populations.

**PROBLEM 5:** The lack of an adequate infrastructure in the protected areas in which the lowland tapir occurs, due to the lack of National Systems of Protected Areas, management plans, managerial autonomy and financial support, leads to a deficient patrolling and conflicting use.

**PROBLEM 6:** The process of implementation of works and infrastructure does not include studies of environmental impact, hindering the development of mitigation proposals, and directly and negatively affecting the protected areas.

**PROBLEM 7:** The deficiency in the dissemination of information on the lowland tapir hinders political decision making and economical investments in the planning of protected areas within the distribution range of the species.

# GOALS

During this step, the Working Group defined goals and carried out an analysis about the sphere of influence of each one of the goals and the general kinds of actions that were required by them. Such approach made the process of structuring the goals easier, given the group was already thinking about the different kinds of actions to be designed in the next step:

**Ma** – Management
**Re** – Research
**Po** – Policy
**Ed** – Education

**PROBLEM 1:** Low population viability of the lowland tapir in small and isolated protected areas.

**GOAL 1:** To stimulate the development of strategies and research projects aimed at ensuring the viability of lowland tapir populations living in isolated and small protected areas, until 2010. To crosscut the actions according to the Final Report of the Lowland Tapir Range-Wide Assessment made during the Workshop of the Wildlife Conservation Society (WCS), carried out in April, 2005, in Santa Cruz, Bolivia, and to boost interactions among different activities. **Kind of Required Actions:** Re and Ma

**PROBLEM 2:** Low representativeness of the biogeographic variation of the lowland tapir in the National Systems of Protected Areas of the different range countries, something that affects the species conservation in the long term.

**GOAL 2:** To promote the inclusion of the biogeographic representativeness criterion (genetic-evolutionary-ecological diversity) in the National Systems of Protected Areas of the lowland tapir range countries. **Kind of Required Actions:** Re and Po

**PROBLEM 3:** The lack of a minimum protocol hinders fund raising for the creation and implementation of lowland tapir monitoring programs in protected areas.

**GOAL 3:** To have, in five (5) years, a standardized program for lowland tapir population monitoring that is implemented in at least two (2) protected areas per lowland tapir range country (Argentina, Bolivia, Brazil, Colombia, Ecuador, French Guyana, Guyana, Paraguay, Peru, Suriname and Venezuela). **Kind of Required Actions:** Re and Ma

**PROBLEM 4:** The lack of an integrated planning among the protected areas and their buffer zones results in conflicting uses, such as deforestation, mining, agriculture, cattle, change in the hydric regime, hunting, fire, among others, all of which cause habitat loss and changes, and isolation and reduction of lowland tapir populations.

**GOAL 4:** To stimulate participative strategic planning of protected areas in order to decrease by 50% the intensity of conflicting practices in five (5) years. **Kind of Required Actions:** Re, Ma, Ed and Po

**PROBLEM 5:** The lack of an adequate infrastructure in the protected areas in which the lowland tapir occurs, due to the lack of National Systems of Protected Areas, management plans, managerial autonomy and financial support, leads to a deficient patrolling and conflicting use.

**GOAL 5:** To have well-equipped protected areas that also have trained human resources in enough numbers to make supervision actions more effective. **Kind of Required Actions:** Re, Ma and Ed

**PROBLEM 6:** The process of implementation of works and infrastructure does not include environmental impact studies, hindering the development of mitigation proposals, and directly and negatively affecting the protected areas.

**GOAL 6:** To produce, until December 2008, a reference document containing recommendations of the Tapir Specialist Group (TSG) for minimizing the environmental impacts of enterprises on lowland tapir populations.

**Note:** The group decided that this goal should be treated by the **Human Conflicts Working Group**.

**PROBLEM 7:** The deficiency in the dissemination of information on the lowland tapir hinders political decision making and economical investments in the planning of protected areas within the distribution range of the species.

**Note:** The group decided that this goal should be treated by the **Education, Politicis and Communication Working Group**.

# PRIORITIZATION OF GOALS

**GOAL 1:** To have, in five (5) years, a standardized program for lowland tapir population monitoring that is implemented in at least two (2) protected areas per lowland tapir range country (Argentina, Bolivia, Brazil, Colombia, Ecuador, French Guyana, Guyana, Paraguay, Peru, Suriname and Venezuela).

**GOAL 2:** To stimulate the development of strategies and research projects aimed at ensuring the viability of lowland tapir populations living in isolated and small protected areas, until 2010. To crosscut the actions according to the Final Report of the Lowland Tapir Range-Wide Assessment made during the Workshop of the Wildlife Conservation Society (WCS), carried out in April, 2005, in Santa Cruz, Bolivia, and to boost interactions among different activities.

**GOAL 3:** To stimulate participative strategic planning of protected areas in order to decrease by 50% the intensity of conflicting practices in five (5) years.

**GOAL 4:** To promote the inclusion of the biogeographic representativeness criterion (genetic-evolutionary-ecological diversity) in the National Systems of Protected Areas of the lowland tapir range countries.

**GOAL 5:** To have well-equipped protected areas that also have trained human resources in enough numbers to make supervision actions more effective.

# ACTION PLAN

**PROBLEM:** The lack of a minimum protocol hinders fund raising for the creation and implementation of lowland tapir monitoring programs in protected areas.

**GOAL 1:** To have, in five (5) years, a standardized program for lowland tapir population monitoring that is implemented in at least two (2) protected areas per lowland tapir range country (Argentina, Bolivia, Brazil, Colombia, Ecuador, French Guyana, Guyana, Paraguay, Peru, Suriname and Venezuela).

**ACTION 1.1:** Preparation of a standard monitoring protocol for lowland tapir populations in protected areas.

**Responsibility:** Miguel Morales (Paraguay), Edsel Moraes Jr. (Brazil), Maurício Talebi (Brazil), Andressa Gatti (Brazil), Marcos Adriano Tortato (Brazil) and Adriane Morais (Brazil).
**Collaborators:** Researchers at the lowland tapir range countries.
**Deadline:** One (1) year for the preparation of the protocol / One (1) year for the publication.
**Indicators:** Published protocol and in process of implementation.
**Costs:** US$2,000 - US$4,000
**Consequences:** Standardized and comparable monitoring program.
**Obstacles:** Financial resources for carrying out methodological workshops.

**ACTION 1.2:** To establish partnerships among protected areas, governmental agencies, non-governmental organizations (NGOs) and private institutions in the lowland tapir range countries, aiming at implementing monitoring programs based on the standard protocol.

**Responsibility:** Andressa Gatti (Brazil), Alexandre de Matos Pereira (Brazil), Maurício Talebi (Brazil) and Miguel Morales (Paraguay).
**Collaborators:** Universities, research institutions, NGOs and governmental agencies.
**Deadline:** One (1) year.
**Indicators:** Number of partnerships made.
**Costs:** US$5,000 - US$10,000
**Consequences:** Acceptance and application of the minimum protocol in different countries.
**Obstacles:** Political and time problems.

**ACTION 1.3:** To identify at least two (2) protected areas per range country for the implementation of lowland tapir monitoring programs.

**Responsibility:** Claudine Sakimin (Suriname), Miguel Morales (Paraguay), Maurício Talebi (Brazil), Andressa Gatti (Brazil), Renato Affonso (Brazil) and Alexandre de Matos Pereira (Brazil).
**Collaborators:** Representatives of environmental bodies of each country and one NGO per country.
**Deadline:** Six (6) months
**Indicators:** Number of indicated areas per country.
**Costs:** US$5,000
**Consequences:** Identified areas for the implementation of monitoring programs
**Obstacles:** Lack of interest by the concerned parties, lack of financial resources and lack of available information on the protected areas on each country.

**ACTION 1.4:** To build capacity of field technicians for collecting data based on the methodology of the monitoring protocol.

**Responsibility:** Maurício Talebi (Brazil)

**Collaborators:** Tapir Specialist Group (TSG) Country Coordinators, protected areas, governmental agencies and NGOs.

**Deadline:** Six (6) to twelve (12) months after the publication of the monitoring protocol / After the implementation, continuous.

**Indicators:** Number of trained technicians.

**Costs:** US$20,000

**Consequences:** Data collected on an effective, standard and regular manner.

**Obstacles:** Funding to maintain the capacity-building program running in the long term.

**ACTION 1.5:** To build a database for the inclusion of the data and information collected through the monitoring programs. To include a policy for database use and access.

**Responsibility:** Edsel de Moraes Jr. (Brazil) and Mathias Tobler (Peru).

**Collaborators:** The remainder of the team which prepared the monitoring protocol.

**Deadline:** One (1) year after conclusion of the protocol.

**Indicators:** Implemented database.

**Costs:** US$5,000 - US$10,000

**Consequences:** Possibility of comparative analyses of the data, allowing a diagnosis of the species.

**Obstacles:** That the researchers do not feed the database and do not use the information for analyses.

**ACTION 1.6:** To periodically evaluate, in a standardized way, the lowland tapir monitoring programs in protected areas.

**Responsibility:** Tapir Specialist Group (TSG) Country Coordinators.

**Collaborators:** Researchers at the lowland tapir range countries, universities, governmental agencies, and NGOs.

**Deadline:** Three (3) years

**Indicators:** Completed evaluation of occurrence.

**Costs:** US$5,000

**Consequences:** Completed periodical evaluations, allowing assessing the effectiveness of the monitoring program and the management decision-making. A more effective management of the occurrence range.

**Obstacles:** Development and fulfillment of previous actions, lack of funding and availability of human resources.

**PROBLEM:** Low population viability of the lowland tapir in small and isolated protected areas.

**GOAL 2:** To stimulate the development of strategies and research projects aimed at ensuring the viability of lowland tapir populations living in isolated and small protected areas, until 2010. To crosscut the actions according to the Final Report of the Lowland Tapir Range-Wide Assessment made during the Workshop of the Wildlife Conservation Society (WCS), carried out in April, 2005, in Santa Cruz, Bolivia, and to boost interactions among different activities.

**ACTION 2.1:** To identify lowland tapir populations in small and isolated protected areas.

**Responsibility:** Miguel Morales (Paraguay), Marcos Adriano Tortato (Brazil) and José Sinisterra (Colombia).
**Collaborators:** Governmental agencies of each country, NGOs, private entities and universities.
**Deadline:** Two (2) years
**Indicators:** Number of surveyed areas and number of identified lowland tapir populations.
**Costs:** US$50,000/year
**Consequences:** Supply of subsidies for effective actions for lowland tapir conservation and planning of the protected areas.
**Obstacles:** Lack of human and financial resources, lack of logistics and lack of international cooperation.

**ACTION 2.2:** To evaluate the potential for improving conservation actions in the small and isolated protected areas identified through ACTION 1.

**Responsibility:** Tapir Specialist Group (TSG) Country Coordinators and TSG Regional Coordinators in Brazil.
**Collaborators:** Governmental agencies of each country, NGOs, private entities and universities.
**Deadline:** Two (2) to three (3) years
**Indicators:** Partnerships identified and established.
**Costs:** US$15,000 - US$20,000/area
**Consequences:** Setting up the necessary actions and initiatives for improving the situation of lowland tapir populations. Better knowledge of each population. Boosting of the actions.
**Obstacles:** Large number of identified areas, lack of financial and human resources.

**ACTION 2.3:** To identify the knowledge gaps in the Tapir Specialist Group (TSG) website and other media of information dissemination.

**Responsibility:** Gilia Angell, Webmaster & Coordinator, Tapir Specialist Group (TSG) Marketing Committee.
**Collaborators:** Researchers at the lowland tapir range countries.
**Deadline:** One (1) year after the compilation of information through other previous actions.
**Indicators:** Available information at the scheduled time.
**Costs:** US$2,000
**Consequences:** Focusing of research efforts towards priority study lines.
**Obstacles:** Dependence on the fulfilling of other actions.

**ACTION 2.4:** To develop a program for the support of research on lowland tapirs in the small and isolated protected areas.

**Responsibility:** Maurício Talebi (Brazil), Adriane Morais (Brazil), Andressa Gatti (Brazil), Leandro Scoss (Brazil), José Sinisterra (Colombia) and Miguel Morales (Paraguay).

**Collaborators:** Governmental agencies, universities, NGOs, and private entities.

**Deadline:** Five (5) years

**Indicators:** Prepared program documents and implementation of five (5) research grants in five (5) years.

**Costs:** US$5,000 for the general program and US$60,000 for the grants.

**Consequences:** To provide scientific back-up for decision-makers about the most effective conservation planning of lowland tapir populations.

**Obstacles:** Lack of human and financial resources.

**PROBLEM:** The lack of an integrated planning among the protected areas and their buffer zones results in conflicting uses, such as deforestation, mining, agriculture, cattle, change in the hydric regime, hunting, fire, among others, all of which cause habitat loss and changes, and isolation and reduction of lowland tapir populations.

**GOAL 3:** To favor participative strategic planning of protected areas in order to decrease by 50% the intensity of conflicting practices in five (5) years.

**ACTION 3.1:** To develop an identification guide of conflicting practices for the protected areas.

**Responsibility:** Tapir Specialist Group (TSG) Country Coordinators.
**Collaborators:** Governmental agencies and NGOs.
**Deadline:** Two (2) years
**Indicators:** Produced and disseminated guide.
**Costs:** US$15,000
**Consequences:** Management plans which are more effective for lowland tapir conservation.
**Obstacles:** Acceptance of the guide

**ACTION 3.2:** To carry out planning workshops with the populations that use protected areas and inhabit their buffer zones.

**Responsibility:** Managers, advisory councils with support from the Tapir Specialist Group (TSG) Country Coordinators.
**Collaborators:** Local agents, community leaders, management bodies.
**Deadline:** Five (5) years
**Indicators:** Number of workshops carried out.
**Costs:** Dependence on local actions.
**Consequences:** Decrease of the intensity of conflicting practices.
**Obstacles:** Lack of financial resources, motivation and production and acceptance of the identification guide of conflicting practices.

**PROBLEM:** Low representativeness of the biogeographic variation of the lowland tapir in the National Systems of Protected Areas of the different range countries, something that affects the species conservation in the long term.

**GOAL 4:** To promote the inclusion of the biogeographic representativeness criterion (genetic-evolutionary-ecological diversity) in the National Systems of Protected Areas of the lowland tapir range countries.

**ACTION 4.1:** To prepare and disseminate a reference document which raise awareness about the importance of biogeographic representativeness in the National Systems of Protected Areas.

**Responsibility:** Eduardo Venticinque (Brazil), Edsel Moraes Jr. (Brazil) and Mathias Tobler (Peru).
**Collaborators:** Tapir Specialist Group (TSG), Wildlife Conservation Society (WCS) and Biotrópicos (Brazil).
**Deadline:** Three (3) years
**Indicators:** Produced and disseminated documents.
**Costs:** US$10,000
**Consequences:** Awareness of the importance of the lowland tapir biogeographic representativeness criterion in the planning of the National Systems of Protected Areas.
**Obstacles:** Lack of human and financial resources.

**ACTION 4.2:** To carry out a gap analysis for the species.

**Responsibility:** Eduardo Venticinque (Brazil), Edsel Moraes Jr. (Brazil), Marcos Adriano Tortato (Brazil) and Mathias Tobler (Peru).
**Collaborators:** Tapir Specialist Group (TSG), governmental agencies, universities, NGOs, and private entities.
**Deadline:** Three (3) years
**Indicators:** Finished analysis in the scheduled time.
**Costs:** US$80,000
**Consequences:** To know the effectiveness of the National Systems of Protected Areas.
**Obstacles:** Lack of financial resources and lack of biogeographic information on the species.

**PROBLEM:** The lack of an adequate infrastructure in the protected areas in which the lowland tapir occurs, due to the lack of National Systems of Protected Areas, management plans, managerial autonomy and financial support, leads to a deficient patrolling and conflicting use.

**GOAL 5:** To have well-equipped protected areas that also have trained human resources in enough numbers to make supervision actions more effective.

**ACTION 5.1:** To build capacity of human resources in the protected areas where the lowland tapir monitoring program is implemented.

**Responsibility:** Team which will be carrying out the monitoring program on each selected area and Tapir Specialist Group (TSG) Country Coordinators.
**Collaborators:** Tapir Specialist Group (TSG), governmental agencies, universities, NGOs, and private entities.
**Deadline:** Five (5) years
**Indicators:** Number of trained persons.
**Costs:** US$10,000
**Consequences:** Improvement in the management of the protected areas.
**Obstacles:** Non-implemented monitoring program.

**ACTION 5.2:** To integrate the research and monitoring programs with the demands for the management of protected areas.

**Responsibility:** Team which will be carrying out the monitoring program on each selected area and Tapir Specialist Group (TSG) Country Coordinators.
**Collaborators:** Tapir Specialist Group (TSG), governmental agencies, universities, NGOs, and private entities.
**Deadline:** Five (5) years
**Indicators:** Amount of available resources.
**Costs:** US$30,000
**Consequences:** Increase in the effectiveness of the patrolling.
**Obstacles:** Lack of financial resources and local management.

# Lowland Tapir (*Tapirus terrestris*) Conservation Workshop

## Population and Habitat Viability Assessment (PHVA)

### Sorocaba, São Paulo, Brazil
### 15 to 19 April, 2007

# WORKING GROUP

# Habitat Management outside Protected Areas

# Habitat Management outside Protected Areas

## PARTICIPANTS

Andrés Arias Alzate – Colombia

Benoit de Thoisy – French Guyana

Carlos Pedraza – Colombia

Diego Varela – Argentina

Flavio Moschione – Argentina

José Luis Passos Cordeiro – Brazil

Juliana Ortiz Rodríguez – Colombia

Luis Fernando Sandoval Cañas – Ecuador

Luiz Gustavo R. Oliveira-Santos – Brazil

Marcelo Lima Reis – Brazil

Olivier Chassot – Costa Rica

Oswaldo de Carvalho Jr. – Brazil

Patrícia Medici – Brazil

# PROBLEMS

The Working Group began its activities discussing the conservation challenges identified in the plenary session of the previous day, during which all participants expressed their opinions to the remainder of the group regarding the major challenges for lowland tapir conservation in the short, medium and long-term. Several of these challenges were related to habitat loss outside protected areas, something that led to the creation of this Working Group. Among the listed challenges, those more directly related to this group were the following ones:

- Habitat loss
- Habitat fragmentation
- Habitat maintenance and conservation
- Identification and maintenance of viable lowland tapir populations
- Sustainable habitat use

A brainstorming was carried out for the generation of issues that were related to the topic of this Working Group. Next, they were grouped in general problems based on their affinities:

- Habitat fragmentation(PROBLEM 7)
- Agribusiness (PROBLEM 4)
- Exploitation of natural resources (PROBLEM 5)
- Human occupation (PROBLEM 1)
- Agriculture (PROBLEM 4)
- Issues of public order (PROBLEM 8)
- Small-scale agriculture (PROBLEM 1)
- Low value of forest resources (PROBLEM 8)
- Lack of basic biological and/or ecological information
- Fire (PROBLEM 6)
- Cattle (PROBLEM 4)
- Contamination (PROBLEM 2)
- Erosion (PROBLEM 4)
- Roads (PROBLEM 2)
- Hydroelectric plants (PROBLEM 2)
- Hunting (PROBLEM 5)
- Disorganized tourism (PROBLEM 3)
- Demand by/from new markets (PROBLEM 8)
- Habitat connectivity(PROBLEM 7)
- Lack of State control (PROBLEM 8)
- Developmental policies conflicting with conservation measures (PROBLEM 8)
- Lack of co-ordination among lowland tapir range countries (PROBLEM 8)
- Demographic pressure (PROBLEM 1)
- Mining companies (PROBLEM 5)
- Changes in land use pattern
- Negative perception of the lowland tapir (pejorative vision, Brazil)
- Deforestation (PROBLEM 7)

## PROBLEM GROUPING

**PROBLEM 1: Human occupation**

Small-scale agriculture
Demographic pressure / Growth of the human population
Human settlements

**PROBLEM 2: Infrastructure development (enterprises)**

Contamination
Road construction
Hydroelectric construction
Waterway construction
Tourism enterprises

**PROBLEM 3: Tourism**

Incorporated to the PROBLEM 2

**PROBLEM 4: Large-scale agricultural development**

Agriculture
Forestry
Cattle ranching
Soil erosion

**PROBLEM 5: Extraction of natural resources**

Logging
Exploitation of resources
Hunting
Mining
Contamination

**PROBLEM 6: Induced fires**

Fire

**PROBLEM 7: Habitat fragmentation and lack of connectivity**

Habitat fragmentation
Loss of habitat connectivity

**PROBLEM 8: Politics / Development / Conservation**

Low value of the forest resources
Lack of State control
Developmental policies conflicting with conservation measures
Lack of co-ordination among countries and among government levels

**OBS: Issues that were either discarded or incorporated by related issues:**

Lack of basic ecological information about the lowland tapir
Demand by new markets
Changes in land use pattern
Negative perception of the lowland tapir (pejorative vision, Brazil)
Disorganized tourism

# CLASSIFICATION OF FACTS (F) AND ASSUMPTIONS (a) and DESCRIPTION OF THE PROBLEMS

## PROBLEM 1: Human occupation

Economic, social, and political causes **(F)** ⇒ need for land **(F)** ⇒ **Human occupation** (agriculture, cattle ranching, settlements).

1 ⇒ habitat loss **(F)** ⇒ habitat fragmentation **(F)** ⇒ isolation of lowland tapir populations **(F)** ⇒ loss of genetic variability **(F)** ⇒ **impact on the lowland tapir population viability (A)**. **Note:** Another consequence of this process is the loss of plant species.

2 ⇒ habitat degradation **(F)** ⇒ habitat availability, quantity, and quality **(F)** ⇒ lack of resources in the environment **(F)** ⇒ **impact on the lowland tapir population viability (A)**.

3 ⇒ hunting increase **(F)** ⇒ reduction of population size **(F)** ⇒ it affects ecological processes of the ecosystem **(F)** ⇒ **reduction of habitat quality (F)**

4 ⇒ contamination by agriculture **(F)** ⇒ it makes the use of environmental resources (water) unfeasible **(F)** ⇒ **unknown consequences (?)**

5 ⇒ landscape connectivity barriers **(F)** ⇒ isolation of lowland tapir populations **(F)** ⇒ loss of genetic variability **(F)** ⇒ **impact on the lowland tapir population viability (A)**. **Note:** Another consequence of this process is the loss of plant species.

**Observations:** Human occupation results in many other consequences which overlap with other items. Regarding the issue of human settlements, in general terms the people have an origin in either rural social or urban economic exclusion processes, but countries have specificities on this respect.

**PROBLEM DESCRIPTION:** Social, economic and political factors (current and historical) generate the need for land for human settlements, causing habitat loss (fragmentation and isolation), habitat degradation (quality and availability), increase in hunting activities, pollution, fires and barriers in the landscape.

## PROBLEM 2: Enterprises

Political causes, economic growth and social compensation **(F)** ⇒ Deficient governmental planning **(F)** ⇒ **Poorly planned enterprise constructions** (oil/gas pipelines, roads, waterways, artificial lakes, companies, touristic enterprises, railways, mining and oil extraction) **(F)**.

1 ⇒ habitat loss **(F)** ⇒ habitat fragmentation **(F)** ⇒ isolation of lowland tapir populations **(F)** ⇒ loss of genetic variability **(F)** ⇒ **impact on the lowland tapir population viability (A)**. **Note:** Another consequence of this process is the loss of plant species.

2 ⇒ habitat degradation **(F)** ⇒ habitat availability, quantity, and quality **(F)** ⇒ lack of resources in the environment **(F)** ⇒ **impact on the lowland tapir population viability (A)**.

3 ⇒ contamination by enterprise construction **(F)** ⇒ makes the use of environmental resources (water) unfeasible **(F)** ⇒ **unknown consequences (?)**

4 ⇒ landscape connectivity barriers **(F)** ⇒ isolation of lowland tapir populations **(F)** ⇒ loss of genetic variability **(F)** ⇒ **impact on the lowland tapir population viability (A)**. **Note:** Another consequence of this process is the loss of plant species.

5 ⇒ Road kill **(F)** ⇒ **impact on the lowland tapir population viability (A)**.

6 ⇒ frontiers of development in areas of lowland tapir habitat **(F)** ⇒ easiness of access to the areas **(F)** ⇒ **idem human occupation**

6.1 ⇒ Fires, hunting, agriculture.

**PROBLEM DESCRIPTION:** The lack of governmental planning in its response to economic needs and social investments leads to the development of enterprises which threaten the viability of lowland tapir populations. These enterprises cause habitat loss and degradation, barriers, pollution, and also open new invasion fronts which cause increase in fires, hunting and future agricultural/cattle ranching projects.

## PROBLEM 3: Large scale agricultural/cattle ranching activities

Increase in the human food demand **(F)**, world energy demand (poorly planned actions) **(F)** and income accumulation **(F)** ⇒ need for production areas **(F)** ⇒ **large scale agriculture/cattle ranching activities** (single-crop farming, cattle ranching) **(F)**.

1 ⇒ habitat loss **(F)** ⇒ habitat fragmentation **(F)** ⇒ isolation of lowland tapir populations **(F)** ⇒ loss of genetic variability **(F)** ⇒ **impact on the lowland tapir population viability (A)**. **Note:** Another consequence of this process is the loss of plant species.

2 ⇒ habitat degradation **(F)** ⇒ habitat availability, quantity, and quality **(F)** ⇒ lack of resources in the environment **(F)** ⇒ **impact on the lowland tapir population viability (A)**.

3 ⇒ contamination by agriculture/cattle ranching **(F)** ⇒ makes the use of environmental resources (water) unfeasible **(F)** ⇒ **unknown consequences (?)**

4 ⇒ landscape connectivity barriers **(F)** ⇒ isolation of lowland tapir populations **(F)** ⇒ loss of genetic variability **(F)** ⇒ **impact on the lowland tapir population viability (A)**. **Note:** Another consequence of this process is the loss of plant species.

5 ⇒ Displacement of local populations **(F)**

5.1 ⇒ Cultural loss of land use patterns **(F)**

5.2 ⇒ New fronts of human occupation **(F)**

**PROBLEM DESCRIPTION:** Large scale agriculture/cattle ranching activities - The increase in the world food and energy demand requires the opening of new areas to fulfill those needs, a practice which comes with inadequate planning, something that causes habitat loss and degradation, barriers, pollution, and also displacement of local human populations, leading to cultural loss of land use patterns and new fronts of human occupation. All those consequences reflect in the viability of lowland tapir populations.

## PROBLEM 4: Unsustainable extractive activities

Lack of sustainable experiences, competition with illegal activities, subsistence, need for wood ⇒ **Unsustainable extractive activities** (cutting, hunting, woody and non-woody forest products).

> 1 ⇒ habitat loss **(F)** ⇒ habitat fragmentation **(F)** ⇒ isolation of lowland tapir populations **(F)** ⇒ loss of genetic variability **(F)** ⇒ **impact on the lowland tapir population viability (A)**. **Note:** Another consequence of this process is the loss of plant species.
>
> 2 ⇒ habitat degradation **(F)** ⇒ habitat availability, quantity, and quality **(F)** ⇒ lack of resources in the environment **(F)** ⇒ **impact on the lowland tapir population viability (A)**.
>
> 3 ⇒ hunting **(F)**

**Observation:** Some of the large oil and mining companies carry out extensive programs of environmental compensation. Nonetheless, other companies do show large problems in the planning of compensation and mitigation programs. We discussed ideas on habitat change as favoring lowland tapir populations.

**PROBLEM DESCRIPTION:** The lack of sustainable experiences, the commercial competition with illegal activities, the subsistence and the demand for wood attract unsustainable cutting and hunting extractive activities which decrease the viability of lowland tapir populations and habitats.

## PROBLEM 5: Fires

Economic need **(F)** ⇒ cheapest management method **(F)** ⇒ opening and management of pastures and crops **(F)** ⇒ caused / induced / accidental / illegal **(F)** / cigarette **(A)**, bonfire, hunting, fire belts, cleaning **(F)** ⇒ **Fire** ⇒ habitat availability, quantity, and quality, habitat fragmentation **(F)** ⇒ lack of resources in the environment **(F)** ⇒ **impact on the lowland tapir population viability (A)**.

**PROBLEM DESCRIPTION:** Accidental fires caused by cleaning off fire belts, cigarette butts, and garbage burning, as well as fires caused by hunting activities and as a cheap and traditional tool in the agriculture/cattle ranching management (sugar cane, pastures, slash and burn) affects habitat quality and availability. This leads to a lack of habitat resources, something that jeopardizes lowland tapir population viability.

## PROBLEM 6: Developmental policy *versus* conservation

Market determinism **(F)**, ability to enforce a government in place **(F)**, lack of coordination among the different governmental levels and among countries **(F)**, there is no established value for environmental goods and services **(A)**, the development lines do not offset the environmental changes **(F)** ⇒ **Development policies *versus* conservation** (F).

1 ⇒ Lack of patrolling and lack of law enforcement

2 ⇒ Planning that does not consider environmental policies

**Observation:** 1 and 2 are causes **(F)** of the previously discussed items.

**PROBLEM DESCRIPTION:** The opposition between development policies and the conservation objective, which is caused by market determinism and lack of ability to enforce a government in place, together with the lack of established value for environmental goods and services, produces lack of control/patrolling and law enforcement and lack of conservation planning. This reflects in the human occupation processes, large scale agricultural/cattle ranching development, enterprises and extractive activities, which, in turn, decreases lowland tapir population viability.

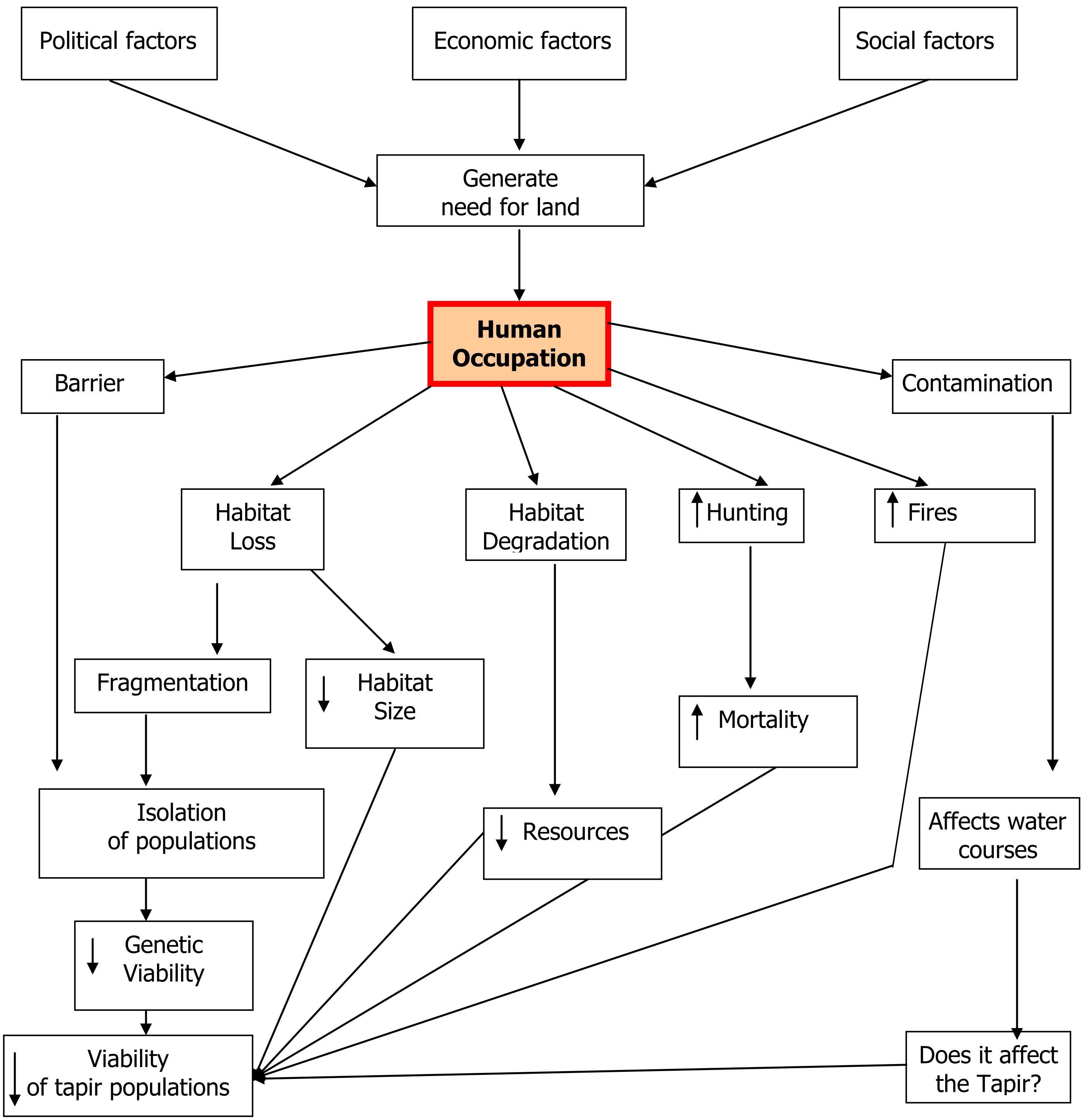
### Broad range issues, set aside for later analysis:

The issues listed below were identified as important ones, but were left aside because we considered them to be hard reaching. Nonetheless, these issues will be available to be incorporated whenever possible in the phases of goals and actions:

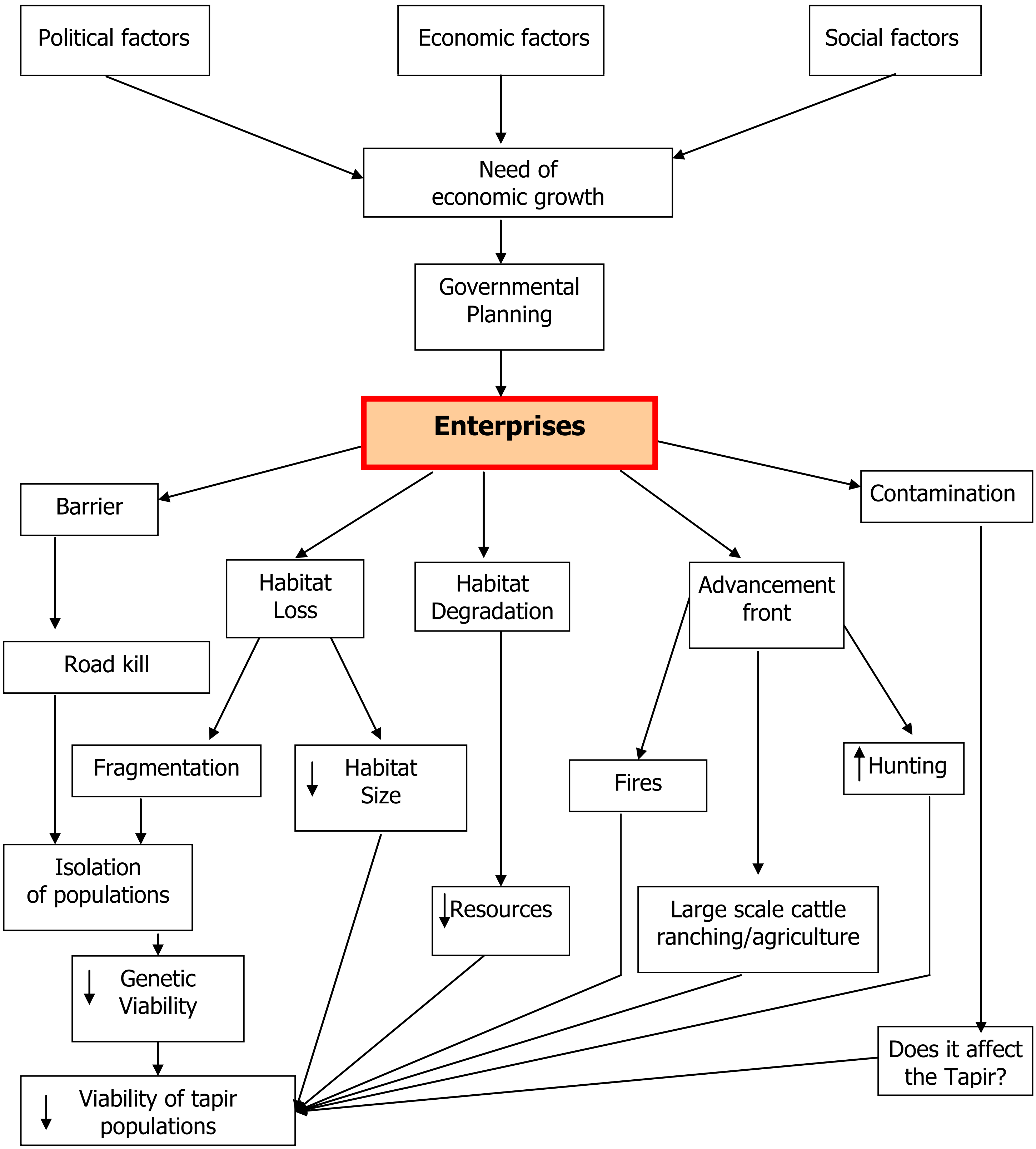
- Political conflicts / Public issues
- Climactic changes
- Regularization of land ownership

## FLUXOGRAM OF PROBLEMS

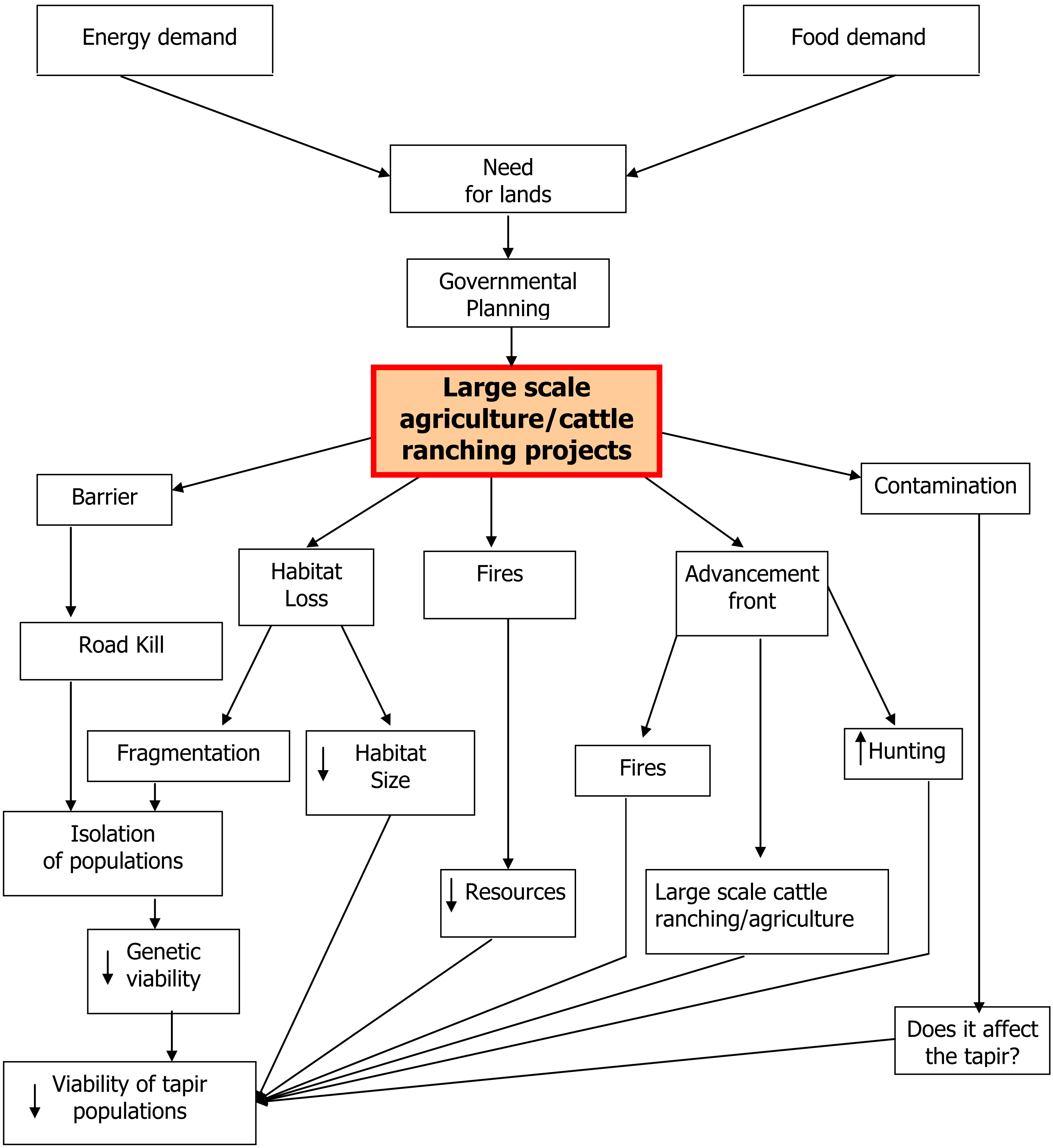
### PROBLEM 1: Human occupation



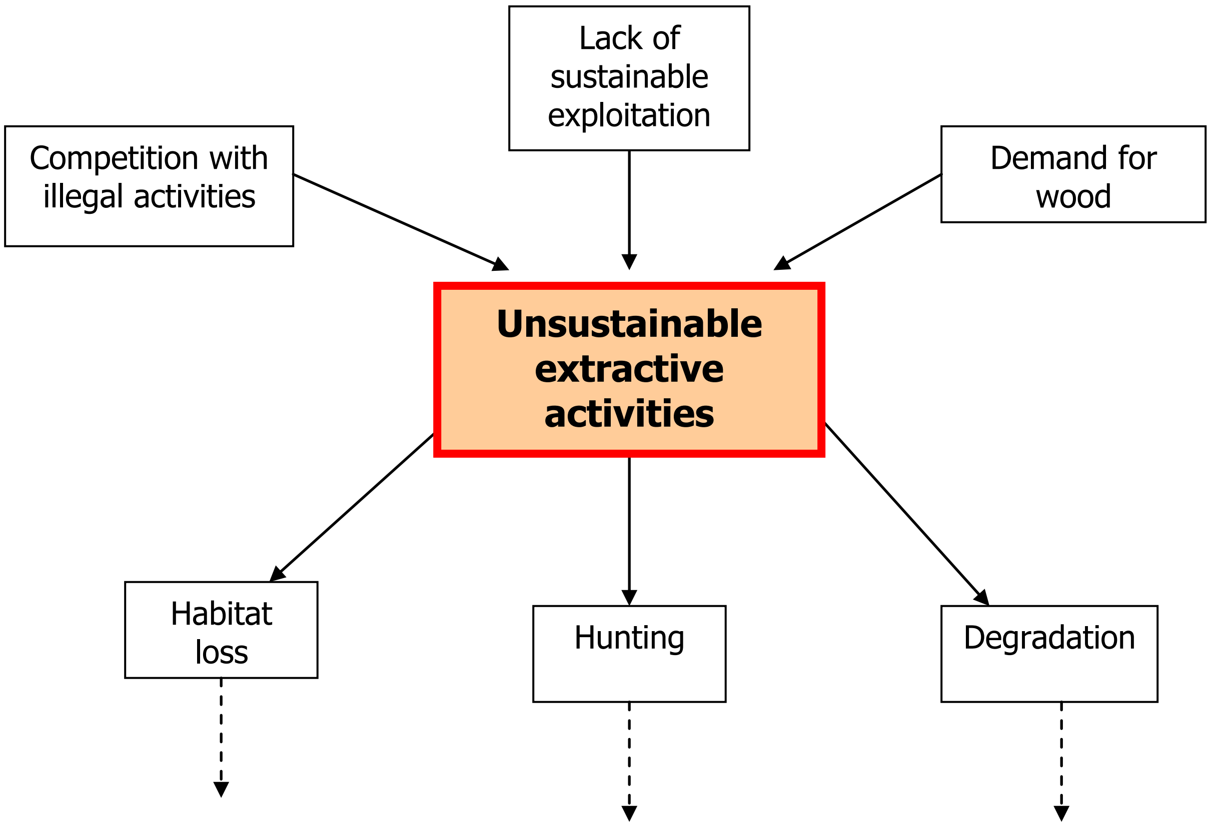
## PROBLEM 2: Enterprises



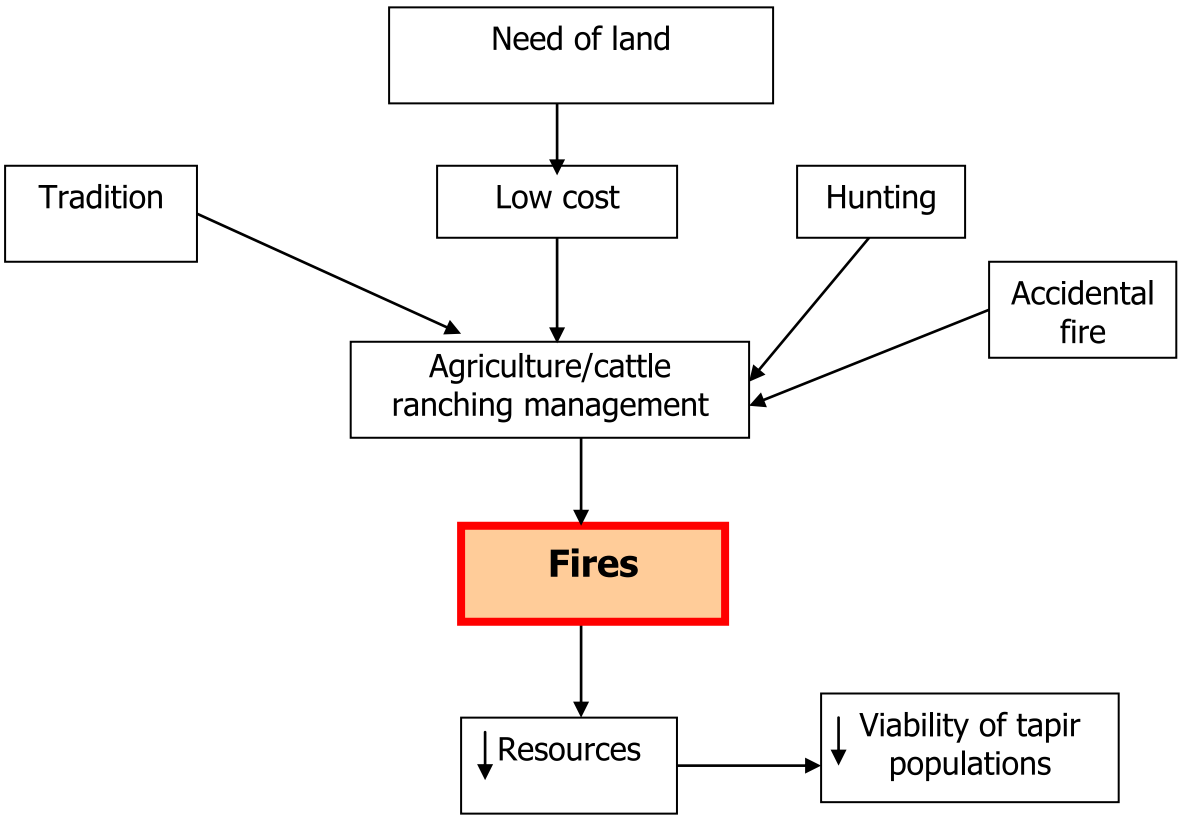
## PROBLEM 3: Large scale agricultural/cattle ranching projects



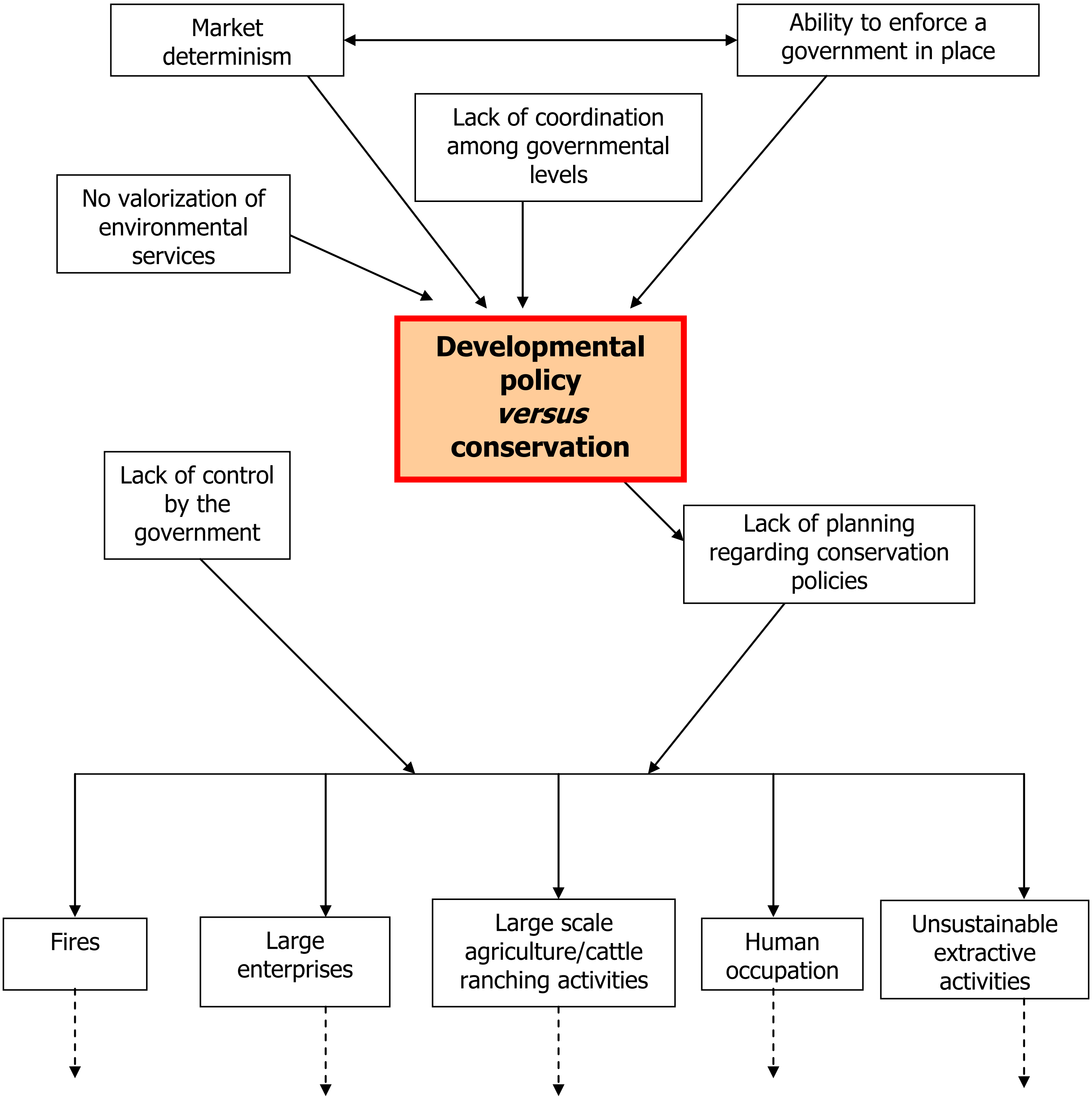
## PROBLEM 4: Unsustainable extractive activities



## PROBLEM 5: Fires



**PROBLEM 6: Developmental policy *versus* conservation**



## PRIORITIZATION OF PROBLEMS

The problems were prioritized through individual voting and the result was as follows:

**PROBLEM 1:** Large scale agriculture/cattle ranching activities - The increase in the world food and energy demand requires the opening of new areas to fulfill those needs, a practice which comes with inadequate planning, something that causes habitat loss and degradation, barriers, pollution, and also displacement of local human populations, leading to cultural loss of land use patterns and new fronts of human occupation. All those consequences reflect in the viability of lowland tapir populations.

**PROBLEM 2:** Human occupation - Social, economic and political factors (current and historical) generate the need for land for human settlements, causing habitat loss (fragmentation and isolation), habitat degradation (quality and availability), increase in hunting activities, pollution, fires and barriers in the landscape.

**PROBLEM 3:** Enterprises - The lack of governmental planning in its response to economic needs and social investments leads to the development of enterprises which threaten the viability of lowland tapir populations. These enterprises cause habitat loss and degradation, barriers, pollution, and also open new invasion fronts which cause increase in fires, hunting and future agricultural/cattle ranching projects.

**PROBLEM 4:** Unsustainable extractive activities - The lack of sustainable experiences, the commercial competition with illegal activities, the subsistence and the demand for wood attract unsustainable cutting and hunting extractive activities which decrease the viability of lowland tapir populations and habitats.

**PROBLEM 5:** Fires - Accidental fires caused by cleaning off fire belts, cigarette butts, and garbage burning, as well as fires caused by hunting activities and as a cheap and traditional tool in the agriculture/cattle ranching management (sugar cane, pastures, slashing) affects habitat quality and availability. This leads to a lack of habitat resources, something that jeopardizes lowland tapir population viability.

**Observation:** The problem "Developmental policy *versus* conservation" was not considered in the prioritization process given it operates at a higher causal level than the others.

# QUANTIFICATION OF PROBLEMS

The quantifiable and unquantifiable parts of the flowcharts were defined, along with the variables that could be modeled through simulations of the VORTEX software. The quantifiable parts were coded according to the following criteria:

**D** – Dispersion
**K** – Carrying capacity
**S** – Death and Survivorship
**F** – Fertility

### Large scale agriculture/cattle ranching activities

**K** – Habitat loss, degradation
**D** – Habitat loss, degradation, barriers
**S** – Road kill, contamination (?)
**F** – Contamination (?)

### Human occupation

**K** – Habitat loss, degradation, fires, isolation
**D** – Barriers, hunting, habitat loss
**S** – Hunting, fires, contamination (?)
**F** – Contamination (?)
**Catastrophe** - Fires

### Enterprises

**K** – Habitat loss, degradation
**D** – Habitat loss, barriers, hunting
**S** – Road kill, hunting, contamination (?)
**F** – Contamination (?)

### Unsustainable extractive activities

**K** – Habitat loss, degradation
**D** – Habitat loss, degradation, hunting
**S** – Hunting

### Fires

**K** – Fires
**S** – Fires
**Catastrophe** – Fires

# KIND OF ACTIONS REQUIRED FOR THE PROBLEMS

All cause-effect relationships of the flowcharts were identified according to the kind of required action. The four categories below were used by the group:

**Ma** – Management
**Re** – Research
**Po** – Politics
**Ed** – Education

### Large scale agriculture/cattle ranching activities

**Ma** – Habitat loss, degradation, pollution, new fronts of human occupation
**Po** – Planning of the land distribution, habitat loss, degradation, pollution, new fronts of human occupation
**Re** – Barriers
**Ed** – Pollution, education

### Human occupation

**Ma** – Habitat loss, habitat degradation, hunting, fires, pollution, landscape barriers
**Po** – Habitat loss, habitat degradation, pollution, landscape barriers
**Re** – Genetic variability
**Ed** – Hunting, fires, pollution, landscape barriers

### Enterprises

**Ma** – Road kill, habitat loss, frontiers of development
**Po** – Road kill, habitat loss, frontiers of development
**Ed** – Road kill

### Unsustainable extractive activities

**Ma** – Competition with illegal activities, lack of examples of sustainable management, hunting, habitat loss
**Po** – Competition with illegal activities, demand for timber
**Re** – Hunting, habitat degradation
**Ed** – Lack of models of sustainable management, hunting

### Fires

**Ma** - Fires
**Ed** – Fires

# GOALS

Based on the problems which were identified in the preceding steps, the group determined the relevant goals to solve them. Given the large range of biomes and socio-political issues in the lowland tapir range countries, some goals had fairly general characteristics.

- **Habitat loss**

  **GOAL 1:** To reduce the loss of lowland tapir habitat due to fires, human settlement, large scale agricultural and cattle ranching activities and enterprises. In the case of critically endangered populations, the reduction must be of 100%.

| Impacts which suppress habitat | Goal of reduction in the habitat loss rate (%) | Time (years) |
|---|---|---|
| Unsustainable extractive activities | 100 | 5 |
| Human occupation | 80 | 5 |
| Fires | 100 | 5 |
| Large scale agriculture/cattle ranching activities | 50 | 5 |

  **Note:** There was a lot of discussion on how to assign percentage values for the goals of habitat loss reduction. There was an attempt to create values for the different biomes where lowland tapir occurs, but this approach was abandoned because the Working Group considered the figures to be imprecise. The issue caused long discussion sessions which were not solved through consensus.

  **GOAL 2:** To promote the compensation for the habitat loss caused by large scale agriculture and cattle ranching activities, unsustainable extractive activities, human settlement and enterprises.

- **Habitat degradation**

  **GOAL 3:** To recover the degraded areas considered to be priority for lowland tapir populations.

- **Hunting**

  **GOAL 4:** To control lowland tapir hunting.

- **Fires**

  **GOAL 5:** To reduce the occurrence and extent of fires.

- **Contamination**

  **GOAL 6:** To avoid the contamination produced by agriculture and cattle ranching activities, enterprises, human settlement and pollution.

- **Barriers to habitat connectivity**

  **GOAL 7:** To ensure the connectivity of the lowland tapir habitat.

- **Unsustainable extractive activities**

  **GOAL 8:** To promote the development of sustainable extractive productive activities.

- **Developmental policy *versus* conservation actions**

  **GOAL 9:** To promote the incorporation of the environmental costs of the conventional production and the evaluation of environmental services.

  **GOAL 10:** To improve the coordination among government levels and among countries.

## PRIORITIZATION OF GOALS

All the goals developed by all the Working Groups were presented in a plenary session and prioritized. The goals of the Habitat Management outside Protected Areas Working Group were prioritized as follows:

**GOAL 1:** To reduce the loss of lowland tapir habitat due to fires, human settlement, large scale agriculture and cattle ranching activities and enterprises. In the case of critically endangered populations, the reduction must be of 100%.

**GOAL 7:** To ensure the connectivity of the lowland tapir habitat.

**GOAL 2:** To promote the compensation for the habitat loss caused by large scale agriculture and cattle ranching activities, unsustainable extractive activities, human settlement and enterprises.

**GOAL 4:** To control lowland tapir hunting.

**GOAL 9:** To promote the incorporation of the environmental costs of the conventional production and the evaluation of environmental services.

**GOAL 8:** To promote the development of sustainable extractive productive activities.

**GOAL 5:** To reduce the occurrence and extent of fires.

**GOAL 10:** To improve the coordination among government levels and among countries.

**GOAL 3:** To recover the degraded areas considered to be priority for lowland tapir populations.

**GOAL 6:** To avoid the contamination produced by agriculture and cattle ranching activities, enterprises, human settlement and pollution.

# ACTION PLAN

**ACTION 1:** To create new protected areas.

**Description:** At the areas which were identified as priority for lowland tapir conservation and without representativeness in the National Systems of Protected Areas, lobbies will be carried out for the creation of protected areas.
**Responsibility:** Benoit de Thoisy (north), Flávio Moschione (Argentina), Marcelo Lima Reis (Brazil), Juliana Rodríguez (Colombia), Luis Sandoval and Leonardo Ordoñez Delgado (Ecuador).
**Collaborators**: Governmental agencies (National Systems of Protected Areas), NGOs, IUCN Protected Areas Commission, civil society, other IUCN Specialist Groups.
**Deadline:** Five (5) years
**Indicators:** Number of proposals and number of protected areas.
**Costs:** ---
**Consequences:** Increase in the surface of protected areas with available habitat for the lowland tapir.
**Obstacles:** Border conflicts, competition with projects for economic development (political will), lack of information exchange among countries.

**ACTION 2:** To form a working group for monitoring habitat loss and degradation in the areas where lowland tapir occurs.

**Description:** To form a technical group that will be responsible for investigating and documenting the habitat changes and reporting them to the control/patrolling organs
**Responsibility:** José Luís Cordeiro (Brazil) and Carlos Pedraza (Colombia).
**Collaborators**: Governmental agencies, NGOs and research institutions.
**Deadline:** One (1) year
**Indicators:** The creation of the group and the production of the first document.
**Costs:** US$5,000
**Consequences:** Information on habitat loss.
**Obstacles:** Lack of basic information and difficulties in the exchange of information among countries.

**ACTION 3:** To update the process of defining priority areas for lowland tapir conservation.

**Description:** To refine the map of priority areas for the lowland tapir by including information about gaps. To prioritize the areas for each country and biome.
**Responsibility:** Tapir Specialist Group (TSG) Country Coordinators.
**Collaborators**: Tapir Specialist Group (TSG) Members throughout all the species geographical range.
**Deadline:** One (1) year
**Indicators**: Publication of the map both overall and per country.
**Costs:** Already calculated
**Consequences:** To make available the information that are needed for lowland tapir conservation actions.
**Obstacles:** Problems with data availability.

**ACTION 4:** Creation of a technical group for the conduction of research projects on the assessment of the impacts affecting the lowland tapir.

**Description:** To compile information on impacts, to advise and participate in all phases of the licensing process.
**Responsibility:** Diego Varela (Argentina) and Carlos Pedraza (Colombia)
**Collaborators:** Tapir Specialist Group (TSG) Country Coordinators.
**Deadline:** One (1) year
**Indicators:** Creation of the group and percentage of processes advised.
**Costs:** ---
**Consequences:** To know the impacts on lowland tapir conservation and to have compensation actions carried out.
**Obstacles**: Conflict of interests.

**ACTION 5:** To identify priority areas for carrying out habitat restoration projects in the following biomes: Cerrado (Brazilian savanna), Atlantic Rain Forest, and North of Colombia.

**Responsibility:** Andrés Arias Alzate (northern Colombia)
**Collaborators:** Other IUCN Specialist Groups, research institutions.
**Deadline:** Three (3) years
**Indicators:** Map with the priority areas on each biome.
**Costs:** ---
**Consequences:** Available information for the conduction of pilot projects.
**Obstacles:** Lack of information.

**ACTION 6:** To carry out pilot projects of lowland tapir habitat restoration in the following biomes: Cerrado (Brazilian savanna), Atlantic Rain Forest, and North of Colombia.

**Responsibility:** Andrés Arias Alzate (northern Colombia).
**Collaborators:** Local communities, other IUCN Specialist Groups, research institutions.
**Deadline:** Five (5) years
**Indicators:** Systematization of the experience.
**Costs:** US$30,000
**Consequences:** Available information for the conduction of pilot projects.
**Obstacles:** Lack of experience, high cost, complexity of project coordination, long-term result.

**ACTION 7:** To establish a network of researchers for estimating lowland tapir carrying capacity for each biome and considering different uses.

**Responsibility:** Luiz Gustavo R. Oliveira-Santos (Brazil)
**Collaborators:** Other IUCN Specialist Groups, research institutes
**Deadline:** Five (5) years
**Indicators:** At least one (1) project for each biome and number of publications.
**Consequences:** Available information.
**Obstacles:** Lack of experience, high cost, scientific complexity.

**ACTION 8:** To identify and compile sustainable experiences compatible with lowland tapir conservation.

**Responsibility:** Tapir Specialist Group (TSG) Country Coordinators.
**Collaborators:** Research institutions, NGOs, researchers, local communities, extension agencies, other IUCN Specialist Groups, responsible persons for protected areas.
**Deadline:** Two (2) years
**Indicators:** One (1) report for each country.
**Costs:** ---
**Consequences:** Available information.
**Obstacles:** It does not have

**ACTION 9:** To carry out model projects of multiple uses of habitat resources.

**Description:** Articulation of current projects of use, and research, design, and development of models.
**Responsibility:** Benoit de Thoisy (Guyanas), Flávio Moschione (Argentina), Oswaldo de Carvalho Jr. (Brazil), Juliana Rodríguez (Colombia), and Luis Sandoval (Ecuador).
**Collaborators:** Research institutions, NGOs, researchers, communities, extension agencies, other IUCN Specialist Groups, responsible persons for protected areas.
**Deadline:** Five (5) years
**Indicators:** Number of projects being carried out and evaluation of the level of sustainability (social, ecological and economic) of each project.
**Costs:** ---
**Consequences:** Models with capacity for replication and reduction of habitat loss.
**Obstacles:** Competition with unsustainable activities.

**ACTION 10:** To produce a document with technical recommendations for the producers on how to improve cattle ranching management in lowland tapir habitat areas, for each biome.

**Responsibility:** Silvia Chalukian (Argentina), Luiz Gustavo R. Oliveira-Santos (Brazil), Carlos Pedraza (Colombia) and Oswaldo de Carvalho Jr. (Brazil - Amazonia).
**Collaborators:** Public bodies, research institutions, agriculture/cattle ranching agencies.
**Deadline:** Three (3) years
**Indicators:** Document with information on at least three (3) countries.
**Consequences:** A management tool for the reduction of habitat degradation.
**Obstacles:** It does not have.

**ACTION 11:** To identify and design relevant corridors for lowland tapir conservation.

**Description:** To restore or maintain the ecologic flow among isolated priority areas.
**Responsibility:** Diego Nea Varela (Argentina), Flávio Noa Moschione (Argentina), Luiz Gustavo R. Oliveira-Santos (Brazil), Carlos Pedraza (Colombia), Patrícia Medici (Brazil) and Marcos Adriano Tortato (Brazil).
**Collaborators:** Research institutions, NGOs, researchers, communities, extension agencies, other IUCN Specialist Groups, responsible persons for protected areas.
**Deadline:** Two (2) years
**Indicators:** Map with the identification of corridors.
**Consequences:** Tool for implementation of corridors.
**Obstacles:** Lack of information.

**ACTION 12:** Implementation of corridors.

**Description:** To participate in the groups of corridor management

**Responsibility:** Diego Varela (Argentina), Flávio Moschione (Argentina), Carlos Pedraza (Colombia) and Marcos Adriano Tortato (Brazil)

**Collaborators:** Research institutions, NGOs, researchers, communities, extension agencies, other IUCN Specialist Groups, responsible persons for protected areas.

**Deadline:** Five (5) years

**Indicators:** Number of corridors either in implementation process or implemented, assessment of the effectiveness of the corridor for the lowland tapir.

**Costs:** ---

**Consequences:** Maintenance of connectivity and reduction of habitat loss.

**Obstacles:** Conflict of interests.

**ACTION 13:** To develop an experience of regional and international planning among Amapá State in Brazil and the three (3) countries of the Guyanas.

**Description:** Experience of international cooperation for carrying out a regional Lowland Tapir Conservation Plan.

**Responsibility:** Benoit de Thoisy (north - French Guyana).

**Collaborators:** Governmental agencies

**Deadline:** Five (5) years

**Indicators:** Number of agreements and partnerships.

**Costs:** ---

**Consequences:** Experience in international cooperation projects.

**Obstacles:** Economical interests among the countries and political problems.

**ACTION 14:** Study of economic evaluation of the lowland tapir as a good and a service.

**Description:** Conduction of a study of economic evaluation of the lowland tapir in comparison with other land uses, for each biome and each country.

**Responsibility:** Consultancy

**Collaborators:** Universities, groups of researchers.

**Deadline:** Five (5) years

**Indicators:** One document for each country.

**Costs:** ---

**Consequences:** Result of the evaluation of the lowland tapir and its habitat.

**Obstacles**: Difficulty in getting a responsible person and the high cost.

**ACTION 15:** To cooperate in the development and implementation of economic tools (incentives) for making habitat maintenance and restoration initiatives viable.

**Responsibility:** Tapir Specialist Group (TSG), a series of initiatives in each country.

**Collaborators:** ---

**Deadline:** ---

**Indicators:** Participation in events, defined instruments, raised resources.

**Costs:** ---

**Consequences:** Increase of the benefit of sustainable and research projects.

**Obstacles:** ---

**ACTION 16:** To start experiences of regularization of land ownership as a mechanism for favoring the conservation of lowland tapir habitat in biological corridors.

**Description:** To set up two pilot experiences of regularization of land ownership in Argentina as a conservation strategy. To identify the responsibilities for the use of the land and its resources is crucial for the negotiation of conservation agendas. There are development experiences in which the recognition of rights of local communities is regarded as a strategy to boost long-term sustainable use and to create opportunities for financing and credit.
**Responsibility:** Flávio Moschione (Argentina) and Diego Varela (Argentina).
**Collaborators:** Province and local governments, communities and NGOs.
**Deadline:** ---
**Indicators:** Percentage of the corridor area in which the land ownership has been regularized and cases which were dealt with.
**Costs:** ---
**Consequences:** Increase of sustainable productive experiences, increase in the available natural areas, decrease of habitat loss, and attraction of strategic partners for conservation.
**Obstacles:** Lack of governability and conflict of interests

**ACTION 17:** To investigate and monitor the impacts produced by the different human activities carried out in the lowland tapir habitat.

**Description:** To improve the knowledge on those contaminants that can potentially affect the biology and ecology of the lowland tapir.
**Responsibility:** Tapir Specialist Group (TSG) Veterinary Committee.
**Collaborators:** University, research institutions, environmental consultants.
**Deadline:** Five (5) years
**Indicators:** Presentation of the document
**Costs:** ---
**Consequences:** ---
**Obstacles:** ---

**ACTION 18:** Presentation of a document to the relevant authorities for avoiding the deforestation of the nucleus area in the corridor of the northern and eastern zones of the Argentinian jungas (Baritu National Park and El Rey National Park) considered essential for the connectivity of the lowland tapir habitat in the region.

**Responsibility:** Flávio Moschione (Argentina)
**Collaborators:** ---
**Deadline:** ---
**Indicators:** Presentation of the document.
**Costs:** ---
**Consequences:** ---
**Obstacles:** ---

# ADITIONAL RECOMMENDATIONS

- To expand the program of fire combat, prevention and monitoring in the Conservation Units and surrounding areas (Brazil).

- To carry out a promotion of sustainable products in the local and global market as a way to increase the competition with unsustainable products.

- To recommend the specific authorities of each country to promote the creation of formal mechanisms of compensation for habitat degradation and loss.

- To recommend the regularization of the extensive management of cattle in Brazil.

- To recommend the creation of an IBAMA (Brazil) Specialized Centre that contemplates the lowland tapir. This would both make easier and increase the prospects of implementation of the actions that were listed in this Action Plan, most of all those related to aspects of public policies.

**Other actions that were developed during the discussions of the Working Group, but which were incorporated in the proposed ones (memoir):**

- To make and improve land use plans taking the conservation of lowland tapir habitat into consideration.

- To look for incentives for establishing agro-forestry systems that are compatible with conservation of the lowland tapir and its habitat.

- To stimulate the preservation of habitats for the lowland tapir in private areas.

- To promote the use of incentives for preventing changes in land use.

- To influence the processes of definition of land ownership.

- To influence the processes of legal recognition of indigenous people.

- To influence the design of infrastructure projects in order to mitigate the impacts on the priority areas.

- To identify and compile sustainable experiences compatible with lowland tapir conservation.

- To include the lowland tapir as a focal species in licensing processes for the establishment of enterprises.

- To form a technical body for carrying out impact assessment studies of large enterprises, but which include the lowland tapir in the evaluation.
- To influence decision making on the compensation and implementation measures.
- To technically advise the local communities during the implementation of sustainable productive activities.  Recovery of traditional activities.
- To include the issue of corridors in possibilities of funding.
- To carry out pilot restoration projects, for each biome.
- To carry out studies of economic evaluation of the lowland tapir as an environmental good and service.
- To integrate the initiatives of lowland tapir conservation in the local governments.
- To create funding lines for sustainable management projects.

# Lowland Tapir (*Tapirus terrestris*) Conservation Workshop

## Population and Habitat Viability Assessment (PHVA)

### Sorocaba, São Paulo, Brazil
### 15 to 19 April, 2007

# WORKING GROUP

## Human Conflicts

# Human Conflicts

## PARTICIPANTS

Agustín Paviolo – Argentina

Carolina Lozano Barrero – Colombia

Cláudia Regina da Silva – Brazil

Fredy Ramírez – Paraguay

Guido Ayala – Bolivia

José Dionicio Machoa – Ecuador

Kevin Flesher – Brazil

Krisna Gajapersad – Suriname

Laure Debeir – French Guyana

Leonardo A. Salas – Venezuela

Olga Lucía Montenegro – Colombia

Victor Manuel Utreras – Ecuador

# INTRODUCTION

The dynamics of this Working Group followed the sequence below:

- A brainstorming was carried out, based on the conservation challenges that were listed in the previous day during the plenary session for generating issues for the Working Groups;

- New ideas were added out during the preliminary discussions of the Working Group;

- The roots of the problems were identified;

- The group identified the causes of the problems and where to act on;

- The identified problems were prioritized for each relevant biome for lowland tapir conservation.

As the next step, the Working Group defined each one of the different forms of impact on lowland tapir populations, considering those impacts caused by conflicts resulting from human actions and which cause the reduction of these populations.

1. Hunting pressure
2. Human actions catastrophic for tapir populations
3. Transmission of diseases
4. Infrastructure construction
5. Road kill
6. Contamination

# CAUSES OF REDUCTION OF LOWLAND TAPIR POPULATIONS

## 1.1. HUNTING TYPES:

**Subsistence hunting:** Due to the human population increase, habitat fragmentation and reduction, and changes in the uses of traditional populations (new techniques and sedentary nature of villages and communities), this kind of hunting has been causing the reduction of lowland tapir populations.

**Sportive hunting:** It may be cultural, for entertainment, due to the increase of the human population, better/easier access to the areas, economic development (income increase) and easiness of access to guns. It also causes reduction of lowland tapir populations.

**Commercial hunting:** Cultural changes, increase of access (such as roads), improvements in the market (as, for example, the increase in the technology that is available for professional hunters in French Guyana) and economic increase.

**Hunting for control:** Habitat loss and increase of the agricultural border.

**Hunting for cultural and medicinal use:** Increase of the human population and habitat loss.

**1.2. ROAD KILL:** It happens in highways. The largest part of the records comes from Brazil, above all in the states of Goiás, Mato Grosso, Mato Grosso do Sul and São Paulo. This is not a reality in most of the Amazonian regions, as for example in the North of Brazil, French Guyana or Suriname. It is also not a reality in other countries, such as Ecuador.

**1.3. CONTAMINATION:** Caused by oil enterprises, mining or agriculture (use of pesticides). One example is in Ecuador, where around 15 tapirs were found dead in an oil region which was abandoned 15 or 20 years ago. Another example is the control of illegal cocaine cultivation by anti-drug agents in Colombia. We do not have enough information to conclude if these contaminations affect the lowland tapir populations. Mining can affect the animals through mercury contamination.

**1.4. TRANSMISSION OF DISEASES:** it results from the increase of the contact between humans and tapirs. It is also caused by the expansion of the agricultural border, habitat reduction and fragmentation, as well as the extensive management of domestic animals (free animals which can enter forest areas). Invasive species can allegedly bring diseases. In Ecuadorian Amazonia, there is concrete evidence that foot-and-mouth disease is transmitted from cattle to wild animals.

**1.5. CATASTROPHES CAUSED BY HUMAN ACTIONS:** The construction of hydroelectric plants cause reduction of tapir populations, something considered a catastrophic event as it can have a great impact on these populations. A clear example was the Hydroelectric Plant of Porto Primavera in São Paulo State, Brazil, where almost all tapirs of the area were killed and the ones which were translocated did not survive. Fire can be considered a catastrophic event, as in the Llanos of Venezuela.

**1.6. INFRASTRUCTURE CONSTRUCTION:** Irrigation channels and control channels deriving from economic growth and human population increase are infrastructure works which can cause great impact on lowland tapir populations.

# Classification of the Causes of Reduction of the Lowland Tapir Populations in Facts (F) and Assumptions (A)

The Working Group, through the experience of its members, historic accounts and knowledge of bibliographic references, classified the possible causes of reduction of lowland tapir populations in Fact **(F)** and Assumption **(A)**.

It is a fact **(F)** that subsistence, commercial, and sportive hunting cause lowland tapir population reduction. Hunting both for control and cultural use allegedly **(A)** cause reduction. Regarding sportive hunting, economic development allegedly **(A)** increases its occurrence, but it is a fact **(F)** that better access to the areas and increase of the human population are factors which stimulate an increase in sportive hunting.

Road kill is, in fact **(F)**, a problem at the Parque Estadual Morro do Diabo (Morro do Diabo State Park), Teodoro Sampaio, São Paulo, Brazil, where, on average, seven (7) tapirs are hit by cars and killed every year on the highway that crosses the park in the east-west direction (personal comment, researcher Patrícia Medici, IPÊ - Institute for Ecological Research).

Poisoning is an assumption **(A)**. The transmission of diseases is an assumption **(A)**, since we do not know any study which was conducted with respect to its effect on lowland tapir populations. Due to a request of the Epidemiology Task Force, the Human Conflicts Working Group discussed possible causes and effects of lowland tapir poisoning:

**Mercury:** it has an effect on the reproductive rate – Assumption **(A)**

**Cianide:** quick death by water intake – Assumption **(A)**

**Oil:** decantation waste water – intoxication – death of adults – Fact **(F)**

**Pesticides:** gliphosate, DDT, in agriculture and in control of illegal crops – decrease reproduction - Assumption **(A)** – There is an example from Bolivia, in which all the illegal compounds used in the illegal cultivations are thrown into the rivers (sulfur acid, kerosene etc.), allegedly causing death of tapirs.

The construction of infrastructure works, such as hydroelectric plants, irrigation and flood control channels, dams, is, allegedly **(A)**, a cause of reduction of tapir populations. Catastrophic events, such as hydroelectric construction, in fact **(F)** reduce lowland tapir populations or take them to extinction. A good example is the Hydroelectric Plant of Porto Primavera in São Paulo State, Brazil. Fire is allegedly **(A)** a cause of reduction of lowland tapir populations.

## IMPORTANCE OF THE PROBLEMS BY EACH BIOME

The importance of the problems was defined for each biome. The Working Group carried out a voting, in a 0 to 5 scale, about the potential effect that these problems have on the lowland tapir populations on each biome:

| Biome | Hunting | Road kill | Poisoning | Transmission of diseases | Infrastructure construction | Catastrophes |
|---|---|---|---|---|---|---|
| **Llanos** | 5 | 0 | 0 | 1 | 0 | 2 |
| **Northern Amazon** | 3 | 0 | 1 | 1 | 0 | 2 |
| **Amazonian Cerrado** | 3 | 0 | 1 | 0 | 1 | 1 |
| **SE Amazon** | 3 | 2 | 1 | 0 | 1 | 1 |
| **NE Amazon** | 4 | 0 | 1 | 1 | 1 | 2 |
| **Atlantic Rainforest** | 2 | 2 | 0 | 1 | 1 | 2 |
| **Pantanal** | 2 | 2 | 0 | 1 | 1 | 5 |

In the **Llanos** of Venezuela and Colombia, hunting is the major problem for the survivorship of the lowland tapir. There is also the risk of transmission of diseases and a larger propensity for the occurrence of catastrophes.

In the **Northern Amazon**, there is a medium pressure because this biome still has large areas of available habitat for the lowland tapir. There is a predisposition to poisoning and transmission of diseases and a low predisposition to catastrophes.

In the **Amazonian Cerrado** there is a medium hunting pressure: there are large areas in Venezuela with no hunting, and in the Brazilian Amazonian cerrado there is an increase in the human population and opening of roads and settlements which lead to an increase in hunting pressure. This biome also shows a predisposition to the transmission of diseases and poisoning episodes due to mining and a low predisposition to catastrophes.

In the **Amazonian Southeast** the hunting pressure is medium due to the existence of big farms and few hunters. There are road kill reports, low predisposition to poisoning and low predisposition to catastrophes.

In the **Amazonian Northeast** there is a high hunting pressure even though this region still has large areas with forest cover. Nonetheless, the human populations in these areas do hunt. The region still shows a predisposition to poisoning, transmission of diseases, infrastructure construction due to the advancement of the agricultural border and logging, as well as predisposition to catastrophes since it has big mining companies in Amapá and Roraima states in Brazil.

The **Atlantic Rainforest** has a high hunting pressure in most of its range, low predisposition to catastrophes and high predisposition to the transmission of diseases and infrastructure construction.

The **Pantanal** currently shows a high possibility for the occurrence of catastrophes, mainly due to the proposal of a hydroelectric plant which, if built, will have the potential to dry the whole region. Hunting pressure is fairly low and there are road kill reports. There is predisposition to the transmission of diseases and infrastructure construction.

The **Cerrado of the Central regions of Brazil** has a medium hunting pressure on the lowland tapir populations and a low predisposition to the occurrence of all other pressures which were listed.

The areas of **Araucária Pine Forest** in southern Brazil have medium hunting pressure, predisposition to road kill, transmission of diseases and infrastructure construction.

The **Wet Chaco** has a medium hunting pressure, as well as predisposition to road kill and transmission of diseases.

The **Dry Chaco** has a medium hunting pressure and predisposition to the transmission of diseases. For the **Beni** region, in Bolivia, it would be the same, but with a higher predisposition to catastrophes.

In the region of the **Andes** there is a high hunting pressure, as well as predisposition to poisoning, transmission of diseases and infrastructure construction.

# GOALS

The goals were defined separately for each kind of hunting. It was a decision of the Working Group that its first goal should be the establishment of programs of sustainable management for the hunting. It was discussed if such sustainable management would include all hunting species or tapirs only, and consensus was reached that the management should include all game species. Regarding commercial hunting, the Working Group had difficulties in reaching a consensus on the definition of the issue.

After several discussion rounds, seven (7) quite broad goals were defined, with difficult applicability in the whole lowland tapir range.

**GOAL 1:** To establish a management program for subsistence hunting which allows the recovery of lowland tapir populations that were reduced due to excessive hunting, and which ensures the dietary quality of those human populations that use the species.
**GOAL 2:** To reduce the impact of commercial hunting on lowland tapir populations within the species range.

**GOAL 3:** To reduce the impact of sportive hunting on lowland tapir populations within the species range.
**GOAL 4:** To mitigate the impact of road kill on lowland tapir populations within the species range.

**GOAL 5:** To reduce the impact of infrastructure projects, such as irrigation and flood control channels, on lowland tapir populations. To reduce tapirs' deaths caused by conflicts and human activities.

**GOAL 6:** To know the impact of poisoning and diseases transmitted by several etiological agents on lowland tapir populations.

**GOAL 7:** To minimize the impact of catastrophic human actions on lowland tapir populations.

**Observation:** Given the questioning by other workshop participants during the plenary session of presentation of GOALS, we decided to define **SUBSISTENCE HUNTING** as follows:

- It is carried out by local inhabitants;
- The meat is locally consumed and a small portion is sold at local markets in order to fulfill basic needs;
- In those cases where it constitutes the main protein source or is a supplementary protein source.

# ACTION PLAN

During the process of identification of actions for each one of the defined goals, the group discussed topics to be considered in general programs of hunting monitoring, and of education, and political and environmental planning for all the species range.

The Working Group decided that fostering the preparation of management plans is not a task of this forum, since it requires political actions. Nonetheless, the monitoring of hunting impact can be carried out, although it involves resources.

Another factor which was considered by this Working Group was that commercial hunting is illegal in most of the lowland tapir range. Commercial hunting is allowed only in Suriname and French Guyana, and direct actions were considered for these countries. In French Guyana, a document asking for the prohibition or regulation of commercial hunting was already put forward by NGOs and research institutions. There are norms for commercial hunting in Suriname, but there are no data on the numbers of hunted animals in the three-month period in which hunting is allowed. More data and information about hunting in Suriname are needed.

**GOAL 1:** To establish a management program for subsistence hunting which allows the recovery of lowland tapir populations that were reduced due to excessive hunting, and which ensures the dietary quality of those human populations that use the species.

**ACTION 1.1:** To identify populations that are reduced due to habitat fragmentation, initially based on the maps produced in the Final Report of the Lowland Tapir Range-Wide Assessment of the Wildlife Conservation Society (WCS).

**Responsibility:** Leonardo Salas (TSG) and representatives of the Tapir Specialist Group (TSG) in the lowland tapir range countries.
**Deadline:** Six (6) months after the publication of the Range-Wide Assessment report.
**Costs:** ---
**Consequences:** Map with the location of the populations and number of identified areas considering the different demographic rates.
**Obstacles:** Non-publication of the Range-Wide Assessment report.

**ACTION 1.2:** To identify the areas showing subsistence hunting and prioritize them according to the potential hunting impact, considering the Final Report of the Lowland Tapir Range-Wide Assessment of the Wildlife Conservation Society (WCS).

**Responsibility:** Leonardo Salas (TSG) and representatives of the Tapir Specialist Group (TSG) in the lowland tapir range countries.
**Deadline:** Six (6) months after the publication of the Range-Wide Assessment report.
**Costs:** ---
**Consequences:** Areas identified and prioritized in a list and maps of occurrence.
**Obstacles:** Non-publication of the Range-Wide Assessment report.

**ACTION 1.3:** To survey existing management plans and related information in the whole lowland tapir geographical range.

**Responsibility:** Mathias Tobler (Peru) representatives of the Tapir Specialist Group (TSG) in the lowland tapir range countries.
**Deadline:** One (1) year
**Costs:** Time of the responsible persons for this action.
**Consequences:** Organized and distributed bibliography.
**Obstacles:** Different languages.

**ACTION 1.4:** To develop guidelines for the preparation of hunting Management Plans that are flexible and consider all the different local situations.

**Responsibility:** Guido Ayala (Bolivia), Carolina Lozano (Colombia) and Victor Utreras (Ecuador).
**Deadline:** Six (6) months after carrying out ACTION 1.3
**Costs:** Time of the responsible persons for this action.
**Consequences:** Prepared document.
**Obstacles:** Translation

**ACTION 1.5:** To make a list of successful or unsuccessful production initiatives which could be used as guide for considering alternatives for the reduction in subsistence hunting.

**Responsibility:** Mathias Tobler (Peru) and representatives of the Tapir Specialist Group (TSG) in the lowland tapir range countries.
**Deadline:** One (1) year
**Costs:** Time of the responsible persons for this action.
**Consequences:** Organized and distributed information.
**Obstacles:** ---

**ACTION 1.6:** To develop a document with guidelines for monitoring hunting activities that includes quantitative variables and different methodologies.

**Responsibility:** Olga Montenegro (Colombia), Krisna Gajapersad (Suriname), Cláudia Regina Silva (Brazil), Guido Ayala (Bolivia) and Laure Debeir (French Guyana).
**Deadline:** One (1) year
**Costs:** ---
**Consequences:** ---
**Obstacles:** ---

**ACTION 1.7:** To disseminate, through the whole lowland tapir geographical range, the documents which were surveyed or produced in the course of the implementation of the previous actions, using different information dissemination strategies.

**Responsibility:** Representatives of the Tapir Specialist Group (TSG) in the lowland tapir range countries.
**Deadline:** One (1) year and one (1) month
**Costs:** ---
**Consequences:** Disseminated and distributed documents.
**Obstacles:** ---

**ACTION 1.8:** Conduction of environmental education campaigns aiming at reducing lowland tapir hunting in the priority areas that were identified by the previous actions.

**Note:** It was decided by the group that this action must be treated by the **Education, Policy and Communication Working Group.**

**GOAL 2:** To reduce the impact of commercial hunting on lowland tapir populations within the species range.

**ACTION 2.1:** To distribute this Action Plan to the governments of the countries where there is commercial hunting of the lowland tapir.

**Note:** It was decided by the group that this action must be treated by the **Education, Policy and Communication Working Group.**

**ACTION 2.2:** To produce support letters, from the Tapir Specialist Group (TSG), IUCN France, IUCN International and Species Survival Commission (SSC), for the request for stopping commercial hunting in French Guyana, which was made through the ORGFH (*Orientations Régionales de la Gestion de la Faune et de ses Habitats – Regional Guidelines for the Management of Fauna and its Habitats*) and responsible entities.

**Responsibility:** Patrícia Medici (President, Tapir Specialist Group - TSG), Benoit de Thoisy and Laure Debeir (French Guyana). Having IUCN France and IUCN International as collaborators.
**Deadline:** The time for us to have the proposal of French Guyana submitted to local authorities.
**Costs:** Time of the responsible persons for this action.
**Consequences:** Support letters
**Obstacles:** ---

**ACTION 2.3:** To make a diagnosis on the commercial hunting of the lowland tapir in Suriname.

**Responsibility:** Krisna Gajapersad and Claudine Sakimin (Suriname)
**Deadline:** Two (2) years
**Costs:** US$5,000
**Consequences:** Conducted diagnosis
**Obstacles:** ---

**ACTION 2.4:** To act as a consultant to Suriname for the preparation of a proposal for abolishing commercial hunting in the whole country, similar to the one of French Guyana.

**Responsibility:** Benoit de Thoisy and Laure Debeir (French Guyana) and Krisna Gajapersad and Claudine Sakimin (Suriname)
**Deadline:** One month for sending the document (Laure Debeir and Benoit de Thoisy)
**Costs:** None
**Consequences:** Support material sent to Suriname
**Obstacles:** ---

**GOAL 5:** To reduce the impact of infrastructure projects, such as irrigation and flood control channels, on lowland tapir populations. To reduce tapirs' deaths caused by conflicts and human activities.

**ACTION 5.1:** To gather information on the issue and to develop a document containing recommendations of mitigation measures and design of infrastructure works.

**Responsibility:** Diego Varela (Argentina)
**Deadline:** One (1) year
**Costs:** None
**Consequences:** Prepared document
**Obstacles:** ---

**ACTION 5.2:** To gather information on the occurrence of lowland tapir deaths due to events such as hydroelectric construction and big fires.

**Responsibility:** Agustín Paviolo (Argentina) and representatives of the Tapir Specialist Group (TSG) in the lowland tapir range countries.
**Deadline:** One (1) year
**Costs:** Time
**Consequences:** Prepared document
**Obstacles:** ---

**GOAL 6:** To know the impact of poisoning and diseases transmitted by several etiological agents on lowland tapir populations.

**ACTION 6.1:** To carry out research projects that are relevant for determining the incidence of poisoning and diseases in lowland tapir populations, in partnership with the group of veterinarians and field researchers of the Tapir Specialist Group (TSG).

> **Note:** It was decided by the group that this action must be treated by the **Epidemiology Task Force and by the Tapir Specialist Group (TSG) Veterinary Committee.**

# Lowland Tapir (*Tapirus terrestris*)
# Conservation Workshop

## Population and Habitat
## Viability Assessment (PHVA)

### Sorocaba, São Paulo, Brazil
### 15 to 19 April, 2007

# WORKING GROUP

# Education, Policy and Communication

# Education, Policy and Communication

## PARTICIPANTS

Andrés Tapia Arias – Ecuador

Gilia Angel – United States

Jeffrey Flocken – United States

José Maria de Aragão – Brazil

Lee Spangler – United States

Leonardo Ordoñez Delgado – Ecuador

Maria Gabriela Rocha – Brazil

Ralph Vanstreels – Brazil

Sheryl Todd – United States

# DESIGN AND DECONSTRUCTION OF PROBLEMS

The group carried out the design and deconstruction of problems from two different focuses:

1. Starting with the principle that education, policies and information diffusion can potentially change those human behaviors that are incompatible with lowland tapir conservation, this Working Group tried to answer the following question "Which are the human behaviors that are currently incompatible with lowland tapir conservation?";

2. In a similar manner, considering the importance of environmental education, this Working Group tried to answer the following question "Which are the flaws in the communication process that have prevented the effective lowland tapir conservation?"

The discussion related to focus **1** produced the two problem flowcharts depicted below, through the rule of "whys". The revision of the proposed issues led to the identification of the problems of the focus **2**, which were the following ones:

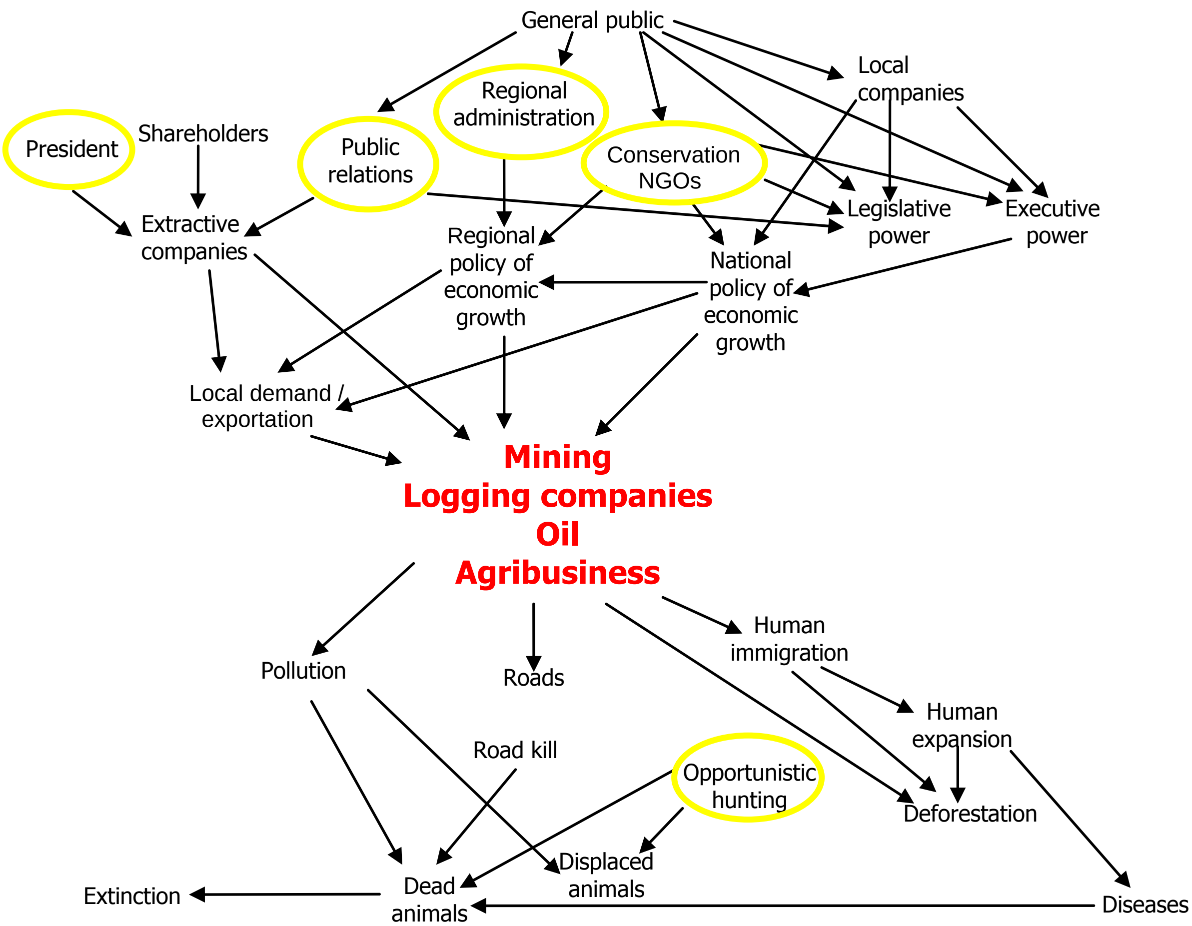
- To increase the influence of conservationists on the public policies for conservation (influence on decision makers)

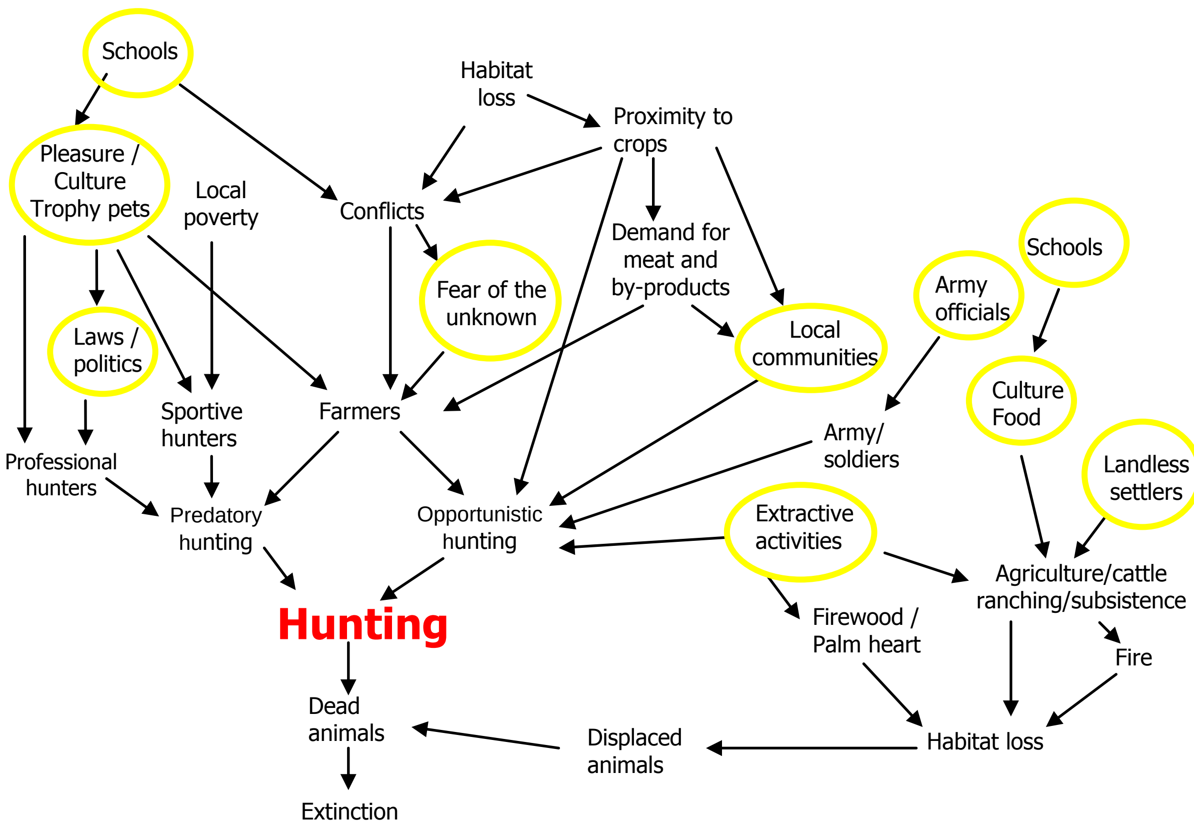
- Wrong image of the species
  - Ignorance / lack of information
  - Depreciatory image (Brazil)

- Different kinds of public to be reached:
  - Direct (local communities)
  - Indirect (urban)

- Conservation enthusiasts (fans, interested local population) have difficulties for getting in contact with those persons working with lowland tapir

- Researchers and institutions fail to communicate and exchange information for achieving an effective conservation.


General public
Local companies
Regional administration
President
Shareholders
Public relations
Conservation NGOs
Legislative power
Executive power
Extractive companies
Regional policy of economic growth
National policy of economic growth
Local demand / exportation
Mining
Logging companies
Oil
Agribusiness
Human immigration
Pollution
Roads
Human expansion
Road kill
Opportunistic hunting
Deforestation
Displaced animals
Extinction
Dead animals
Diseases


Schools
Habitat loss
Proximity to crops
Pleasure / Culture Trophy pets
Local poverty
Conflicts
Demand for meat and by-products
Schools
Fear of the unknown
Army officials
Laws / politics
Local communities
Culture Food
Sportive hunters
Farmers
Army/ soldiers
Landless settlers
Professional hunters
Predatory hunting
Opportunistic hunting
Extractive activities
Agriculture/cattle ranching/subsistence
Hunting
Firewood / Palm heart
Fire
Dead animals
Displaced animals
Habitat loss
Extinction

Based on these two process of group dynamics, and, in addition, already considering which would be our target groups, we chose to partition our issues in five different types, defining them based on: actor (who performs the behavior), behavior (what is the human behavior that is incompatible with lowland tapir conservation), causes (why the agents do behave this way) and consequences (how the tapirs are influenced by this human behavior).

**Habitat loss due to mega-enterprises**

Extractive industries and governmental development programs promote activities which cause habitat loss, such as the construction of new roads, mining, oil exploitation, large scale agricultural/cattle ranching activities and logging. Such activities are caused, most of all, by the lack of knowledge and involvement of the general public in strategically pressing the responsible persons, by the economic interest of the extractive companies, by the national and regional economic growth policies and by the lack of involvement of the decision makers. The consequences of these activities are human immigration, deforestation/erosion, agriculture/cattle ranching development, increase of road kill, pollution, opportunistic hunting and introduction of diseases and invasive species which, ultimately, cause population reduction and extinction of fauna species at the site.

**Local habitat loss**

Local communities, local persons involved with low-impact extractive activities and landless rural farmers promote activities such as subsistence agriculture and extraction (firewood, palm heart). Such activities are caused by the extraction culture, poverty conditions, lack of economic alternatives and lack of control/patrolling (land usurpers or claim-jumpers) which result in deforestation/erosion, burnings, opportunistic hunting and introduction of diseases and invasive species which, ultimately, cause population reduction and extinction.

**Opportunistic hunting**

Farmers, local communities, military personnel, and local persons involved with low-impact extractive activities, all perform opportunistic hunting. Such activity is caused by the culture of trophies/pets, crop destruction by the animals, lack of knowledge of the risks and basic biology of the species and demand for meat and other by-products from the species. This activity results in the removal of individuals from the population, causing population decline and extinction.

## Predatory hunting

Farmers, and furtive and sportive hunters promote predatory hunting. Such activity is caused by the culture of trophies/pets, local poverty, crop destruction by the animals, and lack of control/patrolling. This activity results in the removal of individuals from the population, causing population decline and extinction.

## Lack of communication among conservationists

Researchers in the field and in captivity conditions, researchers from universities, conservation organizations in general, NGOs etc. are essential in the process of information exchange and in achieving effective communication. All these different actors have responsibility for neutralizing any institutional barriers that cause loss of opportunities for the establishment of lowland tapir conservation initiatives. Many of the actors do not know each other, do not work together in the development of projects and, as a consequence, do not share the acquired information. Perhaps such problems occur due to the researcher ego culture, fear of losing copyrights over the work which was carried out, as well as the lack of effective research.

# MODELING THE EFFECT OF EDUCATION WITH THE VORTEX SOFTWARE

**Legend**

**D =** Diffusion
**K =** Carrying capacity
**S =** Survivorship
**F =** Fertility

**High =** 66-100%
**Medium =** 33-66%
**Low =** 0-33%

| Action on the impacts | Target group | D | K | S | F | Costs | Difficulty |
|---|---|---|---|---|---|---|---|
| Opportunistic and predatory hunting | General public | | | M | | Very Expensive | Medium |
| Habitat loss (logging companies, mining, agribusiness, oil) | General public | | L | | | Very Expensive | Medium |
| Hunting and habitat loss | Schools | H | H | H | H | Expensive | Medium |
| Habitat loss | President of companies | | M | | | Low | Difficult |
| Habitat loss | Public relations | | L -M | | | Low | Easy |
| Hunting and habitat loss | Regional governmental agencies | | M | | | Low | Easy |
| Hunting and habitat loss | National government | L | M | L | L | Low | Difficult |
| Hunting and habitat loss | NGOs | M-H | M-H | M-H | M-H | Low | Easy |
| Opportunistic and predatory hunting | Military personnel | | | H | | Low | Easy |
| Hunting and habitat loss | Farmers | M | M | H | M | Low | Medium |
| Hunting and habitat loss | Local communities | | | M-H | M-H | Expensive | Easy |
| Hunting and habitat loss | Landless settlers | | L | M-H | M-H | Medium | Easy |

# GOALS

The following goals aim at estimating the fractions that a communication campaign should expect for attaining significant results. The percentage values shown below represent the fraction “sensitized public/total public”. The values were obtained from the experience of Working Group members, based on their realistic perspective of the fraction of a given public which can actually be reached and sensitized on each context.

- **Habitat loss by mega-enterprises**

**GOAL 1:** To develop education and policy methods aimed at multiple strategic audiences in order to produce an attitude change that results in a smaller habitat loss due both to governmental programs and the activities of extractive companies.

| | |
|---|---|
| a) General public | 30% |
| b) Regional governmental agencies | 40% |
| c) National governments | 15% |
| d) Schools | 36% |
| e) Company holders | 5% |
| f) Departments of public relations of companies | 15% |
| g) NGOs | 45% |
| h) Local communities | 25% |

- **Local habitat loss**

**GOAL 2:** To develop education and policy methods aimed at multiple strategic audiences in order to produce an attitude change that results in a smaller habitat loss due to the activities of local communities.

| | |
|---|---|
| a) Schools - regional level | 40% |
| b) Regional governmental agencies | 20% |
| c) NGOs | 50% |
| d) Local communities | 40% |
| e) Farmers | 15% |
| f) Settlers | 20% |

- **Opportunistic and predatory hunting**

**GOAL 3:** To develop education and policy methods aimed at multiple strategic audiences in order to produce an attitude change that results in less hunting of the lowland tapir.

| | | |
|---|---|---|
| a) | General public | 45% |
| b) | Schools | 65% |
| c) | Regional governmental agencies | 20% |
| d) | National governments | 15% |
| e) | NGOs | 55% |
| f) | Local communities | 45% |
| g) | Military personnel | 55% |
| h) | Farmers | 45% |
| i) | Settlers | 20% |

- **Lack of communication among conservationists**

**GOAL 4:** To develop education and policy methods aimed at multiple strategic audiences in order to produce an attitude change that results in better communication among conservationists.

| | | |
|---|---|---|
| a) | Researchers | 40% |
| b) | Conservationists in the field | 55% |
| c) | Enthusiasts | 55% |
| d) | Local communities (interested members) | 55% |
| e) | Specialists on tapirs | 90% |

# ACTION PLAN

We initiated this step holding the view that we should develop a global diffusion and communication program, with topics for regional, national, and international actions. Nonetheless, the Working Group concluded that this forum does not have people in enough numbers and with the appropriate know-how for really developing (and even less implementing) a program of such magnitude.

Accordingly, the Working Group chose actions that were more focused in developing broad material and recommendations for helping those people interested in pursuing education, communication and diffusion programs as part of their lowland tapir conservation programs.  Thus, the aim of the Working Group was to develop tools, among which a manual containing recommendations and raw material for the preparation and implementation of education, communication and diffusion campaigns.

**ACTION 1:** Production of a manual containing broad recommendations for groups interested in developing Education, Communication and Diffusion Campaigns. Such manual should be adequate for different levels of target public (South American, country, state, region), and annually updated (Focus GOALS 1, 2). This document must include:

- **(a)** Step-by-step instructions and recommendations for the planning and implementation phases of the campaigns;
- **(b)** Subsidies for the identification of the different target-groups to be reached according to the issues at stake, also detailing the communication vehicles that can be used in order to reach them;
- **(c)** Basic material to be adapted and employed during the implementation of the campaigns.

**Responsibility:** Gilia Angell, Webmaster & Coordinator, Tapir Specialist Group (TSG) Marketing Committee.
**Collaborators:** Andrés Tapia (Ecuador), Jeffrey Flocken (United States), Leonardo Ordoñez (Ecuador), Lee Spangler (United States), Maria Gabriela Rocha (Brazil), Ralph Vanstreels (Brazil) and Sheryl Todd (United States).
**Support/Consultancy:** José Maria Aragão (Lowland Tapir Conservation Initiative, IPÊ - Institute for Ecological Research, São Paulo, Brazil), and other persons to be invited.
**Deadline:** July 2008
**Indicators:** Finished document at the proposed deadline.

**ACTION 2:** To form and manage a group of volunteers of the Tapir Specialist Group (TSG) for translating and revising fundraising proposals, reports etc. and also including qualified labor force (designers, marketing specialists etc.) for helping or advising education, communication and diffusion programs (Focus GOALS 1, 2).
**Responsibility:** Sheryl Todd (President, Tapir Preservation Fund - TPF - United States).
**Deadline:** October 2007
**Indicators:** Group of volunteers with 15 or more persons that are not related to the TSG, and working for the TSG.

**ACTION 3:** To encourage Tapir Specialist Group (TSG) members to actively publicize the TSG, its Internet webpage (www.tapirs.org) and the resources it makes available, by employing the networks that were developed by the TSG Country Coordinators and through the contacts that were made in this workshop, (Focus GOALS 1, 3).
**Responsibility:** Gilia Angell, Webmaster & Coordinator, Tapir Specialist Group (TSG) Marketing Committee.
**Deadline:** October 2007
**Indicators:** A 50% increase in the visits to the TSG Internet webpage and in the download of documents available on-line; reduction in the number of contacts looking for information that are already available.

# DESIGN OF THE GUIDE OF THE EDUCATION, COMMUNICATION AND DIFFUSION PROGRAM

## Steps in the planning of an Education and Communication program

**1)** To identify the lowland tapir population;

**2)** To know one's own goal – what is the problem which you are trying to solve? (for example, hunting, habitat loss). To know the information on tapirs. Are their facts clear?;

**3)** To identify the actors and their reasons for putting into practice the actions that are jeopardizing lowland tapir conservation (lack of information, poverty, conflicts and culture);

**4)** To promote lectures which influence these actors (voters, media, children and even the own actors);

**5)** To identify allies. Who can help you to influence the actors? (zoological institutions, NGOs, researchers, enthusiasts (tapirs fans) from the world and the local communities);

**6)** To identify the available resources. What do you already have? (helpers, volunteers, extant materials, funding sources, local universities and traditional festivities);

**7)** Some examples of audiences which can influence conservation professionals (see the other chapter with public/tools);

**8)** To develop an evaluation program for assessing the results of the education program (questionnaires) before, during and after the program, with well-defined success and failure criteria;

**9)** To identify the resources which will be needed, the amount which is lacking and the strategies which will be employed for obtaining it;

**10)** To make a schedule of activities, with deadlines for each action;

**11)** To create a budget and to keep a detailed tracking of expenses;

**12)** To implement!

# LIST OF COMMUNICATION VEHICLES FOR EACH PUBLIC AND OF THE MATERIAL TO BE MADE AVAILABLE

- **General public**

  Influent vehicles: media, radio, billboards, magazines, newspapers, zoological institutions, Internet pages, soap operas, cartoons, comics, as a subject for illustrated children's books, coloring books, posters, T-shirts, videos of the YouTube Internet page, stickers, celebrities and athletes, pamphlets, DVDs, table games, computer games, television programs etc.

  Tools to be made available: video clips (Internet pages and videos), portfolio of research projects including concepts of the well-defined research projects, maps of regions, parks and zoological institutions, photos of the tapir species, lists of Internet pages for the campaigns and for the general public, list of contacts for specific topics and experts on them (lists for the campaigns; lists for the public), lists of qualified labor for campaigns (artists, writers, environmental consultants), biological fact sheets on tapirs, lists of forums and discussion groups, lists of "things you could do to save tapirs" (list for adults according to the region, list for children according to the region).

- **Schools**

  Influent vehicles: work with teachers and trainees, field activities (visits to zoos and parks), invited speakers (researchers, university lecturers/professors), inclusion of the 'lowland tapir conservation' subject in the school curriculum, monitors/story-tellers/activities for kids, programs "Zoo goes to the school", taking ambassador animals to schools etc.

  Tools to be made available: models of PowerPoint presentations (various types, according to different audiences and age groups), models of suggestions for inclusion of the subject in curricula (different age groups and audiences), list of speakers which could be invited on each region (researchers etc.), examples of games (IPÊ – Institute for Ecological Research and the Sorocaba Zoo have positive experiences on this matter), recommendations for the training and use of ambassador animals in schools, models of tapir *souvenirs* to be used in schools and visits.

- **Donors**

  Influent vehicles: direct meetings with potential donors, sending of written proposals, congresses and conferences, TSG Project Endorsement (proposal endorsement system the Tapir Specialist Group), advertisement materials (fliers and folders made to order).

  Tools to be made available: sheet with tips on how to deal with funding institutions, sheet with tips on how to deal with private donors, model of funding proposal, models of PowerPoint presentations to be used with donors, list of potential and past funders (South American list with the TSG Fundraising Committee, national lists with the Tapir Specialist Group Country Coordinators), group of volunteers and editors for translating the proposals.

- **National governments and regional governmental agencies**

  Influent vehicles: media (see general public), direct meetings, to invite politicians to the meetings of specialists, advertisement materials (flyers and folders made to order, see donors), to offer reciprocal help (advertisement), network of contacts (friends, family and other indirect contacts).

  Tools to be made available: list of tips on how to deal with politicians, models of PowerPoint presentations.

- **Local communities, farmers, settlers, land usurpers/claim-jumpers**

  Influent vehicles: direct meetings (informal environment), working groups (for searching and presenting economic alternatives), capacity-building programs for local enthusiasts (to convert them into educators), to obtain religious support (priests, Indians; dealing with issues such as animal equality, or religious tales about the tapir and animals etc.), local schools (see schools).

  Tools to be made available: list of tools and techniques for reducing the conflict of crop predation (peppers, special fences etc.), list of tips on how to deal with local communities, list of economic alternatives to hunting and extractive activities, see general public and schools. Possibility to work together with the Human/Tapir Conflict Working Group of the TSG.

  General tips: to offer solutions (why tapir conservation can be important/useful to them), to create a friendship relation, to attend the local events, not to split opinions or make enemies, to accept even those who are the major conservation enemies, to always make long-term bonds, to give the example to the people, to be included in the day-to-day routine of the community, to share the life style.

- **NGOs - Non-Governmental Organizations**

  Influent vehicles: direct meetings (models of PowerPoint presentations), congresses and conferences, direct contact through e-mail and telephone, field trips to the working sites.

  Tools to be made available: list of NGOs both for each country and international - lists of governmental agencies, Tapir Specialist Group (TSG) and Tapir Preservation Fund (TPF) - example of contracts for partnerships.

- **Military and paramilitary**

  Influent vehicles: see national governments and regional governmental agencies topic above (for the military), to get in contact with the officials for them to order the soldiers not to hunt or degrade the habitat, to ask them to increase the monitoring and patrol of illegal activities at the borders, to show the laws about the illegality of hunting.

  Tools to be made available: list of tips for working with the military and the paramilitary (guerrillas, drug dealers, coca farmers etc.), short compilation on what the laws about hunting say on each country, list of contacts of those persons which have experience on this activity (and also of NGOs and people who have authorized access to some communities).

- **Zoological institutions**

  Influent vehicles: International Association of Zoo Educators (IAZE) for information diffusion, to talk to zoological institutions in order to share education tools (education kits, the same that it was outlined for the item "Schools", but specific to zoos), to invite zoo personnel for visit trips to field projects, programs of "zoo in the schools", meetings and working groups with directors and technical team, animal keepers and volunteers of the zoos (explaining the importance of the zoo and motivating them), to include the lowland tapir in the "curricula" of the environmental education programs, to support the actions that were listed in the *Ex-Situ* Conservation Working Group of this workshop.

  Tools to be made available: list of tips on how to deal with zoo teams, TSG list of contacts in zoos, see general public and schools, detailed biological fact sheet to be used in environmental education programs/activities, documents of captive management and environmental education, list of tools (similar to schools) specific to zoos (differential models of exhibits, interactive environmental enrichment etc.).

## DEADLINES E RESPONSIBILITIES

| Task | Deadline (months) | Responsibility |
|---|---|---|
| Guide coordinator | 16 | Gilia Angell, Webmaster & Coordinator, Tapir Specialist Group (TSG) Marketing Committee and Ralph Vanstreels (Brazil) |
| List of stages and detailed instructions for the planning and implementation of Programs of Education and Communication | 6 | Jeffrey Flocken (International Fund for Animal Welfare, United States) |
| General design of the press kit | 6 | Gilia Angell, Webmaster & Coordinator, Tapir Specialist Group (TSG) Marketing Committee and Jeffrey Flocken (International Fund for Animal Welfare, United States) |
| Educational video clips | 2 | Gilia Angell, Webmaster & Coordinator, Tapir Specialist Group (TSG) Marketing Committee |
| Portfolios of 5-6 tapir researchers, for using with the general press | 2 | Gilia Angell, Webmaster & Coordinator, Tapir Specialist Group (TSG) Marketing Committee |
| Tapir distribution maps and educational graphs (population decline, models of the VORTEX software etc.) | 6 | Andrés Tapia (Centro FÁTIMA, Ecuador) |
| Photos of the four tapir species for the general press | In progress | Gilia Angell, Webmaster & Coordinator, Tapir Specialist Group (TSG) Marketing Committee |
| List of Internet pages related to tapirs, and which contain interesting information for campaigns and for the press | 2 | Gilia Angell, Webmaster & Coordinator, Tapir Specialist Group (TSG) Marketing Committee |
| List of contacts (researchers and people in the field) willing to give more information about tapirs to interested parties (list for the public and for the operator of the campaigns) | 6 | Maria Gabriela Rocha (Sorocaba Zoo, Brazil) |
| List of contacts of the specialized labor force that are useful in the development of campaigns (designers, artists, economists etc.) | 12 | Sheryl Todd (President, Tapir Preservation Fund - TPF - United States) |
| Data sheet about hunting and its impact on the conservation of tapirs, for the general press | 6 | Andrés Tapia (Centro FÁTIMA, Ecuador) |
| Biological fact sheet about tapirs, for the general press | 2 | Gilia Angell, Webmaster Coordinator, Tapir Specialist Group (TSG) Marketing Committee |
| List of arguments and key-messages in favor of tapirs conservation ("talking points") | 6 | Gilia Angell, Webmaster & Coordinator, Tapir Specialist Group (TSG) Marketing Committee and Jeffrey Flocken (International Fund for Animal Welfare, United States) |
| List of "things you could do to save the tapirs" for both children and adults (general points, allowing adaptations to be made) | 6 | Gilia Angell, Webmaster & Coordinator, Tapir Specialist Group (TSG) Marketing Committee and Maria Gabriela Rocha (Sorocaba Zoo, Brazil) |
| List of economic alternatives to the hunting and deforestation by local communities | 6 | Andrés Tapia (Centro FÁTIMA, Ecuador) |

| | | |
|---|---|---|
| List of tips on how to deal and negotiate with the military | 12 | Andrés Tapia (Centro FÁTIMA, Ecuador) and Leonardo Ordoñez (Fundación ArcoIris, Ecuador) |
| Link to the Internet pages with compilations of the legislation about hunting and environmental damage | 6 | Jeffrey Flocken (International Fund for Animal Welfare, United States) |
| List of contacts of people who have contact with and authorization by paramilitary groups and drug dealers (especially in Colombia) | 6 | Andrés Tapia (Centro FÁTIMA, Ecuador) and Leonardo Ordoñez (Fundación ArcoIris, Ecuador) |
| List of tips on how to deal and negotiate with funders of conservation initiatives | 6 | Jeffrey Flocken (International Fund for Animal Welfare, United States) |
| Model of written proposal for funding requests | 6 | Jeffrey Flocken (International Fund for Animal Welfare, United States) |
| Contact with a network of translators and reviewers for the proposals for funders | 6 | Gilia Angell, Webmaster & Coordinator, Tapir Specialist Group (TSG) Marketing Committee |
| Link to the database of funders (CD-ROM) | 6 | Gilia Angell, Webmaster & Coordinator, Tapir Specialist Group (TSG) Marketing Committee |
| List of tips on how to deal and negotiate with the personnel of zoological institutions | 6 | Maria Gabriela Rocha (Sorocaba Zoo, Brazil) and Ralph Vanstreels (Brazil) |
| List of contacts of the TSG in zoological institutions | 6 | Gilia Angell Gilia Angell, Webmaster & Coordinator, Tapir Specialist Group (TSG) Marketing Committee --- to contact Viviana Quse |
| To include documents of captive management and environmental enrichment | 2 | Gilia Angell, Webmaster & Coordinator, Tapir Specialist Group (TSG) Marketing Committee |
| List of alternatives to avoid or reduce the impact of crop predation by tapirs | 6 | (U.S. Fish & Wildlife Service, United States) and Ralph Vanstreels (Brazil) / To work together with the TSG Human/Tapir Conflict Task Force |
| Link to the Ecoindex.org, Cebem.org and other institution networks | 2 | Gilia Angell, Webmaster & Coordinator, Tapir Specialist Group (TSG) Marketing Committee |
| List for the TSG Science Topic, containing projects on each area of concern (genetics, ecology etc.) | 6 | Maria Gabriela Rocha (Sorocaba Zoo, Brazil) and Ralph Vanstreels (Brazil) |
| Links to the projects of scientific visiting to field research projects that are already ongoing and which accept volunteers (Earthwatch etc.) | 6 | Ralph Vanstreels (Brazil) |
| List of "Adopt a Tapir" programs in zoological institutions | 12 | Sheryl Todd (President, Tapir Preservation Fund - TPF - United States |
| List of the volunteer specialists that we need (designers etc.) | 6 | Gilia Angell, Webmaster & Coordinator, Tapir Specialist Group (TSG) Marketing Committee |
| Form for donations | 2 | Gilia Angell, Webmaster & Coordinator, Tapir Specialist Group (TSG) Marketing Committee |
| List of volunteers to be sent to field projects (non-public list) | 12 | Andrés Tapia (Centro FÁTIMA, Ecuador) and Ralph Vanstreels (Brazil) |

| | | |
|---|---|---|
| Coordinator for correcting and revising informative or touristic books about tapirs | In progress | Lee Spangler (United States) |
| Questionnaire with 6-10 questions for volunteers | 6 | Sheryl Todd (President, Tapir Preservation Fund - TPF - United States) |
| Follow-up and cadastre of the answers of the questionnaires for volunteers | In progress | Sheryl Todd (President, Tapir Preservation Fund - TPF - United States) |
| Internet Page at the TSG Web Portal - "Help save tapirs" | 3 | Gilia Angell, Webmaster & Coordinator, Tapir Specialist Group (TSG) Marketing Committee |
| Models of PowerPoint presentations | 6 | Ralph Vanstreels (Brazil) |
| Proposal of inclusion of tapirs in school curricula (for the different age classes) | 12 | Gilia Angell, Webmaster & Coordinator, Tapir Specialist Group (TSG) Marketing Committee --- pedagogues to be contacted |
| List of speakers which could be invited (researchers etc.) | 6 | Maria Gabriela Rocha (Sorocaba Zoo, Brazil) |
| To produce presentation materials (folders, fliers etc.) | 24 | Sheryl Todd (President, Tapir Preservation Fund - TPF - United States) |
| List of ideas of kids games to be used in schools | 6 | Maria Gabriela Rocha (Sorocaba Zoo, Brazil) |
| Tapir souvenirs | 12 | Sheryl Todd (President, Tapir Preservation Fund - TPF - United States) |
| List of NGOs of the TSG and the TPF | 2 | Gilia Angell, Webmaster & Coordinator, Tapir Specialist Group (TSG) Marketing Committee |
| Model of partnership contract between NGOs | 6 | Jeffrey Flocken (International Fund for Animal Welfare, United States) |
| List of tips on how to deal and negotiate with governments | 6 | Andrés Tapia (Centro FÁTIMA, Ecuador) and Leonardo Ordoñez (Fundación ArcoIris, Ecuador) |
| List of tips on how to deal and negotiate with local communities | 6 | Andrés Tapia (Centro FÁTIMA, Ecuador) and Leonardo Ordoñez (Fundación ArcoIris, Ecuador) |

# Lowland Tapir (*Tapirus terrestris*) Conservation Workshop

## Population and Habitat Viability Assessment (PHVA)

### Sorocaba, São Paulo, Brazil
### 15 to 19 April, 2007

# WORKING GROUP

# *Ex-Situ* Conservation

# *Ex-Situ* Conservation

## PARTICIPANTS

Alberto Mendoza – United States/Mexico

Aude Desmoulins – France

Cassiana Javessine – Brazil

Cecíllia Pessutti – Brazil

Gabriella Landau-Remy – Brazil

Lizette Bermudez – Peru

Luis Guilhermo Añez – Venezuela

Luiz Antonio Pires – Brazil

Tânia Ribeiro Borges – Brazil

Valdir Ramos Jr. – Brazil

Viviana B. Quse – Argentina

# INTRODUCTION

The participants of this Working Group are all professionals directly involved with lowland tapir conservation in captivity. There is a large number of individuals kept in captivity. However, since it is not an endangered species, it is not ecologically valued. Therefore, the production and implementation of a Captive Management Plan for the species were never regarded as a priority.

One of the main objectives of zoos is species conservation through education and research. Through *ex-situ* conservation, the lowland tapir holders can contribute for the re-establishment of threatened populations in different regions of the species range.

# PROBLEMS

**1-** Better planning of exhibits/space;
**2-** Incomplete records of the lowland tapir in some countries;
**3-** Consanguinity;
**4-** Poor diets;
**5-** Lack of interaction among conservationists working *in-situ* and *ex-situ*;
**6-** Lack of information on reproductive behavior;
**7-** Lack of information about diseases which can jeopardize *ex-situ* management;
**8-** Lack of education programs in captivity;
**9-** Lack of a Management Plan with recommendations for the reproduction of the species in captivity;
**10-** Space = better planning of exhibits;
**11-** Lack of capacity-building of personnel for the management of the species in captivity;
**12-** Lack of communication among the tapir holders (interchange of experiences);
**13-** Need to implement *ex-situ* research projects;
**14-** Issues of enrichment, conditioning and welfare;
**15-** Identification of sub-species in Venezuela;
**16-** *Ex-situ* overcrowding;
**17-** Lack of control over the animals destination;
**18-** Lack of requirements for the interchange;
**19-** Lack of a *Studbook* for the species;
**20-** Lack of methods for population control;
**21-** Little use of the captive animals for getting data to be used in *in-situ* research projects;
**22-** Lack of information about the origin of the animals;
**23-** Lack of specific information on veterinary medicine;
**24-** Lack of protocols adapted to the South American reality;
**25-** Lack of adequate tests for tuberculin;
**26-** Lack of regional, national and international Collection Plans;
**27-** Lack of protocols for the transport and management of confiscated animals;

**28-** Breeding;
**29-** Issue of the illegally kept animals;
**30-** Poor communication among agencies;
**31-** Lack of interest on the species in the zoological institutions;
**32-** Lack of commitment of the zoological institutions with the management of the species;
**33-** Re-introduction/release;
**34-** Creation and maintenance of a genetic bank.

## PROBLEM GROUPING

The 34 problems which were listed during the brainstorming were grouped into seven (7) main categories, listed below:

**PROBLEM 1:** Poorly planned exhibits regarding animal welfare, lack of adequate reproductive management, lack of education for the visitors;

**PROBLEM 2:** Insufficient or poorly reliable data about the origin and kinship of animals (for the genetic management of the current captive population);

**PROBLEM 3:** Lack of regional, national and international *Ex-Situ* Management Plans;

**PROBLEM 4:** Lack of communication and interchange of experiences among *ex-situ* holders and *in-situ* researchers;

**PROBLEM 5:** Lack of valorization of the lowland tapir in zoological institutions and in the community as a whole, causing the lack of application of environmental education programs;

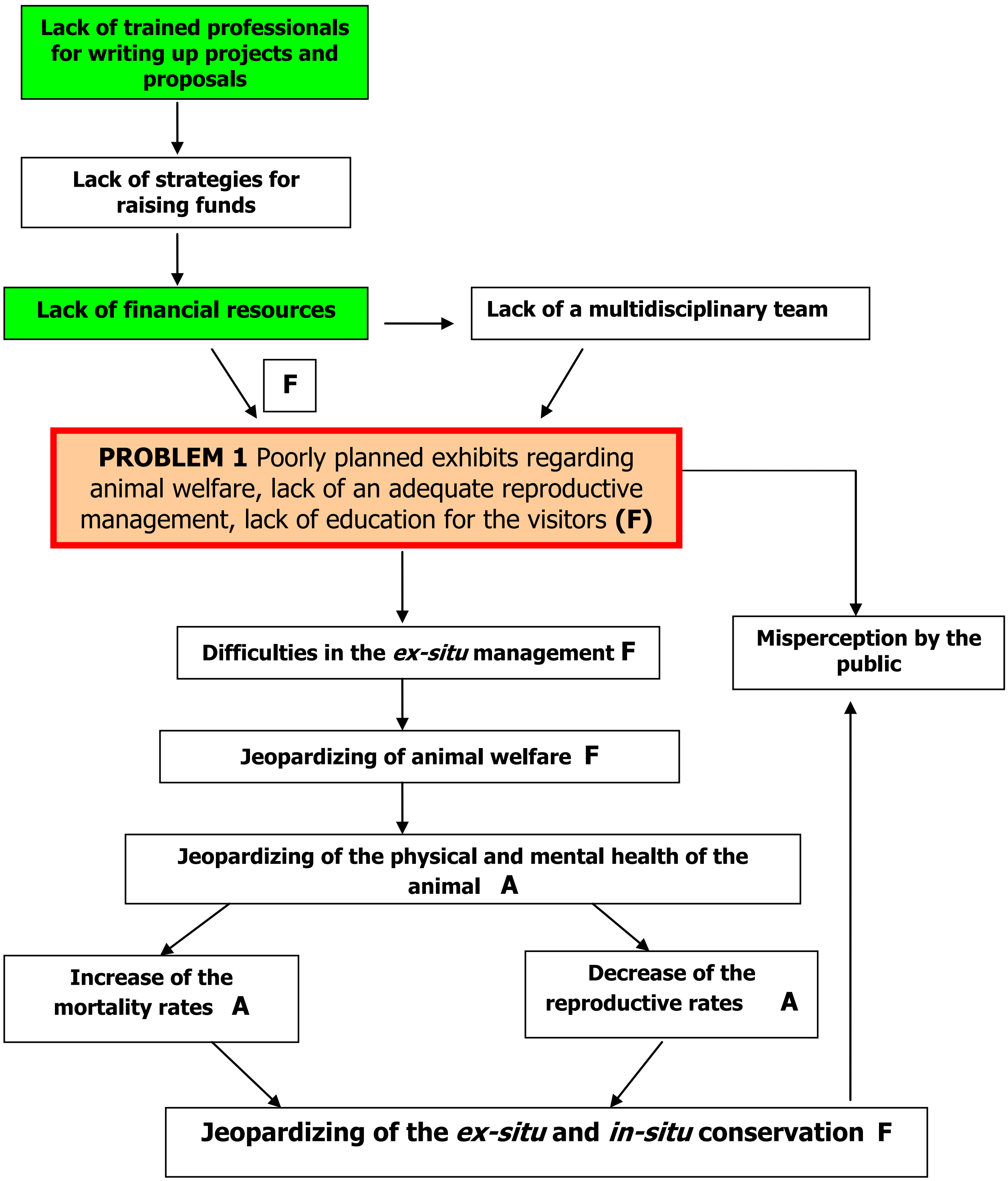
**PROBLEM 6:** Lack of adaptation of *ex-situ* management protocols to the reality of the implementation in Latin America;

**PROBLEM 7:** Lack of information about the procedures for the clearance of animal transference between countries.

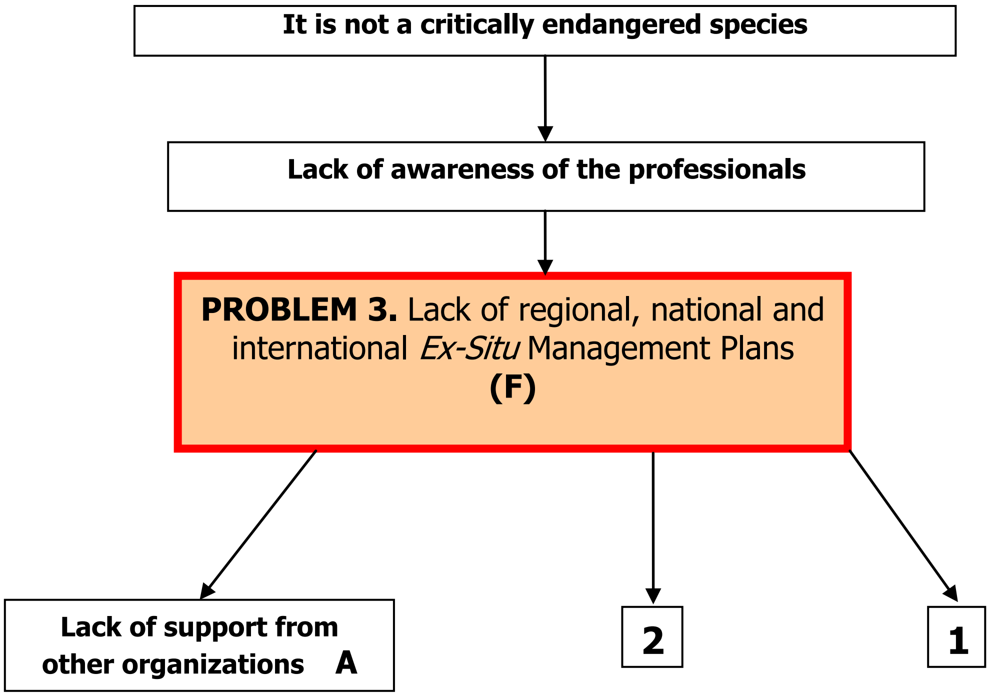
## ANALYSIS OF CAUSE AND EFFECT OF THE PROBLEMS

Starting with these problems, we carried out an analysis of the causes and effects of each one of them, also considering if the main problem was the one we had discussed or if it was mistaken for any of its causes.

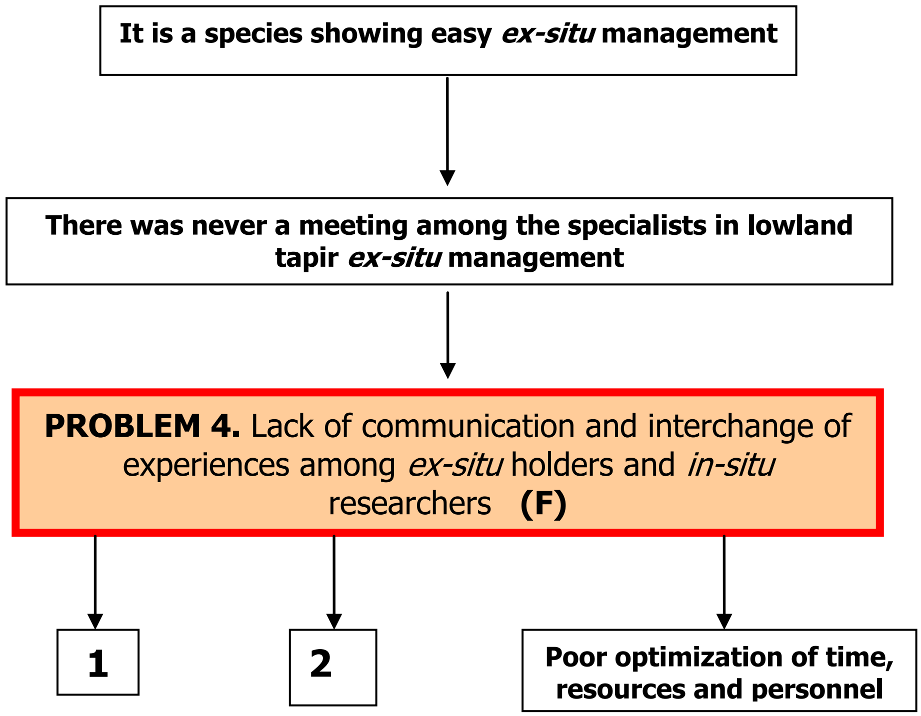
**PROBLEM 1:** The Working Group concluded that the main problem is not the poorly planned exhibits per se, but the lack of financial resources and the lack of a multidisciplinary team to design and build them.



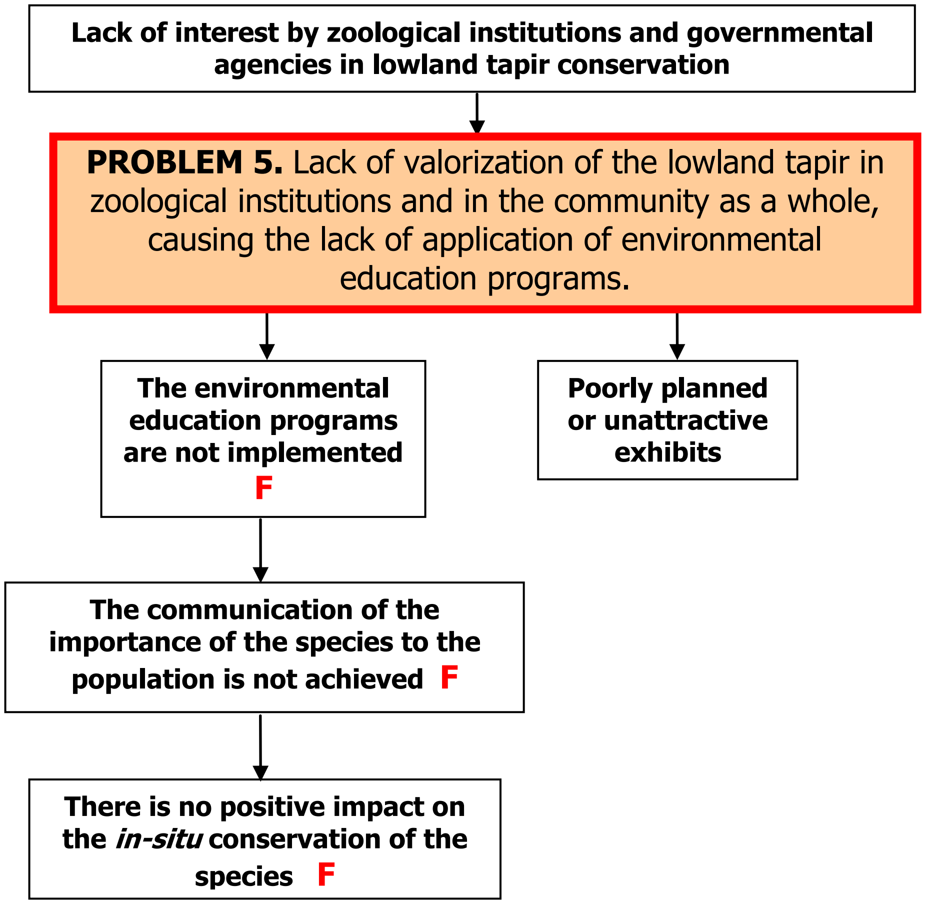
**PROBLEM 3:** The Working Group concluded that the main problem is, in fact, the lack of *Ex-Situ* Management Plans.



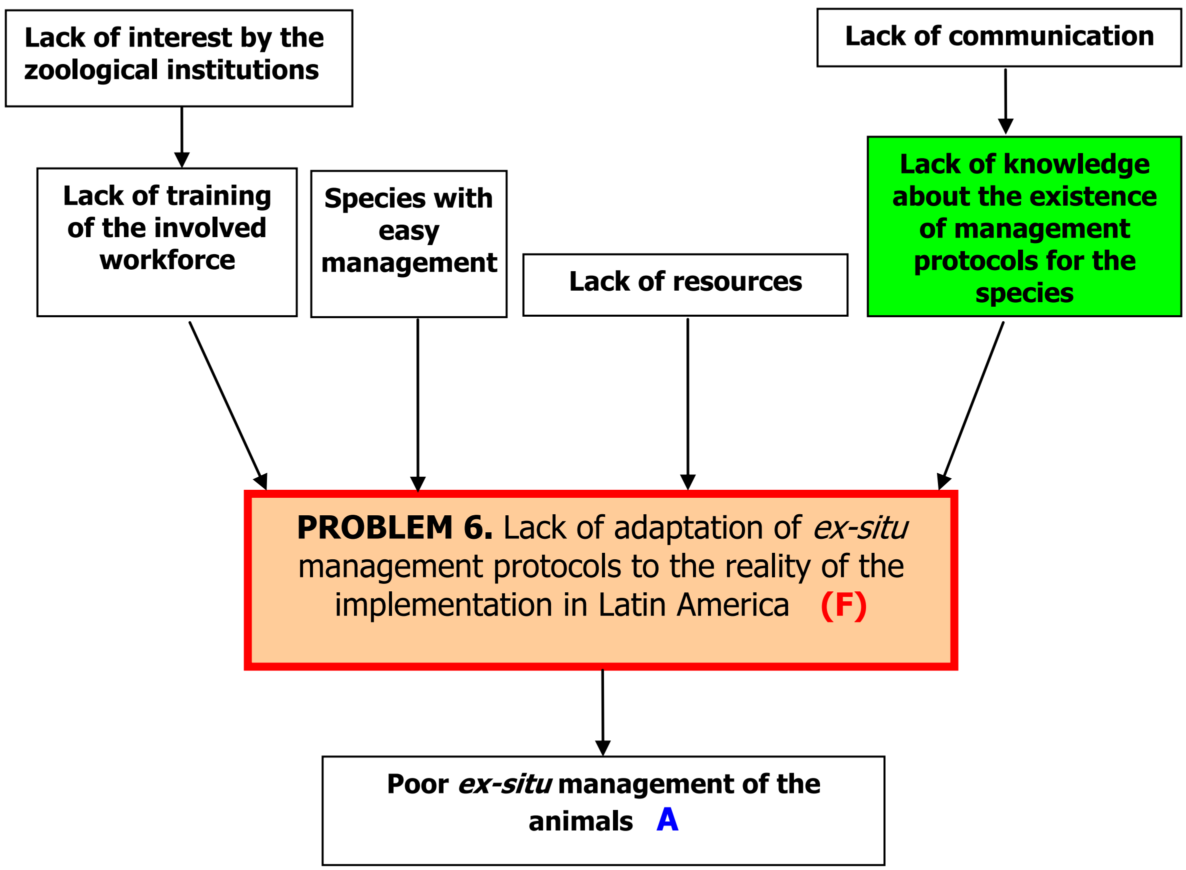
**PROBLEM 4:** The Working Group concluded that the main problem is, in fact, the lack of communication among *ex-situ* and *in-situ* researchers.



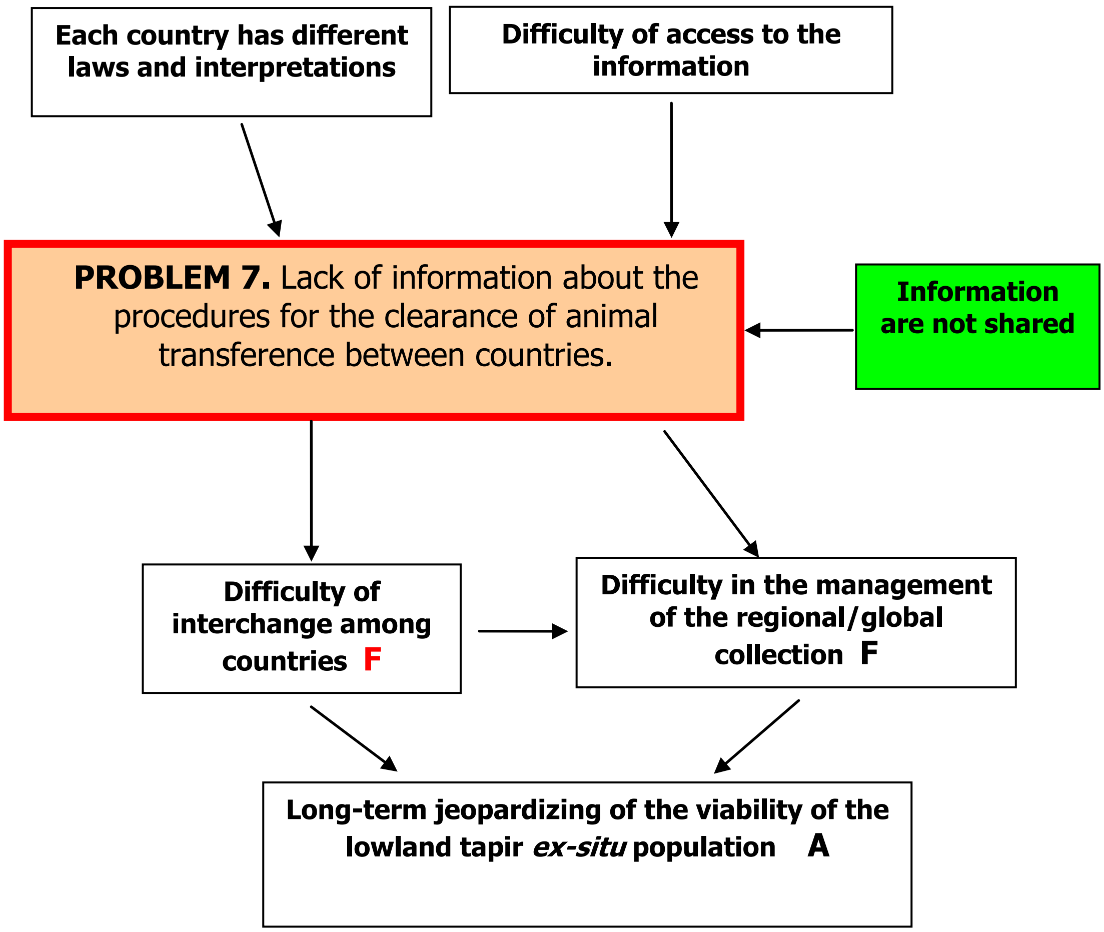
**PROBLEM 5:** The Working Group concluded that the main problem is, in fact, the lack of valorization of the lowland tapir in zoological institutions and the community as a whole, causing the lack of use of environmental education programs.



**PROBLEM 6:** The Working Group concluded that the main problem is the lack of knowledge by the community of zoos about the existence of *ex-situ* management protocols for the lowland tapir (protocols produced by the Tapir Specialist Group (TSG) and available at the TSG Internet page in all the relevant languages, including Spanish and Portuguese).



**PROBLEM 7:** The Working Group concluded that the main problem is the non sharing of information on the procedures for the clearance and transference of animal.



# PROBLEM PRIORITIZATION

**PROBLEM 1:** Lack of Regional, National and International *Ex-Situ* Management Plans.

Consequence: It leads to a jeopardizing of the viability of the *ex-situ* lowland tapir population in the long term.

**PROBLEM 2:** Lack of valorization of the lowland tapir in zoological institutions and in the community as a whole, causing the lack of application of environmental education programs.

Consequence: It does not raise interest for the need of lowland tapir conservation.

**PROBLEM 3:** Lack of communication and interchange of experiences among *ex-situ* holders and *in-situ* researchers.

Consequence: It influences the *ex-situ* management of lowland tapir in a negative way.

# GOALS

**PROBLEM 1:** Lack of Regional, National and International *Ex-Situ* Management Plans.

**GOAL 1:** To have *Ex-Situ* Management Plans (Collection Plans) for the lowland tapir at the regional, national and international levels.

**PROBLEM 2:** Lack of valorization of the lowland tapir in zoological institutions and in the community as a whole, causing the lack of application of environmental education programs.

**GOAL 2:** To advance the ecological valorization of the lowland tapir at the different levels of the society (managers and visitors of zoological institutions, governmental agencies, communities).

Within this GOAL, it appears the idea of designing and implementing a broad Environmental Education Program focused at the lowland tapir, making campaigns for its valorization, maybe creating a character, involving governmental agencies for using the animal as a national monument. It was discussed if the issue of the need to improve the lowland tapir image should be treated by education or marketing. It was also discussed the use of the structure of ALPZA – Latin American Association of Zoos and Aquaria – and it was suggested that this association carries out a wide campaign in 2009 for the promotion and divulgation of the lowland tapir. It was also proposed that the Sorocaba Zoo (São Paulo, Brazil) contributes to such education work, with the help of RioZOO (Rio de Janeiro Zoo, Brazil), conducting the elaboration of games, puzzles, educational booklets etc. It was discussed that the costs to produce educational materials in Brazil (art and formatting) are high, something that does not happen in other countries where there are arts departments and there are no costs, as for example at the Fundación Temaikén in Argentina. Within this topic, it was put forward that the IAZE - International Association of Zoo Educators, based at Africam Safari Zoo in México could support this action. As for the means to disseminate and promote the importance of lowland tapir conservation, it was noted that every country has different forms of communication and the actions to be carried out must be considered according to the possibilities. For the case of Brazil, it was suggested that the Government Secretaries (Municipal, State and Federal) take part in this dissemination process.

**PROBLEM 3:** Lack of communication and interchange of experiences among *ex-situ* holders and *in-situ* researchers.

**GOAL 3:** To increase the participation of zoological institutions (zoos and breeding centers) in the conduction of research projects about the lowland tapir in captivity.

It was discussed that it is important to foster research projects on the lowland tapir and that the holders cooperate, promoting better scientific knowledge about the species. It is necessary to include lowland tapir holders in the Tapir Specialist Group (TSG), so as to promote a larger exchange of information about the captive management of the species. It was advanced that it is of paramount importance that zoological institutions of several countries take part in the meetings about tapirs. It was also put forward the need to create an on-line list of lowland tapir holders for the exchange of information; this network should be linked to the Internet page of the Tapir Specialist Group (TSG). An alternative would be the creation of a *Google* or *Yahoo e-group*, with a responsible person for the moderation and maintenance of the page. That way, we will achieve an effective and swift communication. Viviana Quse of the Fundación Temaikén in Argentina volunteered to check with Temaikén about the possibility to assign someone to keep the page.

# ACTION PLAN

## GOAL 1: To have Ex-Situ Management Plans (Collection Plans) for the lowland tapir at the regional, national and international levels.

**ACTION 1.1:** To name a representative for each country for contacting the lowland tapir holders.

**Responsibility:** Viviana Quse (Fundación Temaikén, Argentina & Tapir Specialist Group Zoo Committee).
**Collaborators:** Alberto Mendonza, Diana Sarmiento, Aude Desmolins.
**Deadline:** One (1) month
**Indicators:** Identification of a representative for every range country which commits him(her)self to provide the information of the tapirs in captivity.
**Costs:** None
**Consequences:** To get in contact with the persons who can contribute data; interchange of experiences.
**Obstacles:** No acquisition of answers to the questionnaires and incomplete data.

**ACTION 1.2:** Preparation of a listing (trilingual) of lowland tapir holders.

**Responsibility:** Viviana Quse (Fundación Temaikén, Argentina & Tapir Specialist Group Zoo Committee).
**Collaborators:** Appointed representatives for each country.
**Deadline:** Six (6) months (June to November 2007).
**Indicators:** To obtain a trilingual directory (English, Spanish and Portuguese).
**Costs:** None
**Consequences:** Knowledge about the lowland tapir holders.
**Obstacles:** Lack of interest/efficiency in data supply.

**ACTION 1.3:** Preparation of a trilingual questionnaire and letter of introduction, and application of the questionnaire for the acquisition of data about lowland tapir.

**Responsibility:** Viviana Quse (Fundación Temaikén, Argentina & Tapir Specialist Group Zoo Committee).
**Collaborators:** Alberto Mendonza (AZA Tapir TAG, United States) and Cecília Pessutti (Sorocaba Zoo, Brazil).
**Deadline:** Two (2) months
**Indicators:** Finished, distributed and answered trilingual questionnaires.
**Costs:** None
**Consequences:** To obtain a complete questionnaire with data on the holding institutions.
**Obstacles:** Lack of interest by the institutions.

**Observation:** It was agreed that this Working Group needs a referral letter from the Tapir Specialist Group (TSG), in order to the representatives start the process of putting the actions into practice. We also discussed the model of questionnaire to be sent to the holding zoos and it was chosen to use the already existing one, previously prepared by the Tapir Specialist Group (TSG) Zoo Committee. Gabriella Landau-Remy of the RioZOO Foundation (Rio de Janeiro, Brazil) was responsible for translating the document into Portuguese, for it to be distributed for the Brazilian zoological institutions.

**ACTION 1.4:** Conduction of working meetings in the lowland tapir range countries. To inform the lowland tapir holding institutions of the results of this workshop and the resulting recommendations from this Working Group.

**Responsibility:** Appointed representatives for each country.
**Collaborators:** Zoological associations of each country, governmental agencies.
**Deadline:** Six (6) months.
**Indicators:** Participation and commitment of the lowland tapir holding institutions.
**Costs:** US$1,500 - US$6,000
**Consequences:** Development of recommendations for the elaboration of National Management Plans.
**Obstacles:** Lack of financial resources, lack of interest by the institutions.

**Observation:** It was discussed that it would be very difficult, in logistic terms, to organize an event in Brazil in order to disseminate the results of this workshop and the discussions of this Working Group. As an option, it was suggested to use video-conferences among the Brazilian institutions. For the Brazilian case, we also talked about sending the information via postal mail at the present moment and, within a year, to organize a specific event for the institutions that hold the species. In the other countries, the necessary time will be defined according to the local conditions and realities.

**ACTION 1.5:** To develop the regional, national and international Lowland Tapir *Studbooks*.

**Responsibility:** Viviana Quse (Fundación Temaikén, Argentina & TSG Zoo Committee).
**Collaborators:** Alberto Mendonza (AZA Tapir TAG, United States), Aude Desmoulins (EAZA Tapir TAG, France), Tânia Ribeiro Borges (Brasília Zoo, Brazil), appointed representatives for each country, Marcelo Reis (IBAMA - Brazilian Institute for the Environment and Renewable Natural Resources).
**Deadline:** Two (2) years after the meeting (Related with GOAL 4).
**Indicators:** Prepared and distributed *Studbooks*
**Costs:** US$2,500
**Consequences:** Maintenance of a genetically viable captive population.
**Obstacles:** Lack of financial resources and information.

**Observation:** It was discussed the need to have Regional, National and International *Studbooks* for the lowland tapir. In the case of Brazil, the assignment of the national *Studbook Keeper* depends on official recognition by the IBAMA. The name of Gabriella Landau-Remy of RioZOO Foundation (Rio de Janeiro, Brazil) was agreed as the Brazilian nominee.

**ACTION 1.6:** To contact people on each country for making the adaptation of the protocols of the Lowland Tapir *Ex-Situ* Management Plan.

**Responsibility:** Appointed representatives for each country.
**Collaborators:** ABRAVAS - Associação Brasileira de Veterinários de Animais Silvestres, SZB - Sociedade de Zoológicos do Brazil, SPZ - Sociedade Paulista de Zoológicos, ALPZA - Associación Latinoamericana de Parques Zoológicos y Acuarios (Committees).
**Deadline:** Eighteen (18) months
**Indicators:** Protocols adapted to the reality of each country.
**Costs:** None
**Consequences:** Following of the recommendations and rules for lowland tapir captive management in a similar way.
**Obstacles:** Lack of interest in adapting the protocols.

**ACTION 1.7:** To spread, within each country, the adapted management protocols.

**Responsibility:** Appointed representatives for each country.

**Collaborators:** Zoological associations of each country, in case there are instances of the government; Alberto Mendonza (AZA Tapir TAG, United States); Aude Desmoulins (EAZA Tapir TAG, France).

**Deadline:** One (1) to six (6) months after the adaptation.

**Indicators:** General knowledge and use of the adapted protocols by the lowland tapir holders.

**Costs:** US$500

**Consequences:** Knowledge of the management of lowland tapir in captivity, consultation material.

**Obstacles:** Lack of economic resources.

**Observation:** It was discussed the need of adaptation for each country, given their particular reality regarding factors such as availability of materials, drug acquisition and the possibility to use some other drugs. It was also discussed dissemination costs and forms.

**ACTION 1.8:** To make a database listing and describing the available exhibits for the lowland tapir (to include images and their architectural layout, if possible).

**Responsibility:** Gilia Angell, Webmaster & Coordinator, Tapir Specialist Group (TSG) Marketing Committee.

**Collaborators:** Appointed representatives for each country, Zoolex Internet page.

**Deadline:** Open, and with continuous update.

**Indicators:** Creation of a database for the construction and architectural layout of lowland tapir exhibits.

**Costs:** None

**Consequences:** Different models for changing the design of the architectural layouts of lowland tapir exhibits.

**Obstacles:** Lack of interest on receiving the information.

**ACTION 1.9:** To make a list of funders for exhibits and equipment for lowland tapir captive management.

**Responsibility:** Alberto Mendonza (AZA Tapir TAG, United States) and Aude Desmoulins (EAZA Tapir TAG, France).

**Collaborators:** Patrícia Medici (President, Tapir Specialist Group - TSG) – available lists, Sheryl Todd (President, Tapir Preservation Fund - TPF - United States), Zoolex Internet page.

**Deadline:** Three (3) months

**Indicators:** Complete and updated list of possible funders.

**Costs:** None

**Consequences:** Funding for exhibits.

**Obstacles:** Not obtaining the financial resources.

**GOAL 2:** To increase the participation of the zoological institutions (zoos and breeding centers) in the conduction of research projects about the lowland tapir in captivity.

**ACTION 2.1:** To make the resources and animals of lowland tapir holders available for the use of researchers through the Internet page of the Tapir Specialist Group (TSG) - www.tapirs.org.

**Responsibility:** Appointed representatives for each country.
**Collaborators:** lowland tapir holders and governmental agencies
**Deadline:** Six (6) months
**Indicators:** To have a larger quantity and higher quality of established research projects in the zoological institutions
**Costs:** None
**Consequences:** Higher interrelation among tapir holders and researchers producing greater knowledge about the species.
**Obstacles:** Not making the data available, lack of interest by the researchers.

**ACTION 2.2:** To include more lowland tapir holders as members of the Tapir Specialist Group (TSG).

**Responsibility:** Patrícia Medici (President, Tapir Specialist Group - TSG)
**Deadline:** Three (3) months
**Indicators:** Higher number of zoological institutions exchanging information.
**Collaborators:** Tapir Specialist Group (TSG) members in the lowland tapir range countries, TSG Country coordinators, TSG Zoo Committee.
**Costs:** None
**Consequences:** Higher number of tapir holders as TSG members.
**Obstacles:** Tapir holders are not included as TSG members.

**ACTION 2.3:** To make an on-line network of lowland tapir holders for the interchange of information; this should be linked to the Internet page of the Tapir Specialist Group (TSG) - www.tapirs.org

**Responsibility:** Viviana Quse (Fundación Temaikén, Argentina & Tapir Specialist Group Zoo Committee).
**Collaborators:** Appointed representatives for each country.
**Deadline:** Eight (8) months
**Indicators:** Effective and swift communication.
**Costs:** US$1,000
**Consequences:** Ease in making information available.
**Obstacles:** To find a moderator and to create and keep the group in the Internet.

**GOAL 3:** To advance the ecological valorization of the lowland tapir at the different levels of the society (managers and visitors of zoological institutions, governmental agencies, communities).

**ACTION 3.1:** To create, disseminate and implement a specific Environmental Education Program for the lowland tapir among all the involved zoological institutions.

**Responsibility:** Cecília Pessutti (Sorocaba Zoo, Brazil), Viviana Quse (Fundación Temaikén, Argentina & Tapir Specialist Group Zoo Committee), and Parque Sur (Venezuela).
**Collaborators:** SZB - Sociedade de Zoológicos do Brazil; SPZ - Sociedade Paulista de Zoológicos (Brazil); INRENA - Instituto Nacional de Recursos Naturais (Peru) and all lowland tapir holders.
**Deadline:** One (1) year
**Indicators:** To have an Environmental Education Program for the lowland tapir.
**Costs:** Undefined
**Consequences:** For Brazil, a positive change in the perception of the lowland tapir image; for the other countries, to valorize the lowland tapir among the public in general and to broaden the action range of the zoos.
**Obstacles:** Lack of financial resources, lack of interest in the participation.

**ACTION 3.2:** To spread the ecological importance of the lowland tapir in the mass communication media (through reportages, articles etc.)

**Responsibility:** Representatives of each country.
**Collaborators:** Communication media, governmental agencies of the environment and education sectors, communication agencies and education and marketing team of zoos.
**Deadline:** Undefined
**Indicators:** Higher knowledge about the lowland tapir by the public in general.
**Costs:** Depends on each country and on each institution.
**Consequences:** lowland tapir converted into an interesting and attractive animal.
**Obstacles:** No cooperation by the communication media and governmental agencies.

**ACTION 3.3:** To suggest the ALPZA the inclusion of the lowland tapir as a symbol species in the calendar of the institution.

**Responsibility:** Viviana Quse (Fundación Temaikén, Argentina & Tapir Specialist Group Zoo Committee).
**Collaborators:** Diana Sarmiento (Colombia)
**Deadline:** Two (2) months
**Indicators:** Election of the lowland tapir as a symbol by the ALPZA.
**Costs:** None
**Consequences:** Higher valorization of the zoos by having the lowland tapir in their collections.
**Obstacles:** Non acceptance of the proposal by the ALPZA.

# Lowland Tapir (*Tapirus terrestris*) Conservation Workshop

## Population and Habitat Viability Assessment (PHVA)

### Sorocaba, São Paulo, Brazil
### 15 to 19 April, 2007

# TASK FORCE

# Epidemiology

# Epidemiology

## PARTICIPANTS

Cátia Dejuste de Paula – Brazil

Evelio Narvaez – Paraguay

Joares Adenilson May Jr. – Brazil

Magdalena Cubas – Paraguay

Marcelo Gomes da Silva – Brazil

Paulo Rogerio Mangini – Brazil

Pilar Alexander Blanco – Venezuela

Viviana B. Quse – Argentina

## Importance of the Diseases

Diseases are natural processes characterized by the relation among parasites and hosts. However, the current environmental changes, such as expansion of cattle ranching and forest fragmentation, cause a situation of population crowding, thus increasing the risk of the appearance of diseases. In this scenario, where many populations are reduced and isolated, diseases start to be decisive, with potential to cause mortality and reduction of the reproductive capacity of the populations, leading to the local disappearance of the species.

## Creation of the Task Force

The purpose of gathering a group of veterinarians as a task force during the workshop was justified by the need to analyze the issue of tapirs' health, both in the wild and in captivity, working as a source of data and contributing for the modeling of tapir population viability using the VORTEX software. Within this purpose, the compilation, analysis and insertion of data in population modeling were carried out, showing the effect of diseases in different threat scenarios for lowland tapir populations.

## Selection of Population Modeling Variables of the VORTEX *Software* possibly related to Diseases

Within the modeling system employed by the VORTEX *software*, we could identify, with the help of the workshop modelers, the variables which would be related to the effects of diseases on the animals and populations, besides different ways of using the data.

The model allows the data on animal health to be inserted with respect to basically two contexts of population health. Situations of ENDEMIC are those represented by well-established diseases in a given area, where the rates of incidence, prevalence, mortality and impairments of reproductive nature affecting birth rate could all be introduced in the models of the VORTEX *software*. In the case of the model of endemic, these values would be represented by percentages and absolute figures that are "predicted and constant" in the time interval of iteractions.

The situations of EPIDEMIC would be represented by events in which a given disease would appear in a population in a given time interval within the proposed viability prediction model. These diseases would cause local or global damage, leading to higher mortality rates or lower reproductive rates. In this analysis situation, it is also possible to predict new epidemics in pre-set time intervals.

The influence of diseases within a population could also be modeled by inserting those data related to the dispersion of individuals, since some diseases cause mortality or body weakness for a specific age class, something that could decrease dispersion rates. In addition, when one works with metapopulation models, the dispersion rate could be associated to the capacity of a disease to reach one sub-population from another.

The influence of diseases can also be modeled through the "*Harvest*" option, where a given number of deaths (removals from the population) could be predicted at regular time intervals, a pattern that is compatible with the profile of some diseases, which depend on the interactions among complex biological cycles (cyclic diseases). One can also employ functions, through which the percentage of individuals which would die in epidemic cycles defined at regular time intervals can also be estimated.

**Situations of Endemic:** Established diseases in a given area or population.

- Constant mortality rates and depression of the reproductive capacity over time
- Mortality rates which can be specified by age class
- Reduced reproductive rates
- Decrease of dispersion rates

**Situations of Epidemic:** Appearance of a new disease or significant increase in the number of cases of a disease.

- Data inserted within a 'Catastrophe' considering:
    - Frequency that each epidemic could occur
        - Global/local distribution (related to the dispersion capacity of the pathogen agent in the environment)
    - Effects on reproduction (loss of a % of the reproductive capacity)
    - Effects on the survivorship (% mortality rates in the population)
- *Harvest* – mortality within previously defined cycles
- Decrease of dispersion rate as a consequence of epidemic cycles

# Revision of the Literature and Field Data for Determining the Diseases that could be Used in the Modeling

With the aim of raising data on the diseases which affect the lowland tapir, in order to produce the information which can feed the population viability models generated by the VORTEX *software*, the most important diseases for the species were determined through an exercise of bibliographic compilation and personal experiences of the Task Force participants.

The diseases which were observed in this exercise produced **five grouping categories**:

1) **Clinical diseases** with occurrence in wild or captive tapirs;

2) Diseases with only **serological evidence**;

3) **Probable diseases** for the species, not observed yet;

4) **Predisposing situations** which lead to the appearance of other illnesses;

5) **Mistakes of captive management** which cause clinical problems.

Based on the definition of the groups of diseases, the group determined the criteria for prioritizing the diseases selected in the survey.

**Criteria**

1. **Economic / Political / Social**
Those which cause economic conflicts and impacts or have a correlation with health problems in domestic animals, public health, environmental sanitation, health surveillance.

2. **Disease Morbidity**
It represents the capacity of dissemination of the disease in the population, being represented by the percentage of individuals hit by the disease.

3. **Mortality / Lethality**
It represents the percentage of affected individuals which actually die due to the disease.

4. **Pathogenicity**
The disease effects and the way it acts on the body.

5. **Reproductive Effects**
Potential of the disease to reduce the reproductive capacity of the population and/or cause lesions to the reproductive system of the individuals.

6. **Dissemination Capacity of the Disease**
It is represented by the R zero, of the epidemiology, or the reproducibility of the agent within the population.

7. **Ecology of the Disease**
Relative to the biological cycle and path of transmission of the pathogenic agent.

8. **Relation of the Agent with the degradation of the environments**
Relative to the capacity of the pathogenic agent in benefiting from environmental changes, such as population crowding and cattle presence.

In relation to these criteria, the diseases were classified as:

**(H)** **High importance** for the population viability
**(M)** **Medium importance** for the population viability
**(L)** **Low importance** for the population viability
**(N)** **Null importance** for the population viability

Following the criteria and assigned importance level, the different illnesses were grouped as shown below:

### Clinical Diseases

**1.** Foot-and-Mouth Disease (H)
**2.** *Campylobacter* (H)
**3.** Tuberculosis (H)
**4.** *Balantidium* (M)
**5.** Giardia (M)
**6.** *Salmonella* (M)
**7.** Blepharitis (L)
**8.** Respiratory problems (L)
**9.** Tetanus (L)
**10.** Actinomycosis (N)
**11.** Keratitis (N)
**12.** Diabetes (N)
**13.** Vesicular exanthematous disease (N)
**14.** Filariasis (N)
**15.** Laminitis (N)
**16.** Phleas (N)
**17.** Scabies (N)
**18.** Schistosomiasis (N)

### Serological Evidence

**1.** Equine infectious anemia (H)
**2.** Equine Encephalitis WEE and EEE (H)
**3.** Vesicular stomatitis (H)
**4.** Leptospirosis (H)
**5.** Trypanossomosis (H)
**6.** *Babesia* (M)
**7.** Encephalomyocarditis (picorna vírus) (M)
**8.** Infectious bovine rinotracheitis (M)
**9.** Equine herpesvirus (L)
**10.** Bluetongue (L)
**11.** Mycoplasmosis (L)
**12.** *Toxoplasma* (L)
**13.** Enteric red-mouth disease (L)

**Possible Diseases**

1. Brucelosis (H)
2. Intoxication by pesticides and heavy metals (H)
3. Rabies (H)
4. Aujeszky's Disease (M)
5. Clostridiosis (M)
6. Leishmaniasis (M)
7. Bovine viral diarrhoea (L)
8. Influenza (L)
9. Swine parvovirosis (L)
10. Rhinoviroses (L)

**Mistakes of captive management**
**High Importance for Population Viability (H)**

To follow the management protocols, aiming at reducing mortality and reproductive problems and improving survival rates of offspring, increases the viability of maintaining the captive population as a genetic bank. The (H) categorization is also justified because the management mistakes generate health information which has low applicability to wild populations, producing situations which would not happen in the wild and providing data which has low applicability to the conservation of wild populations. Important points that must be emphasized:

- Offspring mortality
- Nutritional problems
- Acclimatization
- Restraint
- Preventive medicine protocols

**Predisposing situations**

1. High tick infestation (H)
2. Environmental stress (H)
3. Infestation with intestinal parasites (M)
4. Loss of genetic variability / inbreeding depression (M)

# Definition of Values for the Creation of Modeling Scenarios

Based on the importance grades ascribed to the diseases according to the previously defined categories, the values that could be assigned within the modeling patterns of the VORTEX *software* were determined as shown below:

| | Birth rate | Mortality | Dispersion |
|---|---|---|---|
| *Campylobacter* | -15% | 0 | 0 |
| Leptospirosis | -20% | +10% | 0 |
| Scabies (Frequency 5 years) | 0 | +20% | - 80% |
| Management mistakes | +5% | -15% | 0 |

### Predisposing Situation

3% (annual incidence)

| MORTALITY rates | With tuberculosis | Without tuberculosis |
|---|---|---|
| High tick infestation | Base model + 6% | Base model + 0,3% |
| Without ticks | Base model + 1% | Base model |

20%

Annual infestation20%

0.3 % (annual incidence)

# DEFINITION OF GOALS and ACTION PLAN

***OBS:*** *The proposed goals have communication networks as a basis, with the costs being related to the activity of volunteers, hence without measurable financial costs.*

## GOAL 1: To disseminate the need of research projects on lowland tapir health issues and to encourage the participation of veterinarians in field projects, as well as the need for researchers to foresee the importance of research programs on health issues within their fieldwork projects.

**SUB-GOAL 1.1:** To identify professionals willing to offer training opportunities, as well as their sites and availability periods, describing the opportunities according to the following criteria:

- Distribution among countries and regions;
- Characteristics of the working method;
- Period and capacity to accommodate the candidates;
- Selection criteria.

**ACTION:** Contact, through electronic means, about the demands of health research (TWO PHASES).

**Phase 1:** Consultation through e-mail with the field researchers about the willingness of offering training and internships turned to lowland tapir conservation.

**Responsibility:** Paulo R. Mangini (Member, Veterinary Committee, Tapir Specialist Group - TSG).
**Execution:** Tapir Specialist Group (TSG) Veterinary Committee.
**Deadline:** Six (6) months

**Phase 2:** Publicization to the class associations (veterinary, biology, ecology, forestry engineer), zoo associations, universities, governmental agencies and conservation NGOs the opportunities for lowland tapir conservation, research and traineeship opportunities.

**Responsibility:** Paulo R. Mangini (Member, Veterinary Committee, Tapir Specialist Group - TSG) and Pilar Alexander Blanco (FUNPZA, Venezuela).
**Execution:** Publicization through the Veterinary and Education & Outreach Committees of the Tapir Specialist Group (TSG).
**Deadline:** Twelve (12) months.

## GOAL 2: To build an information network on lowland tapir health issues.

**SUB-GOAL 2.1:** To identify experts in the fields of epidemiology, pathology, microbiology (bacteriology, virology etc.), parasitology, clinical pathology, toxicology, nutrition and endocrinology.

**ACTION:** Consultation with the Tapir Specialist Group (TSG) Country Coordinators, which will attempt to produce a list of professionals, either by delegation or making it themselves.

**Responsibility:** Paulo R. Mangini (Member, Veterinary Committee, Tapir Specialist Group - TSG) and Joares May Jr. (Pró-Carnívoros Institution & Lowland Tapir Conservation Initiative, IPÊ - Institute for Ecological Research, Brazil).
**Execution:** Tapir Specialist Group (TSG) Veterinary Committee.
**Collaborators:** Marcelo Gomes (São Bernardo do Campo Zoo, Brazil), Cátia Dejuste de Paula (Tríade/CECFAU - São Paulo Zoo, Brazil), Pilar Alexander Blanco (FUNPZA, Venezuela) and Evelio Narvaez (Binational Yacyreta Entity, Paraguay).
**Deadline:** Twelve (12) months.

**SUB-GOAL 2.2:** To identify reference laboratories for different countries and geographical regions (TWO PHASES).

**Action Phase 1:** To write an institutional letter of clarifications about the creation of the health network and a list of the expertise which is intended to be included in this reference list.

**Responsibility:** Joares May Jr. (Pró-Carnívoros Institution & Lowland Tapir Conservation Initiative, IPÊ - Institute for Ecological Research, Brazil).
**Execution:** Joares May Jr. (Pró-Carnívoros Institution & Lowland Tapir Conservation Initiative, IPÊ - Institute for Ecological Research, Brazil), Marcelo Gomes (São Bernardo do Campo Zoo, Brazil), Paulo R. Mangini (Member, Veterinary Committee, Tapir Specialist Group - TSG) and Patrícia Medici (President, Tapir Specialist Group - TSG).
**Deadline:** Three (3) months.

**Action Phase 2:** Consultation with the Tapir Specialist Group (TSG) Country Coordinators, which will make a list of qualified laboratories, either by delegation or making it themselves.

**Responsibility:** Paulo R. Mangini (Member, Veterinary Committee, Tapir Specialist Group - TSG) and Joares May Jr. (Pró-Carnívoros Institution & Lowland Tapir Conservation Initiative, IPÊ - Institute for Ecological Research, Brazil).
**Execution:** Tapir Specialist Group (TSG) Veterinary Committee.
**Collaborators:** Marcelo Gomes (São Bernardo do Campo Zoo, Brazil), Cátia Dejuste de Paula (Tríade/CECFAU - São Paulo Zoo, Brazil), Pilar Alexander Blanco (FUNPZA, Venezuela) and Evelio Narvaez (Binational Yacyreta Entity, Paraguay).
**Deadline:** Twelve (12) months.

**SUB-GOAL 2.3:** To thoroughly disseminate, via Internet, the available protocols on sanitary management and collection of biological data on tapirs (TSG Tapir Field Veterinary Manual – published in June 2007).

**ACTION:** To distribute the protocols to zoo associations, zoological institutions and breeding centers, as well as to federal public bodies in the lowland tapir range countries.

**Responsibility:** Cátia Dejuste de Paula (Tríade/CECFAU - São Paulo Zoo, Brazil) and Paulo R. Mangini (Member, Veterinary Committee, Tapir Specialist Group - TSG).
**Deadline:** Six (6) months.

**SUB-GOAL 2.4:** To foster the revision of contents and to evaluate the need of new protocols for tapir health issues (TSG Tapir Field Veterinary Manual - published in June 2007).

**ACTION 1:** To ask the institutions which have received the Manual about its use and those deficient points that could be modified in the contents.

**ACTION 2:** To include the health issue in discussions at the **International Tapir Symposium**, setting up a tapir health section and fostering the discussion about the most important contagious infectious diseases for the four species.

**Responsibility:** Cátia Dejuste de Paula (Tríade/CECFAU - São Paulo Zoo, Brazil).
**Execution:** Cátia Dejuste de Paula (Tríade/CECFAU - São Paulo Zoo, Brazil), Paulo R. Mangini (Member, Veterinary Committee, Tapir Specialist Group - TSG), Joares May Jr. (Pró-Carnívoros Institution & Lowland Tapir Conservation Initiative, IPÊ - Institute for Ecological Research, Brazil) and Pilar Alexander Blanco (FUNPZA, Venezuela).
**Deadline:** 2009

## **GOAL 3:** To establish a system of compilation, interpretation and diffusion of those epidemiological data that are applicable to the Population Viability Analysis (PVA).

**SUB-GOAL 3.1:** To create a database of global *in-situ* and *ex-situ* health data of the four tapir species.

**Note:** Partially dependent on the running of the Captive Management Plan and on the *Studbook*, as well as on the publication and dissemination of field data.

**ACTION 1:** To ask for health data via researchers and Tapir Specialist Group (TSG) Country Coordinators. To request data.

**ACTION 2:** To compile and organize bibliographic data on lowland tapir health.

**Note:** Possibility to stimulate Bachelor degree monographs with such aim.

**Responsibility:** Paulo R. Mangini (Member, Veterinary Committee, Tapir Specialist Group - TSG) and Patrícia Medici (President, Tapir Specialist Group - TSG).
**Collaborators:** Cátia Dejuste de Paula (Tríade/CECFAU - São Paulo Zoo, Brazil), Joares May Jr. (Pró-Carnívoros Institution & Lowland Tapir Conservation Initiative, IPÊ - Institute for Ecological Research, Brazil) and Marcelo Gomes (São Bernardo do Campo Zoo, Brazil).
**Deadline:** Two (2) years

**SUB-GOAL 3.2:** To create a health data processing system which can be employed in population viability models applied to the Outbreak software.

**ACTION 1:** To create a Task Force with members of the Tapir Specialist Group (TSG) and other professionals.

**ACTION 2:** To create a discussion forum on how to produce this system, on how to proceed to compile and add the different epidemiological information on the lowland tapir in the wild and also in captivity, and on the epidemiological variables that can be entered into population viability models.

**Responsibility:** Tapir Specialist Group (TSG) Veterinary Committee
**Deadline:** Start after (2) years.

**GOAL 4:** To encourage in-situ and ex-situ research projects on health issues which generate more knowledge on:

- Interactions between ectoparasites (e.g. ticks) and hematozoans;
- Contagious infectious diseases and zoonoses;
- Environmental stress;
- Contaminant toxic agents;
- Diseases affecting reproduction;
- Research models in epidemiology.

**ACTION 1:** Dissemination to all the researchers about the importance of the research on health issues. In conjunction with GOAL 1, related to the encouragement of participation of veterinarians in the projects.

**ACTION 2:** To show the research demands and possibilities to the established health network, presenting samples and issues that are available for scientific investigations.

**ACTION 3:** To prepare a document containing information on research recommendations and possibilities related to lowland tapirs' health. This document will provide subsidies to the Tapir Specialist Group (TSG) Fundraising Committee for defending the need of funds for these research projects.

**Responsibility:** Tapir Specialist Group (TSG) Veterinary Committee
**Deadline:** Six (6) months

**SUB-GOAL 4.1:** To identify a group of professionals specialized on laboratory techniques; to establish a discussion network on the issue of health research projects aimed at the population viability of the four tapir species and to produce a manual about these laboratory techniques.

**ACTION 1:** To produce a manual of laboratory diagnosis techniques with the aim of validating or standardizing the tests that are applicable to the needed diagnoses.
**Responsibility:** Paulo R. Mangini (Member, Veterinary Committee, Tapir Specialist Group - TSG).
**Execution:** To contact Claudia Filoni - Tríade, inviting her to edit and coordinate this task.
**Deadline:** Two (2) years

**SUB-GOAL 4.2:** To answer the demand of field researchers about poisoning episodes of the four tapir species.

**ACTION 1:** To determine, from the assumptions raised by field researchers, the research possibilities on this field, as well as the health consequences on the animals and populations caused by the pollutants pointed by these researchers and to create a toxicology data bank, according to the identification of possible problems.
**Responsibility:** Tapir Specialist Group (TSG) Veterinary Committee
**Deadline:** According to the demand.

# Lowland Tapir (*Tapirus terrestris*) Conservation Workshop

## Population and Habitat Viability Assessment (PHVA)

### Sorocaba, São Paulo, Brazil
### 15 to 19 April, 2007

# TASK FORCE

# Genetics

# Genetics

## PARTICIPANTS

Anders Gonçalves da Silva – Brazil/Canada

Robert C. Lacy – United States

# INTRODUCTION

The Genetics Task Force was entrusted with identifying the main problems that lead to the loss of genetic variability and the consequences for the populations of having a low genetic variability. The Task Force identified problems for the captive and wild lowland tapir populations. Problems, causes and consequences were identified and models for illustrating some situations were developed.

# Wild Populations

### 1. Loss of genetic diversity in locally isolated populations

#### Causes

Increases in human populations are leading to a rise in the economic demand for wood, food etc., something that causes an increase in wood extraction and in the land conversion for agriculture/cattle ranching. These pressures lead to road construction, which lead to an increase in wood extraction and more agriculture/cattle ranching in positive feedback. These factors lead to higher rates of habitat loss and fragmentation and to the increase of the population isolation in small fragments, leading to the loss of genetic variability through genetic drift. Besides, habitat degradation, hunting, diseases/parasites and road kill lead to lower population densities in remnant habitats. This, on its turn, speeds up genetic drift.

#### Consequences

The consequences of the loss of genetic variability include: the possibility of a decrease in the potential to adapt to environmental changes due to climactic changes, increase in the susceptibility to pesticides and other pollutants, and random fixation in the population of poorly adapted alleles. In the long term, this can result in the reduction of fertility and in the increase of mortality. Moreover, even if other threats (such as hunting, habitat degradation etc.) are removed, it can still have a significant impact on the population.

## 2. Random loss of alleles which can be important in the future

### Causes

Increases in human populations are leading to a rise in the economic demand for wood, food etc., something that causes an increase in wood extraction and in the land conversion for agriculture/cattle ranching. These pressures lead to road construction, which lead to an increase in wood extraction and more agriculture/cattle ranching in positive feedback. These factors lead to higher rates of habitat loss and fragmentation and to the increase of the population isolation in small fragments, leading to the loss of genetic variability through genetic drift. Besides, habitat degradation, hunting, diseases/parasites and road kill lead to lower population densities in remnant habitats. This, on its turn, speeds up genetic drift.

### Consequences

Loss of the power to react and adapt to environmental variations such as, for example, alterations related to climactic changes, introduction of diseases, pesticides etc.

## 3. Loss of genetic variability due to the structure of metapopulations

### Causes

Increases in human populations are leading to a rise in the economic demand for wood, food etc., something that causes an increase in wood extraction and in the land conversion for agriculture/cattle ranching. These pressures lead to road construction, which lead to an increase in wood extraction and more agriculture/cattle ranching in positive feedback. These factors lead to higher rates of habitat loss and fragmentation and to the increase of the population isolation in small fragments. The formation of fragments can lead to the creation of metapopulations where they did not exist before, with high extinction/human re-occupation rates. Such structuring of the population leads to the loss of genetic variability due to genetic drift and natural selection.

### Consequences

The consequences of the loss of genetic variability include: the possibility of a decrease in the potential to adapt to environmental changes due to climactic changes, increase in the susceptibility to pesticides and other pollutants, and random fixation in the population of poorly adapted alleles. In the long term, this can result in the reduction of fertility and in the increase of mortality. Moreover, even if other threats (such as hunting, habitat degradation etc.) are removed, it can still have a significant impact on the population.

## 4. Inbreeding in isolated populations

### Causes

Decrease of populations by the above-mentioned causes, which lead to reproduction between related individuals.

### Consequences

Inbreeding can lead to inbreeding depression, which would cause mortality increase, fertility reduction, and increase in the susceptibility of the population to diseases, pesticides, and environment and habitat changes.

## 5. Loss of local adaptations through the movement / connection of populations with different evolutionary stories

### Causes

The reduction and isolation of populations lead to the need of supplementing/re-introducing individuals in decimated populations or connecting populations through corridors.

### Consequences

This problem can lead to the loss of local adaptations, mortality increase and fertility reduction.

# Captive Populations

## 1. Inbreeding depression in captive populations

### Causes

There is no history of management of the lowland tapir captive population, not even the maintenance of good records. Consequently, the records are generally poor, which results in few effective management plans for the captive populations. Therefore, animals of unknown origin are being mixed in the breeding programs.

### Consequences

This problem can lead to inbreeding, causing fertility reduction and mortality increase – so-called inbreeding depression. This can also reduce the survivorship of these individuals if they are re-introduced to the wild, and significantly reduce the political acceptability of the use of these animals in reintroduction programs. The consequences of these processes would be the decrease in the viability of captive populations and a reduced number of captive animals which could be used in management plans (but that could be used in education programs).

## 2. Outbreeding depression

### Causes

There is no history of management of the lowland tapir captive population, not even the maintenance of good records. Consequently, the records are generally poor, which results in few effective management plans for the captive populations. Therefore, animals of unknown origin are being mixed in the breeding programs.

### Consequences

This problem can lead to outbreeding, causing fertility reduction and mortality increase when individuals coming from populations adapted to very different local conditions are paired. This can also reduce the survivorship of these individuals if they are re-introduced to the wild, and can significantly reduce the political acceptability of the use of these animals in reintroduction programs. The consequences of these processes would be the decrease in the viability of captive populations and a reduced number of captive animals which could be used in management plans (but that could be used in education programs).

### 3. Selection for alleles adapted to the captivity, or poorly adapted to the wild (significant only in cases of many generations of a closed population)

#### Causes

There is no history of management of the lowland tapir captive population, not even the maintenance of good records, something that is partially due to the traditional character of zoos (something that has been changing at present). As a result, the records are generally poor, resulting in few effective management plans for the captive populations. Besides, in some zoos, where the exhibit conditions are very different from what is found in the wild, genes and alleles adapted to the artificial conditions can be favored.

#### Consequences

This problem can lead to the loss of the behavioral traits that are essential for the survivorship in the wild; it can lead to fertility reduction and mortality increase of those individuals reintroduced to the wild and can fix in the population genes poorly adapted to the wild conditions.

# Lowland Tapir (*Tapirus terrestris*) Conservation Workshop

## Population and Habitat Viability Assessment (PHVA)

### Sorocaba, São Paulo, Brazil
### 15 to 19 April, 2007

# WORKING GROUP

# Population Biology and Simulation Modeling

# Population Biology and Simulation Modeling

# MODELERS


## ARNAUD DESBIEZ

Ph.D. Royal Zoological Society of Scotland (RZSS), Edinburgh Zoo
Associate Researcher, EMBRAPA Pantanal, Brazil
Modeler, IUCN/SSC Conservation Breeding Specialist Group (CBSG) - Brazilian Network
Rua América, 1.090, Centro, Corumbá CEP: 79300-070, Mato Grosso do Sul, Brazil
Tel. & Fax: +55-67-3232-5842 / E-mail: adesbiez@hotmail.com

## ANDERS GONÇALVES DA SILVA

Ph.D. Post-Doctoral Student, University of British Columbia (UBC), Canada
Coordinator, Genetics Committee, IUCN/SSC Tapir Specialist Group (TSG)
Modeler, IUCN/SSC Conservation Breeding Specialist Group (CBSG) - Brazilian Network
E-mail: anders.goncalvesdasilva@ubc.ca

## ROBERT C. LACY

Ph.D. Chair, IUCN/SSC Conservation Breeding Specialist Group (CBSG) - Headquarters
E-mail: rlacy@ix.netcom.com

# INTRODUCTION

## POPULATION VIABILITY ANALYSIS

Computer modeling is a valuable and versatile tool for assessing the risk of decline and extinction of wildlife populations. Complex and interacting factors that influence population persistence and health can be explored, including natural and anthropogenic causes. Models can also be used to evaluate the effects of alternative management strategies, to identify the most effective conservation actions for a population or species and to identify research needs. Such an evaluation of population persistence under current and varying conditions is commonly referred to as a population viability analysis (PVA).

Population viability analysis (PVA) can be an extremely useful tool for assessing current and future risk of wildlife population decline and extinction. In addition, the need for and consequences of alternative management strategies can be modeled to suggest which practices may be the most effective in conserving lowland tapirs in its wild habitat. VORTEX, a simulation software package written to conduct PVAs, was used here as a tool to study the interaction among a number of lowland tapir life history and population parameters, treated stochastically, and to explore which demographic parameters may be the most sensitive to alternative management practices. Because of the wide-distribution of lowland tapirs, spanning several countries across many different ecological conditions, detailed modeling of each distinct subpopulation is impossible. Six different steps were taken in order to provide researchers and decision makers with sufficient information and scenarios to adapt the modeling results both to the reality of their local populations and to the different situations lowland tapirs face throughout their distribution.

1. To help participants in the working groups take into account the diversity of biomes lowland tapirs occur, a questionnaire on threat occurrence and severity was distributed. Each participant ranked the severity of threats to lowland tapirs occurring in the biome they worked in. The purpose of this exercise was to examine whether threat occurrence and severity varies between biomes, so as to guide future conservation measures.

2. A baseline model reflecting the biological potential of the species is presented.

3. A sensitivity analysis reviewing those parameters that generated most discussions between participants was conducted.

4. A theoretical analysis that focused on assessing the effects of principal threats on populations was carried out.

5. An analysis of minimum viable population using different measures was conducted.

6. Several case studies are described in order to illustrate conservation challenges facing lowland tapirs throughout their distribution.

These different exercises enabled us to create a large set of possible scenarios that approximate or represent real populations from the wild. The different models presented in this report should help provide initial conservation guidelines for population managers to adapt to any part of the species' distribution.

# 1. BIOME THREAT ANALYSIS

To identify the main threats in each biome where lowland tapirs occur, a questionnaire was distributed to workshop participants (Figure 1.1). The table listed 6 possible threats, but included space for additional threats participants may choose to add. For each threat in each biome, participants ranked its severity into High (H), Medium (M), or Low (L), or Non Applicable (NA), when the threat did not apply or when information on the threat lacked. Participants only filled in the questionnaire for those biomes they work in or are well familiar with. Some participants ranked threats for more than one area in the same biome. We present here the total number of rankings in each severity category for each threat in the different biomes.

**ECOSYSTEM - THREATS RANKING**

| |
|---|
| **NAME:** |
| **COUNTRY:** |
| **MAIN STUDY SITE(S):** |
| **OTHER RELEVANT INFORMATION:** |

| | ECOSYSTEM | ECOSYSTEM | ECOSYSTEM |
|---|---|---|---|
| | | | |
| Hunting | | | |
| Deforestation/Habitat Alteration | | | |
| Resource Extraction | | | |
| Fragmentation/Isolation/ Small Populations/Low Connectivity | | | |
| Cattle Ranching | | | |
| Disease | | | |
| Others: | | | |
| Others: | | | |
| Others: | | | |
| **Severity: H** – High / **M** – Medium / **L** – Low / **NA** – Does not apply | | | |

**AMAZON** (1- Northeastern Amazon; 2- Southeastern Amazon; 3- Upper Amazon; 4- Savanna)
**ATLANTIC FOREST** (1- Coast; 2- Interior)
**PANTANAL**
**CERRADO**
**ARAUCARIA**
**CHACO** (1- Humid; 2- Dry)
**SAVANNA BENI**
**SUBTROPICAL ANDES FOREST**
**LLANOS**
**OTHERS:**

**Figure 1.1.** Questionnaire of biome threats distributed to the participants.

Forty-three participants (61%) filled in the questionnaire. A total of 22 biomes (Tables 1.1-1.22) were identified, as well as 13 threats. Seven threats were presented to the participants and 5 were added by them (they are presented in italic in the tables). Three countries presented specific biomes (Colombia, Suriname and Venezuela). These are listed separately. We encouraged participants to base their biomes on those defined by the Wildlife Conservation Society (WCS) Range Wide Assessment. Threats ranked as high were compared between biomes (Table 1.23). Results show that the main threats vary between biomes. In general, all identified threats are important. The impact of each threat also varies between biomes (Table 1.23). However, one threat suggested to the participants, disease, was almost always ranked as low or non applicable. As identified by the veterinary taskforce, though, disease can in fact represent an important threat to tapir conservation and must be considered in future studies.

**Table 1.1.** Threats ranked for the North-eastern Amazon (N=4).

| | High | Medium | Low | NA |
|---|---|---|---|---|
| Hunting | 3 | 0 | 1 | 0 |
| Deforestation/Habitat Alteration | 1 | 1 | 2 | 0 |
| Resource extraction | 1 | 1 | 2 | 0 |
| Fragmentation/Isolation/Small populations/ Low connectivity | 1 | 1 | 1 | 1 |
| Cattle ranching | 1 | 1 | 1 | 1 |
| Disease | 0 | 0 | 0 | 4 |
| Road kill | 0 | 0 | 2 | 2 |
| *Fire* | 1 | 0 | 0 | 3 |
| *Human density* | 1 | 0 | 0 | 3 |
| *Plantations of monocultures* | 0 | 1 | 0 | 3 |
| *Patrolling of Protected Areas* | 0 | 0 | 0 | 0 |
| *Size of Protected Areas* | 0 | 0 | 0 | 0 |
| *Tourism* | 0 | 0 | 0 | |

**Table 1.2.** Threats ranked for the South-eastern Amazon (N=2).

| | High | Medium | Low | NA |
|---|---|---|---|---|
| Hunting | 0 | 1 | 1 | 0 |
| Deforestation/Habitat Alteration | 0 | 2 | 0 | 0 |
| Resource extraction | 1 | 0 | 1 | 0 |
| Fragmentation/Isolation/Small populations/ Low connectivity | 1 | 0 | 1 | 0 |
| Cattle ranching | 1 | 0 | 0 | 0 |
| Disease | 0 | 1 | 0 | 0 |
| Road kill | 0 | 0 | 0 | 2 |
| *Fire* | 0 | 1 | 1 | 0 |
| *Human density* | 0 | 1 | 0 | 1 |
| *Plantations of monocultures* | 1 | 0 | 0 | 1 |
| *Patrolling of Protected Areas* | 0 | 0 | 0 | 2 |
| *Size of Protected Areas* | 0 | 0 | 0 | 2 |
| *Tourism* | 0 | 0 | 0 | 2 |

**Table 1.3.** Threats ranked for the Upper Amazon (N=9).

| | High | Medium | Low | NA |
|---|---|---|---|---|
| Hunting | 7 | 0 | 2 | 0 |
| Deforestation/Habitat Alteration | 3 | 4 | 2 | 0 |
| Resource extraction | 3 | 4 | 1 | 1 |
| Fragmentation/Isolation/Small populations/ Low connectivity | 0 | 3 | 4 | 2 |
| Cattle ranching | 2 | 0 | 3 | 4 |
| Disease | 0 | 0 | 1 | 8 |
| Road kill | 0 | 0 | 3 | 6 |
| *Fire* | 0 | 1 | 0 | 8 |
| *Human density* | 0 | 0 | 1 | 8 |
| *Plantations of monocultures* | 2 | 1 | 0 | 6 |
| *Patrolling of Protected Areas* | 0 | 0 | 0 | 9 |
| *Size of Protected Areas* | 0 | 0 | 0 | 9 |
| *Tourism* | 0 | 0 | 0 | 9 |

**Table 1.4.** Threats ranked for the Amazon-Savanna (N=1).

| | High | Medium | Low | NA |
|---|---|---|---|---|
| Hunting | 0 | 1 | 0 | 0 |
| Deforestation/Habitat Alteration | 1 | 0 | 0 | 0 |
| Resource extraction | 0 | 0 | 0 | 1 |
| Fragmentation/Isolation/Small populations/ Low connectivity | 0 | 0 | 0 | 1 |
| Cattle ranching | 0 | 1 | 0 | 0 |
| Disease | 0 | 0 | 1 | 0 |
| Road kill | 0 | 0 | 1 | 0 |
| *Fire* | 0 | 0 | 0 | 1 |
| *Human density* | 0 | 0 | 0 | 1 |
| *Plantations of monocultures* | 0 | 0 | 0 | 1 |
| *Patrolling of Protected Areas* | 0 | 0 | 0 | 1 |
| *Size of Protected Areas* | 0 | 0 | 0 | 1 |
| *Tourism* | 0 | 0 | 0 | 1 |

**Table 1.5.** Threats ranked for Araucária (N=1).

| | High | Medium | Low | NA |
|---|---|---|---|---|
| Hunting | 0 | 0 | 1 | 0 |
| Deforestation/Habitat Alteration | 0 | 1 | 0 | 0 |
| Resource extraction | 1 | 0 | 0 | 0 |
| Fragmentation/Isolation/Small populations/ Low connectivity | 1 | 0 | 0 | 0 |
| Cattle ranching | 0 | 1 | 0 | 0 |
| Disease | 1 | 0 | 0 | 0 |
| Road kill | 0 | 0 | 1 | 0 |
| *Fire* | 0 | 0 | 0 | 1 |
| *Human density* | 0 | 0 | 0 | 1 |
| *Plantations of monocultures* | 0 | 0 | 0 | 1 |
| *Patrolling of Protected Areas* | 0 | 0 | 0 | 1 |
| *Size of Protected Areas* | 0 | 0 | 0 | 1 |
| *Tourism* | 0 | 0 | 0 | 1 |

**Table 1.6.** Threats ranked for the Cerrado (N=5).

| | High | Medium | Low | NA |
|---|---|---|---|---|
| Hunting | 1 | 3 | 0 | 1 |
| Deforestation/Habitat Alteration | 4 | 1 | 0 | 0 |
| Resource extraction | 2 | 2 | 1 | 0 |
| Fragmentation/Isolation/Small populations/ Low connectivity | 3 | 1 | 1 | 0 |
| Cattle ranching | 1 | 4 | 0 | 0 |
| Disease | 1 | 0 | 4 | 0 |
| Road kill | 0 | 2 | 2 | 1 |
| *Fire* | 0 | 0 | 0 | 5 |
| *Human density* | 0 | 0 | 0 | 5 |
| *Plantations of monocultures* | 0 | 1 | 0 | 4 |
| *Patrolling of Protected Areas* | 0 | 0 | 0 | 5 |
| *Size of Protected Areas* | 0 | 0 | 0 | 5 |
| *Tourism* | 0 | 0 | 0 | 5 |

**Table 1.7.** Threats ranked for the dry Chaco (N=7).

| | High | Medium | Low | NA |
|---|---|---|---|---|
| Hunting | 5 | 1 | 1 | 0 |
| Deforestation/Habitat Alteration | 5 | 2 | 0 | 0 |
| Resource extraction | 3 | 0 | 2 | 1 |
| Fragmentation/Isolation/Small populations/ Low connectivity | 3 | 2 | 2 | 0 |
| Cattle ranching | 4 | 3 | 0 | 0 |
| Disease | 0 | 0 | 1 | 6 |
| Road kill | 0 | 1 | 3 | 3 |
| *Fire* | 0 | 0 | 0 | 7 |
| *Human density* | 0 | 0 | 0 | 7 |
| *Plantations of monocultures* | 0 | 0 | 0 | 7 |
| *Patrolling of Protected Areas* | 1 | 0 | 0 | 6 |
| *Size of Protected Areas* | 0 | 0 | 0 | 7 |
| *Tourism* | 0 | 0 | 0 | 7 |

**Table 1.8.** Threats ranked for the humid Chaco (N=5).

| | High | Medium | Low | NA |
|---|---|---|---|---|
| Hunting | 5 | 0 | 0 | 0 |
| Deforestation/Habitat Alteration | 0 | 5 | 0 | 0 |
| Resource extraction | 1 | 0 | 3 | 1 |
| Fragmentation/Isolation/Small populations/ Low connectivity | 4 | 1 | 0 | 0 |
| Cattle ranching | 4 | 1 | 0 | 0 |
| Disease | 0 | 0 | 0 | 5 |
| Road kill | 0 | 0 | 2 | 3 |
| *Fire* | 0 | 0 | 0 | 5 |
| *Human density* | 0 | 0 | 0 | 5 |
| *Plantations of monocultures* | 0 | 0 | 0 | 5 |
| *Patrolling of Protected Areas* | 0 | 1 | 0 | 4 |
| *Size of Protected Areas* | 0 | 0 | 0 | 5 |
| *Tourism* | 0 | 0 | 0 | 5 |

**Table 1.9.** Threats ranked for the Subtropical Andes Forest (N=3).

| | High | Medium | Low | NA |
|---|---|---|---|---|
| Hunting | 2 | 1 | 0 | 0 |
| Deforestation/Habitat Alteration | 2 | 1 | 0 | 0 |
| Resource extraction | 3 | 0 | 0 | 0 |
| Fragmentation/Isolation/Small populations/ Low connectivity | 1 | 2 | 0 | 0 |
| Cattle ranching | 3 | 0 | 0 | 0 |
| Disease | 0 | 0 | 1 | 2 |
| Road kill | 0 | 0 | 0 | 3 |
| *Fire* | 0 | 0 | 0 | 3 |
| *Human density* | 0 | 0 | 0 | 3 |
| *Plantations of monocultures* | 0 | 0 | 0 | 3 |
| *Patrolling of Protected Areas* | 0 | 1 | 0 | 3 |
| *Size of Protected Areas* | 0 | 0 | 0 | 3 |
| *Tourism* | 0 | 0 | 0 | 3 |

**Table 1.10.** Threats ranked for the Llanos (N=7).

| | High | Medium | Low | NA |
|---|---|---|---|---|
| Hunting | 5 | 2 | 0 | 0 |
| Deforestation/Habitat Alteration | 4 | 3 | 0 | 0 |
| Resource extraction | 4 | 2 | 1 | 0 |
| Fragmentation/Isolation/Small populations/ Low connectivity | 4 | 3 | 0 | 0 |
| Cattle ranching | 7 | 0 | 0 | 0 |
| Disease | 0 | 0 | 2 | 5 |
| Road kill | 1 | 0 | 2 | 4 |
| *Fire* | 1 | 0 | 0 | 6 |
| *Human density* | 0 | 1 | 0 | 6 |
| *Plantations of monocultures* | 0 | 0 | 0 | 7 |
| *Patrolling of Protected Areas* | 0 | 0 | 0 | 7 |
| *Size of Protected Areas* | 0 | 0 | 0 | 7 |
| *Tourism* | 0 | 0 | 0 | 7 |

**Table 1.11.** Threats ranked for the Coastal Atlantic forest (N=6).

| | High | Medium | Low | NA |
|---|---|---|---|---|
| Hunting | 3 | 2 | 0 | 1 |
| Deforestation/Habitat Alteration | 2 | 2 | 1 | 1 |
| Resource extraction | 3 | 2 | 0 | 1 |
| Fragmentation/Isolation/Small populations/ Low connectivity | 5 | 0 | 1 | 0 |
| Cattle ranching | 0 | 2 | 0 | 4 |
| Disease | 0 | 0 | 2 | 4 |
| Road kill | 0 | 3 | 2 | 1 |
| *Fire* | 0 | 1 | 0 | 5 |
| *Human density* | 0 | 0 | 0 | 6 |
| *Plantations of monocultures* | 0 | 0 | 0 | 6 |
| *Patrolling of Protected Areas* | 0 | 1 | 0 | 6 |
| *Size of Protected Areas* | 0 | 0 | 0 | 6 |
| *Tourism* | 0 | 0 | 0 | 6 |

**Table 1.12.** Threats ranked for the Interior Atlantic Forest (N=17).

| | High | Medium | Low | NA |
|---|---|---|---|---|
| Hunting | 12 | 4 | 1 | 0 |
| Deforestation/Habitat Alteration | 9 | 5 | 2 | 1 |
| Resource extraction | 5 | 5 | 4 | 3 |
| Fragmentation/Isolation/Small populations/ Low connectivity | 13 | 2 | 2 | 0 |
| Cattle ranching | 7 | 5 | 1 | 4 |
| Disease | 1 | 2 | 3 | 11 |
| Road kill | 4 | 4 | 6 | 3 |
| *Fire* | 0 | 2 | 0 | 15 |
| *Human density* | 1 | 1 | 0 | 15 |
| *Plantations of monocultures* | 2 | 0 | 0 | 15 |
| *Patrolling of Protected Areas* | 1 | 0 | 0 | 16 |
| *Size of Protected Areas* | 1 | 0 | 0 | 16 |
| *Tourism* | 0 | 0 | 1 | 16 |

**Table 1.13.** Threats ranked for the Pantanal (N=2).

| | High | Medium | Low | NA |
|---|---|---|---|---|
| Hunting | 0 | 2 | 0 | 0 |
| Deforestation/Habitat Alteration | 2 | 0 | 0 | 0 |
| Resource extraction | 0 | 0 | 0 | 2 |
| Fragmentation/Isolation/Small populations/ Low connectivity | 0 | 0 | 1 | 1 |
| Cattle ranching | 2 | 0 | 0 | 0 |
| Disease | 0 | 1 | 1 | 0 |
| Road kill | 1 | 0 | 1 | 0 |
| *Fire* | 0 | 0 | 0 | 2 |
| *Human density* | 0 | 0 | 0 | 2 |
| *Plantations of monocultures* | 0 | 0 | 0 | 2 |
| *Patrolling of Protected Areas* | 0 | 0 | 0 | 2 |
| *Size of Protected Areas* | 0 | 0 | 0 | 2 |
| *Tourism* | 0 | 0 | 0 | 2 |

**Table 1.14.** Threats ranked for the Beni Savanna (N=1).

| | High | Medium | Low | NA |
|---|---|---|---|---|
| Hunting | 0 | 0 | 1 | 0 |
| Deforestation/Habitat Alteration | 0 | 1 | 0 | 0 |
| Resource extraction | 0 | 0 | 1 | 0 |
| Fragmentation/Isolation/Small populations/ Low connectivity | 1 | 0 | 0 | 0 |
| Cattle ranching | 1 | 0 | 0 | 0 |
| Disease | 0 | 0 | 0 | 1 |
| Road kill | 0 | 0 | 0 | 1 |
| *Fire* | 0 | 0 | 0 | 1 |
| *Human density* | 0 | 0 | 0 | 1 |
| *Plantations of monocultures* | 0 | 0 | 0 | 1 |
| *Patrolling of Protected Areas* | 0 | 0 | 0 | 1 |
| *Size of Protected Areas* | 0 | 0 | 0 | 1 |
| *Tourism* | 0 | 0 | 0 | 1 |

**Table 1.15.** Threats ranked for the Yunga (N=1).

| | High | Medium | Low | NA |
|---|---|---|---|---|
| Hunting | 0 | 1 | 0 | 0 |
| Deforestation/Habitat Alteration | 0 | 0 | 1 | 0 |
| Resource extraction | 0 | 0 | 1 | 0 |
| Fragmentation/Isolation/Small populations/ Low connectivity | 0 | 1 | 0 | 0 |
| Cattle ranching | 0 | 1 | 0 | 0 |
| Disease | 0 | 0 | 0 | 1 |
| Road kill | 0 | 0 | 1 | 0 |
| *Fire* | 0 | 0 | 0 | 1 |
| *Human density* | 0 | 0 | 0 | 1 |
| *Plantations of monocultures* | 0 | 0 | 0 | 1 |
| *Patrolling of Protected Areas* | 0 | 0 | 1 | 0 |
| *Size of Protected Areas* | 0 | 0 | 0 | 1 |
| *Tourism* | 0 | 0 | 0 | 1 |

## Biomes of Colombia

**Table 1.16.** Threats ranked for the Oriental Amazon (N=6).

| | High | Medium | Low | NA |
|---|---|---|---|---|
| Hunting | 4 | 2 | 0 | 0 |
| Deforestation/Habitat Alteration | 1 | 2 | 3 | 0 |
| Resource extraction | 2 | 4 | 0 | 0 |
| Fragmentation/Isolation/Small populations/ Low connectivity | 1 | 1 | 4 | 0 |
| Cattle ranching | 1 | 1 | 3 | 1 |
| Disease | 0 | 0 | 2 | 5 |
| Road kill | 0 | 0 | 1 | 5 |
| *Fire* | 1 | 0 | 0 | 5 |
| *Human density* | 0 | 0 | 0 | 6 |
| *Plantations of monocultures* | 0 | 0 | 0 | 6 |
| *Patrolling of Protected Areas* | 0 | 0 | 0 | 6 |
| *Size of Protected Areas* | 0 | 0 | 0 | 6 |
| *Tourism* | 0 | 0 | 0 | 6 |

**Table 1.17.** Threats ranked for the Occidental Amazon (N=6).

| | High | Medium | Low | NA |
|---|---|---|---|---|
| Hunting | 5 | 1 | 0 | 0 |
| Deforestation/Habitat Alteration | 3 | 2 | 1 | 0 |
| Resource extraction | 3 | 3 | 0 | 0 |
| Fragmentation/Isolation/Small populations/ Low connectivity | 1 | 3 | 2 | 0 |
| Cattle ranching | 0 | 4 | 2 | 0 |
| Disease | 0 | 0 | 1 | 5 |
| Road kill | 0 | 0 | 1 | 5 |
| *Fire* | 0 | 0 | 1 | 5 |
| *Human density* | 0 | 0 | 0 | 6 |
| *Plantations of monocultures* | 0 | 0 | 0 | 6 |
| *Patrolling of Protected Areas* | 0 | 0 | 0 | 6 |
| *Size of Protected Areas* | 0 | 0 | 0 | 6 |
| *Tourism* | 0 | 0 | 0 | 6 |

**Table 1.18.** Threats ranked for the Orinoquía (N=6).

| | High | Medium | Low | NA |
|---|---|---|---|---|
| Hunting | 3 | 2 | 0 | 1 |
| Deforestation/Habitat Alteration | 4 | 2 | 0 | 0 |
| Resource extraction | 4 | 2 | 0 | 0 |
| Fragmentation/Isolation/Small populations/ Low connectivity | 4 | 2 | 0 | 0 |
| Cattle ranching | 5 | 0 | 1 | 0 |
| Disease | 0 | 1 | 0 | 5 |
| Road kill | 0 | 1 | 2 | 3 |
| *Fire* | 0 | 0 | 0 | 6 |
| *Human density* | 0 | 0 | 0 | 6 |
| *Plantations of monocultures* | 0 | 0 | 0 | 6 |
| *Patrolling of Protected Areas* | 0 | 0 | 0 | 6 |
| *Size of Protected Areas* | 0 | 0 | 0 | 6 |
| *Tourism* | 0 | 0 | 0 | 6 |

**Table 1.19.** Threats ranked for the North-eastern Antioqueño (N=6).

| | High | Medium | Low | NA |
|---|---|---|---|---|
| Hunting | 3 | 3 | 0 | 0 |
| Deforestation/Habitat Alteration | 3 | 3 | 0 | 0 |
| Resource extraction | 5 | 1 | 0 | 0 |
| Fragmentation/Isolation/Small populations/ Low connectivity | 4 | 2 | 0 | 0 |
| Cattle ranching | 4 | 2 | 0 | 0 |
| Disease | 0 | 0 | 1 | 5 |
| Road kill | 0 | 1 | 2 | 3 |
| *Fire* | 0 | 0 | 1 | 5 |
| *Human density* | 0 | 0 | 0 | 6 |
| *Plantations of monocultures* | 0 | 0 | 0 | 6 |
| *Patrolling of Protected Areas* | 0 | 0 | 0 | 6 |
| *Size of Protected Areas* | 0 | 0 | 0 | 6 |
| *Tourism* | 0 | 0 | 0 | 6 |

**Table 1.20.** Threats ranked for the Sierra Nevada de Santa Marta (N=6).

| | High | Medium | Low | NA |
|---|---|---|---|---|
| Hunting | 2 | 4 | 0 | 0 |
| Deforestation/Habitat Alteration | 5 | 1 | 0 | 0 |
| Resource extraction | 5 | 1 | 0 | 0 |
| Fragmentation/Isolation/Small populations/ Low connectivity | 5 | 1 | 0 | 0 |
| Cattle ranching | 5 | 1 | 0 | 0 |
| Disease | 0 | 0 | 1 | 5 |
| Road kill | 1 | 0 | 2 | 3 |
| *Fire* | 1 | 0 | 0 | 5 |
| *Human density* | 0 | 0 | 0 | 6 |
| *Plantations of monocultures* | 0 | 0 | 0 | 6 |
| *Patrolling of Protected Areas* | 0 | 0 | 0 | 6 |
| *Size of Protected Areas* | 0 | 0 | 0 | 6 |
| *Tourism* | 0 | 0 | 0 | 6 |

## Biomes of Suriname

**Table 1.21.** Threats ranked for the Floresta da Costa (N=2).

| | High | Medium | Low | NA |
|---|---|---|---|---|
| Hunting | 0 | 0 | 2 | 0 |
| Deforestation/Habitat Alteration | 0 | 0 | 2 | 0 |
| Resource extraction | 0 | 0 | 2 | 0 |
| Fragmentation/Isolation/Small populations/ Low connectivity | 0 | 0 | 0 | 2 |
| Cattle ranching | 0 | 0 | 2 | 0 |
| Disease | 0 | 0 | 0 | 2 |
| Road kill | 0 | 0 | 0 | 2 |
| *Fire* | 0 | 0 | 0 | 2 |
| *Human density* | 0 | 0 | 0 | 2 |
| *Plantations of monocultures* | 0 | 0 | 0 | 2 |
| *Patrolling of Protected Areas* | 0 | 0 | 0 | 2 |
| *Size of Protected Areas* | 0 | 0 | 0 | 2 |
| *Tourism* | 0 | 0 | 0 | 2 |

## Biomes of Venezuela

**Table 1.22.** Threats ranked for the North Andes (N=2).

| | High | Medium | Low | NA |
|---|---|---|---|---|
| Hunting | 1 | 1 | 0 | 0 |
| Deforestation/Habitat Alteration | 1 | 1 | 0 | 0 |
| Resource extraction | 1 | 1 | 0 | 0 |
| Fragmentation/Isolation/Small populations/ Low connectivity | 1 | 1 | 0 | 0 |
| Cattle ranching | 1 | 0 | 0 | 1 |
| Disease | 0 | 1 | 0 | 1 |
| Road kill | 0 | 0 | 0 | 2 |
| *Fire* | 0 | 0 | 0 | 2 |
| *Human density* | 0 | 0 | 0 | 2 |
| *Plantations of monocultures* | 0 | 0 | 0 | 2 |
| *Patrolling of Protected Areas* | 0 | 0 | 0 | 2 |
| *Size of Protected Areas* | 0 | 0 | 0 | 2 |
| *Tourism* | 0 | 0 | 0 | 2 |

**Table 1.23.** Threats ranked as high in each biome. Only previously identified threat categories were examined. For some biomes no threats were ranked as high. (H: hunting; Def: deforestation/habitat alteration; E: resource extraction; F: fragmentation/small population; CR: Cattle ranching; Dis: disease; RK: Road kill).

| | H | Def | E | F | CR | Dis | RK |
|---|---|---|---|---|---|---|---|
| ***General Biomes*** | | | | | | | |
| Northeastern Amazon | X | | | | | | |
| Southeastern Amazon | | | X | X | X | | |
| Upper Amazon | X | | | | | | |
| Amazon savanna | | X | | | | | |
| Araucária | | | X | X | | X | |
| Cerrado | | X | | | | | |
| Chaco dry | X | X | | | | | |
| Chaco humid | X | | | | | | |
| Subtropical Andes forest | | | X | | X | | |
| Llanos | | | | | X | | |
| Atlantic forest Coast | | | | X | | | |
| Atlantic forest Interior | | | | X | | | |
| Pantanal | | X | | | X | | |
| Yunga | | | | | | | |
| ***Colombian Biomes*** | | | | | | | |
| Oriental Amazon | X | | | | | | |
| Occidental Amazon | X | | | | | | |
| Orinoquía | | | | | X | | |
| Northeast Antioqueño | | | X | | | | |
| Sierra Nevada de Santa Martha | | X | X | X | X | | |
| ***Suriname Biomes*** | | | | | | | |
| Coast Forest | | | | | | | |
| ***Venezuelan Biomes*** | | | | | | | |
| North Andes | X | X | X | X | X | | |
| **Total** | **7** | **6** | **6** | **6** | **7** | **1** | **0** |

# 2. BASELINE MODEL: BIOLOGICAL POTENTIAL

## VORTEX Simulation Model

The simulation software program VORTEX (Version 9.60) was used to examine the viability of lowland tapir populations. VORTEX employs a Monte Carlo simulation of the effects of deterministic forces as well as demographic, environmental, and genetic stochastic events on wild populations. *Vortex* models population dynamics as discrete sequential events that occur according to defined probabilities. The program begins by creating individuals to form the starting population and stepping through life cycle events (*e.g.* births, deaths, dispersal) and catastrophic events, typically on an annual basis. Outcomes such as breeding success, litter size, sex at birth, and survival are determined based upon designated probabilities. Consequently, each run (iteration) of the model gives a different result. By running the model hundreds of times, it is possible to examine the most probable outcome and the range of possibilities.

VORTEX is not intended to give absolute answers, since it is stochastically projecting the interactions of the several parameters used as input to the model and because of the random processes involved in nature. Interpretation of the output depends upon our knowledge of the biology of lowland tapirs, the environmental conditions affecting the species, and possible future changes in these conditions. For a more detailed explanation of VORTEX and its use in population viability analysis, see Lacy (1993, 2000) and Miller & Lacy(2003).

## Input Parameters for Simulation Modeling

### Biological Potential

Due to the variation of various parameters between countries, regions and populations, it was decided to construct a general baseline model for lowland tapirs that could then be tailored to biomes or specific regional populations. The baseline population model was designed to investigate the viability of a non-existent, but biologically accurate, lowland tapir population. The baseline model reflects the biological potential of lowland tapirs. Alternative values for demographic parameters were then explored through sensitivity testing.

### Scenario Settings

<u>Duration of simulation:</u> The population was modeled for 100 years (approximately 10 generations), so that long-term population trends could be observed. One hundred years is far enough into the future so as to decrease the chances of omitting a yet unknown event, but also not too short to fail to observe a slowly developing event.

<u>Number of iterations</u>: 500 independent iterations were run for each scenario.

## Species Description

Definition of extinction: Extinction is defined in the model as no animals of one or both sexes remaining.

Concordance of environmental variation (EV) between reproductive rates and survival rates: No evidence of such concordance exists in tapirs. It is generally assumed that large, long-lived animals with long gestation periods show little correlation between breeding and survival. Baird's tapirs in Corcovado National Park, Costa Rica, kept breeding throughout the severe droughts of El Niño in 1997/98 (Charles Foerster, pers. obs.). In other PVAs, concordance of environmental variation (EV) between reproductive rates and survival rates was not used either (Lizcano *et al.*, 2005; Medici *et al.*, 2006; Medici *et al.*, 2003).

Inbreeding depression: VORTEX includes the ability to model the detrimental effects of inbreeding through reduced first-year survival of inbred individuals. Inbreeding is thought to have major effects on reproduction and survival, especially in small populations. However, as population size of tapirs continues to decline and populations become fragmented, genetic considerations are becoming very important. The impact of inbreeding was modeled as 3.14 lethal equivalents, the median value estimated from an analysis of studbook data for 40 captive mammal populations (Ralls *et al.*, 1988), with 50% of the effect of inbreeding ascribed to recessive lethal alleles. A special task force on genetic considerations was run during the workshop.

## Reproductive System and Rates

Breeding system: Monogamous. In previous PVAs, tapirs were modeled as monogamous, because VORTEX is not spatially explicit. The selection of a polygynous system would suggest a panmictic scenario, which is less similar to what current data suggests than monogamy (Lizcano *et al.*, 2005; Medici *et al.*, 2006; Medici *et al.*, 2003). Observations from Charles Foerster show that tapirs are monogamous, but observations in other areas tend to show that they may be facultatively polygynous. This was the parameter that was most debated during the workshop. However, since the sex ratio between males and females is equal and threats are generally not sex-specific, the choice of short term monogamy or polygyny does not have an impact on population dynamics of lowland tapirs.

Age of first reproduction: VORTEX precisely defines reproduction as the time at which offspring are born, not simply the age of sexual maturity. The program uses the mean age rather than the earliest recorded age of offspring production. Lowland tapirs are usually sexually mature by 14-24 months and captive tapirs have conceived at around 3 years of age, in general (Barongi, 1993). At Madrid zoo, a 27 month lowland tapir gave birth to a fully developed calf (Barongi, 1993). In Rio de Janeiro, a 30 month old female successfully gave birth to a healthy calf (Gabriella Landau-Remy, pers. comm.). Andres Tapia reported that in Ecuador, in a semi-captivity condition, females gave birth to their first offspring at 3 years of age, while males generally started breeding at 4 years of age. The age of first reproduction was assumed to be 4 years for both female and male wild tapirs.

Maximum age of reproduction: VORTEX initially assumes that animals can reproduce (at the normal rate) throughout their adult life. We conservatively set this maximum age at 22 years. According to Robinson and Redford (1986), the average age of last reproduction for wild tapirs is 23.5 years. In Rio de Janeiro, a 32 year old female successfully gave birth to a healthy calf (Gabriella Landau-Remy, pers. comm.).

Longevity: Tapirs were modeled to live and reproduce up to 22 years of age.

Maximum number of offspring per year: Tapirs have a gestation period of approximately 401 days (13.4 months), ranging from 390 to 407 days, and females rarely do give birth to more than one young per litter (Barongi, 1993). During the workshop, none of the participants reported having observed the birth of twin calves.

Sex ratio at birth: Sex ratio at birth was assumed to be 50% males and females. There is no a priori evidence to suggest a skewed sex ratio at birth in the wild. In over 40 capture events in Morro do Diabo State Park, an equal number of male and female wild tapirs were captured (Medici, pers. comm.). However, evidence from captivity is very different. Studbooks report a ratio of 3 males to 1 female birth, and most participants with experience from captivity report that lowland tapirs have a biased sex ratio, with more males being born than females.

Female breeding success: 60% (± 6% EV). Data on gestation and lactation comes from captive populations, and suggest that inter-birth interval in captivity is close to 18 months (Barongi, 1993). A pair kept together gave birth to 9 calves with an average inter-birth rate of 19.6 months (ranging from 17 to 22 months) (Baker, 1920). Other zoo evidence and field observations in Corcovado National Park (Charles Foerster, pers. obs.) indicate that females may become pregnant while lactating, which can reduce the interval to as few as 16 months. In addition, some females may lose their offspring during lactation, or due to stillbirths or neonatal deaths, and come into estrus sooner afterward, therefore reducing the inter-birth interval. In a semi-captivity center in Ecuador, the average interval between births was 19 months (Andre Tapias, pers. comm.). For the purpose of the VORTEX model it was assumed that 60% of the females would be reproducing in a given year (see Table 2.1 for values used in other PVAs).

Environmental variation in breeding: Annual environmental variation in female reproduction is modeled in VORTEX by specifying a standard deviation (SD) for the proportion of adult females that successfully produce offspring in a given year. No data are available for this parameter. Given their body size and reproductive rate, it is expected that lowland tapirs show very little variation (Robinson & Eisenberg, 1985). Assuming no variation in breeding may be less realistic than assuming a small variation. Thus, 10% of the initial rate, or 6%EV, is considered as a small value and was used in the simulation.

**Table 2.1.** Values previously used for female breeding success and environmental variation in breeding by other modelers.

| Baird's Tapir | Malayan Tapir | Mountain Tapir | Baird's Tapir | Lowland Tapir | Lowland Tapir |
|---|---|---|---|---|---|
| PVA | PHVA | PHVA | PHVA | Report | Thesis |
| 1994 | 2003 | 2004 | 2005 | 2005 | 2005 |
| Miller, P.S. | Miller, P.S. | Miller, P.S. | Miller, P.S.<br>Gonçalves, A. | Gonçalves, A.<br>Medici, E.P. | Gatti, A. |
| 50% | 60% | 50% | 45% | 61% | 50% |
| (± 12.5% EV) | (± 6% EV) | (± 12.5% EV) | (± 10% EV) | (± 5% EV) | (± 12.5% EV) |

Density dependent reproduction: Density dependent reproduction was not modeled in the baseline model, but should be considered for smaller fragmented populations.

Mate monopolization: In many species, some adult males may be socially restricted from breeding, despite being physiologically capable. Young males might be sexually mature, but because they are still dispersing or have not established their own territory yet, they might not be an effective part of the breeding pool. This can be modeled in VORTEX by specifying a portion of the total pool of adult males that may be considered "available" for breeding each year. Although there is a lack of field data, it was considered that an average of 90% of the males was reproducing each year.

## Mortality Rates

Mortality rates: No data exist on mortality rates for lowland tapirs.
Based on discussions with tapir researchers and on data from previous PVAs, best guesses of mortality rates for lowland were made (Table 2.2)

**Table 2.2.** Male and female lowland tapir mortality rates.

| |
|---|
| from age 0 to 1: 10% (SD=2.50%) |
| from age 1 to 2: 15% (SD=3.75%) |
| from age 2 to 3: 15% (SD=3.75%) |
| from age 3 to 4: 15% (SD=3.75%) |
| after age 4: 8% (SD=2%) |

## Population Description

Number of populations: In the baseline model, only one population was considered (*e.g.* no metapopulation dynamics were explored).

Dispersal among populations: In the baseline model only one population was considered, with no immigration or emigration.

Initial population size (N): 100

Carrying capacity (K): The carrying capacity was considered to be the same as the initial population size (N=100). No environmental variation was added to the carrying capacity, as variations in population size are accounted for by environmental variation in reproduction and survival.

Number of catastrophes: Catastrophes are singular environmental events that are outside of the bounds of normal environmental variation affecting reproduction and/or survival. Natural catastrophes can be tornadoes, floods, droughts, disease, or similar events. These events are modeled in *Vortex* by assigning an annual probability of occurrence and a pair of severity factors describing their impact on survival (across all age-sex classes) and the proportion of females successfully breeding in a given year. These factors range from 0 (maximum or absolute effect) to 1 (no effect), and are imposed during the single year of the catastrophe, after which time the demographic rates rebound to their baseline values.

Catastrophes will vary between biomes. The following catastrophes were mentioned during the workshop, although none was included in the baseline model:

Severe fire
Severe drought
Disease
Curse
Oil spills
Oil company entering an area to search for oil.

Harvest: No harvest was included in the baseline model. Causes and intensity of harvest varies between countries, biomes, and specific populations. Values for this parameter were explored through sensitivity testing and will be examined for each biome

Supplementation: No supplementation from other unrelated populations, wild or captive, was incorporated into the baseline model.

Parameters used in the baseline model (Table 2.3) were tested in the sensitivity analysis and adapted for the biome case studies.

**Table 2.3.** Summary of parameter input values used in the baseline model.

| Parameter | Baseline Value |
|---|---|
| Number of populations | 1 |
| Initial population size | 100 |
| Carrying capacity | 100 |
| Inbreeding depression | 3.14 LE |
| % of the effect of inbreeding due to recessive lethal alleles | 50 |
| Breeding system | monogamy |
| Age of first reproduction (♀ / ♂) | 4 years |
| Maximum age of reproduction | 22 years |
| Annual % adult females reproducing (SD) | 60 (6) |
| Density dependent reproduction? | No |
| Maximum litter size | 1 |
| Overall offspring sex ratio | 50:50 |
| % adult males in breeding pool | 90 |
| % mortality from age 0-1 (SD) | 10 (2.5) |
| % mortality from age 1-2 (SD) | 15 (3.75) |
| % mortality from age 2-3 (SD) | 15 (3.75) |
| % mortality from age 3-4 (SD) | 15 (3.75) |
| % mortality from age above 4 (SD) | 8 (2) |
| Catastrophe | None |
| Harvest | None |
| Supplementation | None |

## BASELINE MODEL RESULTS

It is important that caution be used when interpreting the results from the baseline model. The baseline model represents the biological potential of lowland tapirs based on the parameters previously described. No harvest rates, no increase in mortality due to road kill, disease or fire, and no catastrophes were included.

### Deterministic Output

The demographic rates (reproduction and mortality) included in the baseline model can be used to calculate the deterministic characteristics of the model population. These values reflect the biology of the population in the absence of stochastic fluctuations (both demographic and environmental variation), inbreeding depression, limitation of mates, and immigration/emigration. The baseline model results in a deterministic growth rate ($r_{det}$) of 0.050 ($\lambda$= 1.051). This represents an annual potential growth rate of about 5%. Generation time (the average age of reproduction) is approximately 10 years (9.97) for both males and females. Adult sex ratio of adult males to adult females is 1.

Overall, these population characteristics were accepted as realistic for lowland tapirs and lend validity to this model as a reasonable representation of lowland tapir populations. They also suggest that lowland tapirs' populations do not have the potential to grow very rapidly, even in the absence of additional threats or stochastic events. Therefore, populations will take time to recover from events that severely reduce their numbers.

### Stochastic Baseline Results

Results from the baseline model project that a population of 100 tapirs is likely to persist over the next 100 years in the absence of threats. The stochastic growth rate ($r_{stoch}$) is 0.040, representing an annual population growth of 4%, enabling the population to grow when below carrying capacity. There is zero probability of extinction (PE) in 100 years, and the mean population size at 100 years is 97.07 tapirs with 90.48% gene diversity remaining. The loss of gene diversity is in part due to the relatively small population size and because we modeled a closed population in which no immigration of unrelated animals can occur.

# 3. SENSITIVITY ANALYSIS

## Demographic Rates

Sensitivity analysis is a tool used to evaluate the robustness of a model to variations in parameter values. The more robust the model is to variations in a particular parameter, the less sensitive the model's results are to the input values of that parameter. This tool is used, in the current context, to uncover particularly sensitive parameters that, if changed, could significantly alter the results and conclusions derived from the model. The most sensitive parameters require greater certainty in the input values to produce more confident results. Sensitivity analyses using highest and lowest values for each parameter (Table 3.1) were performed to evaluate the effect of variation of model parameters on the stochastic growth rate (r-stoc) of lowland tapir populations (Figure 3.1).

**Table 3.1.** Highest and lowest parameter values and standard deviation (SD) use for sensitivity analysis.

| Parameter | Low | Baseline | Highest |
|---|---|---|---|
| % juvenile mortality (age 0-1) | 5 (1.25) | 10 (2.5) | 15 (3.75) |
| % sub-adult mortality (age 1-4) | 7.5 (1.87) | 15 (3.75) | 22.5 (5.62) |
| % adult mortality (age above 4) | 4 (1) | 8 (2) | 12 (3) |
| Age of first reproduction (♀ / ♂) | 3 | 4 | 5 |
| Annual % of adult females reproducing | 55 (6) | 60 (6) | 65 (6) |
| Maximum Age of Reproduction | 17 | 22 | 27 |

Results from the sensitivity testing show that sub-adult and adult mortality have the largest influence on the population dynamics of lowland tapirs (Figure 3.1). Tapirs are long-lived late maturing species with slow reproductive rates, and these species are typically characterized by high adult survival (Oli & Dobson, 2003). This means that any threats impacting this parameter, such as hunting of adult animals, can rapidly decrease the number of animals in an area. The age of first reproduction appears to be a sensitive parameter. This is mostly due to the fact that a year of sub-adult mortality (the highest mortality rate of any age class) is either added or subtracted along with the age of first reproduction. Therefore, this parameter actually shows the impact of sub-adult mortality. Studies on adult and sub-adult mortality rates in tapirs would be very important in order to obtain more accurate values for these parameters, not the less because they are the most difficult ones to obtain.

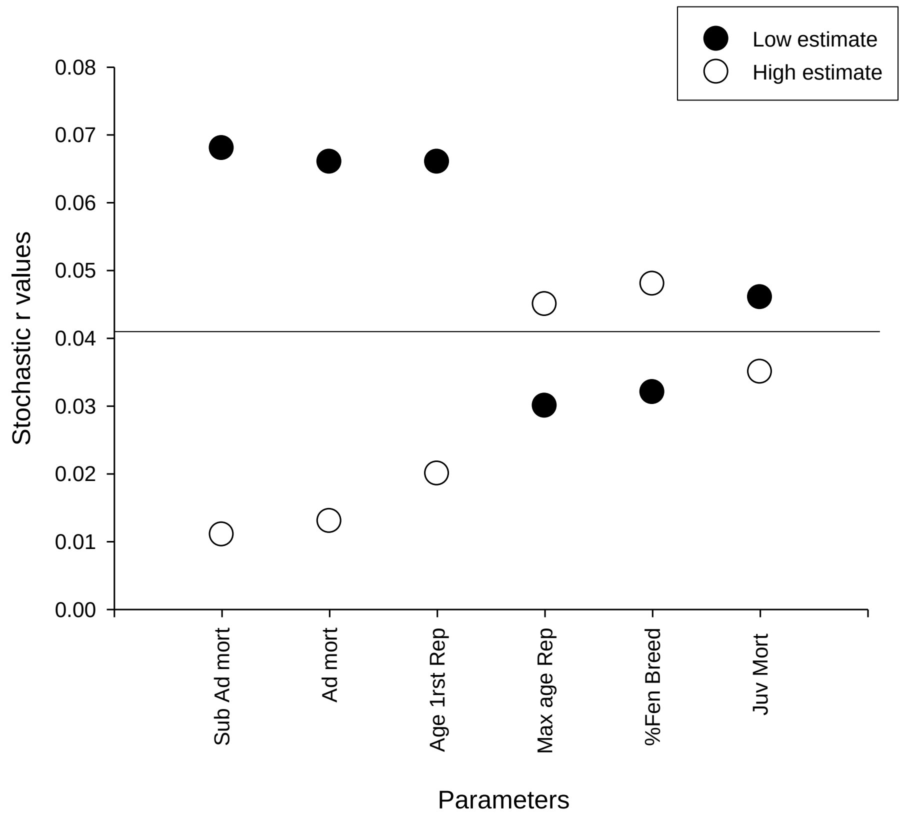



**Figure 3.1.** Results from the sensitivity testing using values from Table 3.1. The line represents the value of stochastic population growth from the baseline model.

Sub Ad mort: Sub Adult Mortality
Ad mort: Adult Mortality
Age 1rst Rep: Age of first reproduction
%Fem Breed: Percentage of females breeding in a given year
Juv Mort: Juvenile mortality

During the sensitivity testing, the influence of sex ratio was also examined. Participants working with tapirs in captivity reported that 3 males are born for every female. If this were true, the mean stochastic growth rate for the population would be ($r_{stoc}$ = -0.031) according to the baseline model. This means the population decreases by 3% each year. The probability of extinction of the baseline model population (N=100) is 68.2% (Figure 3.2) under this sex ratio value.

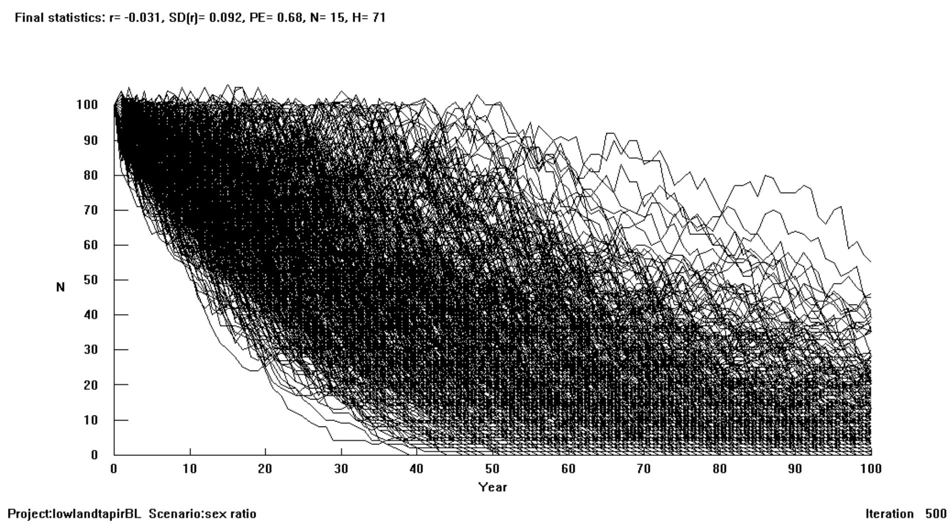



**Figure 3.2.** VORTEX output of male biased 3:1 population.

# 4. THEORETICAL ANALYSIS OF THREATS

The two main threats identified for tapirs were hunting and habitat loss. Impacts of these threats will be examined in a theoretical context here. In the case studies in section 6, examples of impacts of these threats on populations of tapirs from different biomes are presented.

## Hunting

Since the mortality of adults and sub-adults appears to be one of the most sensitive parameters, it was further evaluated in the sensitivity analysis. The probability of extinction of tapir populations, ranging from small (N=25) to large (N=3000) was tested. Results show that small populations go extinct, even with minimal harvest levels (Figure 4.1). The larger the initial population, the more resilient it is to hunting. However, even very large populations will go extinct when hunting levels become high. The model shows that this long lived, slow maturing, slow reproducing species can not sustain high levels of harvest. Many field studies confirm these results. Research on hunting practices in indigenous communities show that species such as tapirs and large monkeys rapidly go locally extinct when they are hunted, while other species that have higher intrinsic growth rates, such as peccaries, deer and rodents can sustain higher levels of harvest (Bodmer *et al.*, 1997; Gavin, 2007; Milner-Gulland *et al.*, 2003; Peres, 2000). Furthermore, studies in the Atlantic forest have shown that tapirs are one of the first species to go extinct in the smaller fragments (Cullen Jr. *et al.*, 2000).

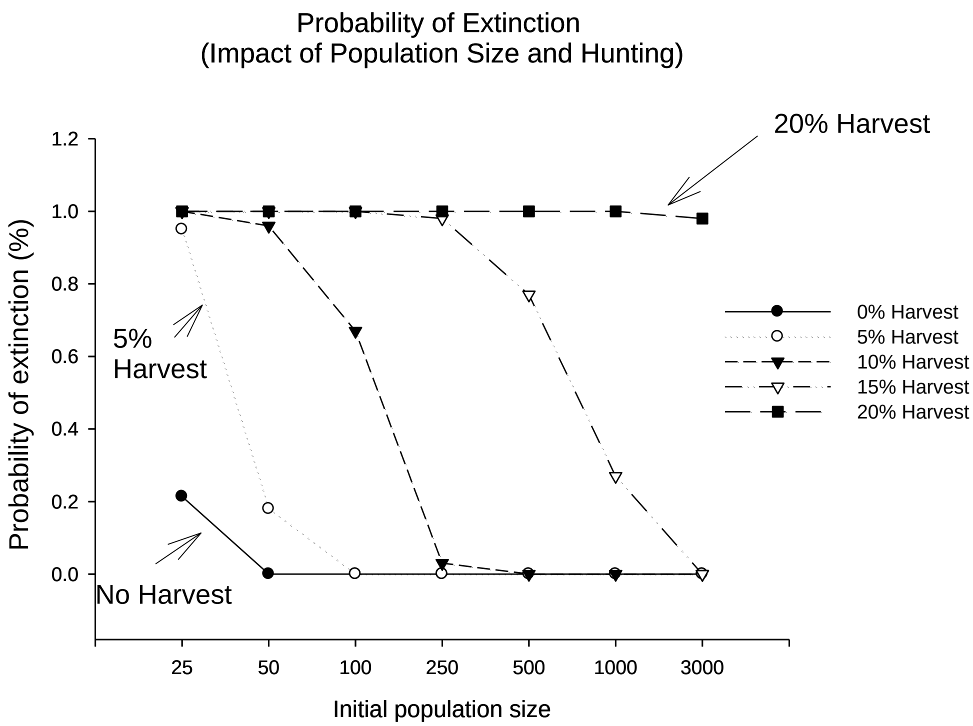



**Figure 4.1.** Probability of extinction due to hunting on lowland tapir populations of different sizes.

## Habitat Fragmentation

Habitat loss, fragmentation and isolation of tapir populations are recurrently mentioned as threats to tapir populations (Section 1). Habitat loss causes the decrease in the carrying capacity of the habitat. In VORTEX, if the population size N exceeds the carrying capacity K at the end of a particular time cycle, additional mortality is imposed across all age and sex classes in order to reduce the population back to this upper limit. The probability of a tapir dying during this truncation process is set to (N-K/N), so that the expected population size after mortality is K. Habitat loss therefore directly causes a decrease in the population size and the upper limit of the population.

Habitat fragmentation means that a population is divided into separated populations. For example (Figure 4.2), a population of 200 tapirs is fragmented into 3 separated populations of 30, 50 and 100 animals. According to the baseline model, with not a single additional threat, in 100 years the biological potential of each population is:

**<u>Without fragmentation</u>**

**$N_{initial}$ = 200**

- Probability of Extinction (PE) = 0
- Genetic Diversity (GD) = 95%
- Tapirs in the population (N)= 199

**<u>With fragmentation</u>**

**$N_{initial}$ = 30**

- Probability of Extinction (PE) = 10%
- Genetic Diversity (GD) = 70%
- Tapirs in the population (N) = 20

**$N_{initial}$ = 50**

- Probability of Extinction (PE) = 0
- Genetic Diversity (GD) = 81%
- Tapirs in the population (N) = 46

**$N_{initial}$ = 100**

- Probability of Extinction (PE) = 0
- Genetic Diversity (GD) = 90%
- Tapirs in the population (N) = 98

Without fragmentation, the genetic diversity of the tapir population (N initial = 200) remains high in 100 years and the population is expected to survive in the absence of any extra threats. When the population is fragmented, the genetic diversity of the two smaller fragments becomes so low in 100 years that the population will in fact go extinct.

Habitat fragmentation reduces population size and causes loss of genetic diversity and ultimately the natural extinction of smaller populations.

A theoretical example of management options of fragmented habitats is presented in the case studies.

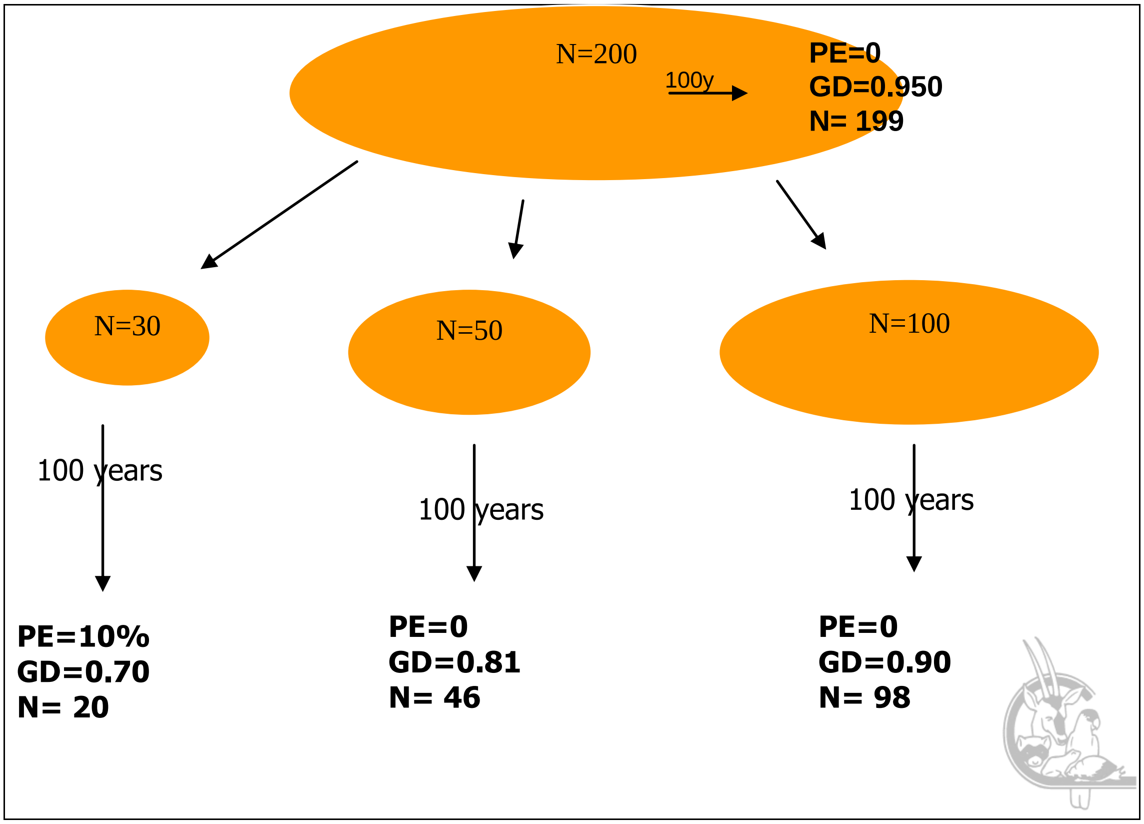



**Figure 4.2.** Impact of fragmentation on a population of lowland tapirs. A population of N=200 is fragmented into three unconnected population. Results from VORTEX simulation of Probability of Extinction (PE), Genetic Diversity (GD), and mean number of animals N in 100 years are presented.

## Disease

Disease is frequently mentioned as a serious threat to the conservation of wildlife species (*e.g.* Fiorello *et al.* 2006). In herbivores in general, and in ungulates in particular, there is a whole series of known diseases affecting cattle and other domestic animals, which are problematic from the point of view of animal health (foot-and-mouth disease, for example). Regarding tapirs, there is little available information on the individual and population effects of both epidemic and endemic diseases. Nonetheless, there are studies being currently carried out which point out that tapir populations are exposed to diseases that can reduce individual fertility and survival, at least. Besides, as the lowland tapir habitat is increasingly threatened and fragmented, due both to the increase in human population densities and to the increase in the demand for beef, the probability that diseases, both epidemic and endemic, become a significant threat to the conservation of both tapirs and the domestic animals (since tapirs can carry pathogens or strains that the domestic animals are not immune for) in a near future are big.

As mentioned above, we know little about the effect of epidemic diseases on tapirs. Such diseases can be modeled in VORTEX as catastrophes that would decrease survival and/or fertility of the individuals during the year(s) in which they occur in the population. Once the disease has completed its cycle, the survival and/or fertility rates would return to their normal values, and the population, if large enough and in the absence of any other threats, could probably recover without further consequences. Thus, in relation to VORTEX, modeling an epidemic is not different from modeling the effects of a fire (see below) and, therefore, we decided not to double the exercise. An epidemic disease, however, once present in the population, it will probably last in the population and the environment during several generations. Besides, such pathogens usually do not kill their hosts, but often just reduce fertility and the lifetime of the carrier individuals, resulting in a small reduction in the stochastic growth of the population. Nonetheless, the long-term results of this reduction are still unknown.

Working together with the Epidemiology Task Force, we modeled a typical endemic disease, such as leptospirosis. Using the baseline model, we modeled a closed tapir population, in which all the individuals are already infected since the start with the bacteria that causes leptospirosis. Judging from the effects of the bacteria on other species, the veterinarians suggested that the presence of the disease would cause a 1% increase in the mortality rate of all age classes (for example, the adult mortality in the baseline model is 8% per year, and in a population infected with leptospirosis, the adult mortality would be 9% per year), and the percentage of females breeding would be reduced by 5% (for example, the percentage of females breeding in each year is 60% in the baseline model, and in a population infected with leptospirosis it would become 55%). After 100 years, we did not see a significant reduction in the probability of extinction in this model when compared to the baseline model (Table 4.1). However, the stochastic growth rate decrease from 0.039 to 0.032 (Table 4.1), which amounts to a decrease of almost 20%.

Besides cattle (an important source of diseases for wild animals, as mentioned above), several participants pointed out hunting as one of the largest threats to tapir conservation. Thus, it is possible to imagine that a population infected with some endemic disease can also be suffering some hunting pressure. To model this situation, we added to the endemic diseases model above a certain level of hunting, considered as of the subsistence type, in which just two (2) individuals were removed every year (one of each sex) along the 100 years.

Besides, for us to be able to compare all the effects, we modeled the baseline model with the same hunting level. The results are shown in Table 4.1. Maybe the most striking result is the increase in the $P(E)_{100}$. While in the population that suffers only hunting the $P(E)_{100}$ is 3% after 100 years, in the population that is hunted and is infected with the endemic disease, the $P(E)_{100}$ is 11.2% after 100 years. In other words, almost four times larger. Besides, the $r_{stoc}$ also reduces almost to the half when we compare both models.

**Table 4.1.** Results of the endemic disease model and of comparative scenarios.

| Scenario | $N_{init}$ | $r_{stoch}$ | $SD(r_{stoch})$ | $P(E)_{100}$ | MTE | $N_{100}$ | $SD(N_{100})$ | $GD_{100}$ |
|---|---|---|---|---|---|---|---|---|
| Baseline model | 100 | 0.039 | 0.054 | 0 | +100 | 98.1 | 4.28 | 0.9 |
| Disease | 100 | 0.032 | 0.054 | 0 | +100 | 96.82 | 6.05 | 0.87 |
| Hunting | 100 | 0.022 | 0.058 | 0.03 | 78.9 | 91.77 | 14.58 | 0.8963 |
| Disease + hunting | 100 | 0.010 | 0.063 | 0.112 | 77.4 | 83.09 | 22.74 | 0.8896 |

In conclusion, we have little information on the individual and population effects of diseases on lowland tapir populations. Recent information from long-term field studies suggests that diseases can be more spread in wild populations than previously imagined (Patrícia Medici, pers. comm.). Faced with such a lack of information, we have just evaluated very simple models, which assume an endemic disease with small population effects. If considered in isolation, the modeled disease does not seem to be a serious threat to lowland tapir populations. However, in conjunction with an extremely low hunting level (smaller than reported for some areas, see below), the synergistic effect of these two variables can lead to significant reductions in the viability of lowland tapir populations in te long term. These results, even being simple, do suggest that diseases can be a significant threat, and efforts should thus be made to investigate the epidemiology of tapir populations.

# 5. MINIMUM VIABLE POPULATION ANALYSIS

Lowland tapirs have a wide distribution, across different biomes, where they face various kinds and levels of threats. It is thus difficult to establish a common definition of minimum population viability for this species. In some areas, populations are small and fragmented, while in others, populations are large and continuous. In this section we want to help wildlife managers realize that results from the minimum population analysis will depend on their objective and the measure that they use to characterize it. To illustrate this, we will use four different measures. This exercise is based on the baseline model, which is based on the biological potential of lowland tapirs without any environmental or anthropogenic threats added.

**The mean rate of stochastic population growth ($r_{stoc}$)**. This is calculated, averaging the population growth across years and iterations, for all simulated populations. The population growth rate is calculated each year of the simulation, prior to any truncation of the population size due to the population exceeding the carrying capacity. If a positive growth rate is used as a measure of minimum viable population then, according to the model, a population of 10 to 20 animals is necessary (Figure 5.1).

**Average probability that the population will go extinct**. Extinction is defined in the model as no animals of one or both sexes remaining. $P(E)_{100}$ is determined by the proportion of the 500 iterations within a given scenario that go extinct within 100 years. If a probability of extinction equal to zero is used as a measure of minimum viable population then, according to the model, a population of at least 50 animals is necessary (Figure 5.2).

**The gene diversity of the extant populations (GD)**. It is expressed as a percent of the initial gene diversity of the population. If maintaining 90% gene diversity after 100 years is used as a measure of minimum viable population then, according to the model, a population of at least 150 animals is necessary (Figure 5.3).

**The mean population size at the end of simulations**. It is calculated as the average population size at the end of the iterations across all simulated populations, including those that go extinct. This number is arbitrary, and the target may depend on the objective of the manager. Possibilities include maintaining the same number of animals after 100 years or losing only 50%.

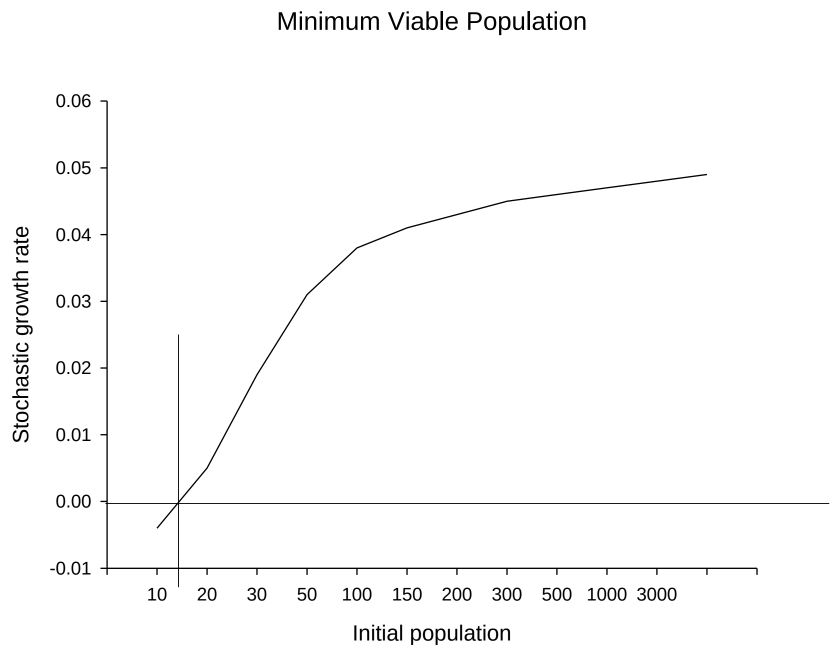



**Figure 5.1.** Measure of the Minimum Viable Population using stochastic growth rate as a measure.

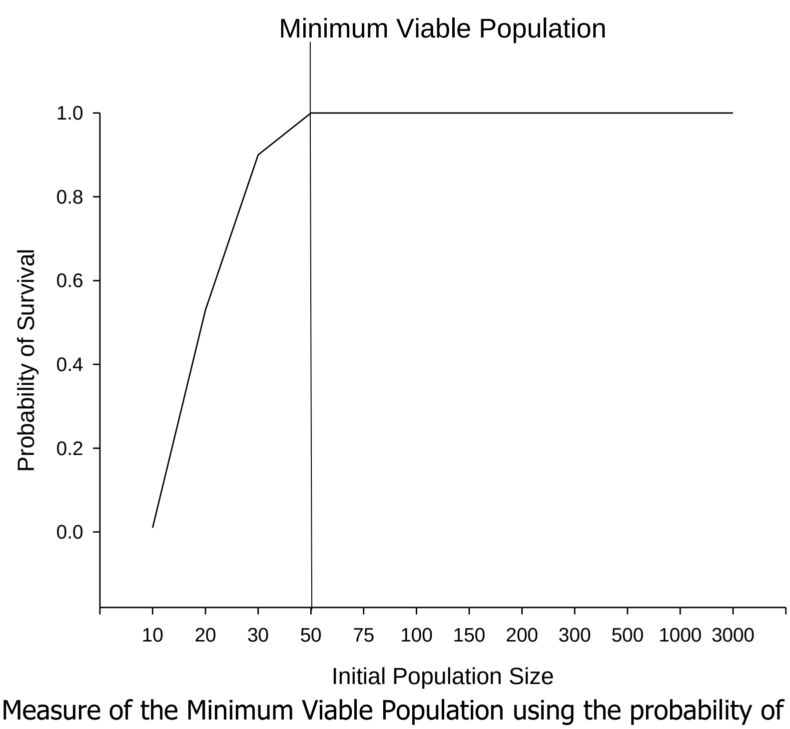



**Figure 5.2.** Measure of the Minimum Viable Population using the probability of extinction or probability of survival as a measure.

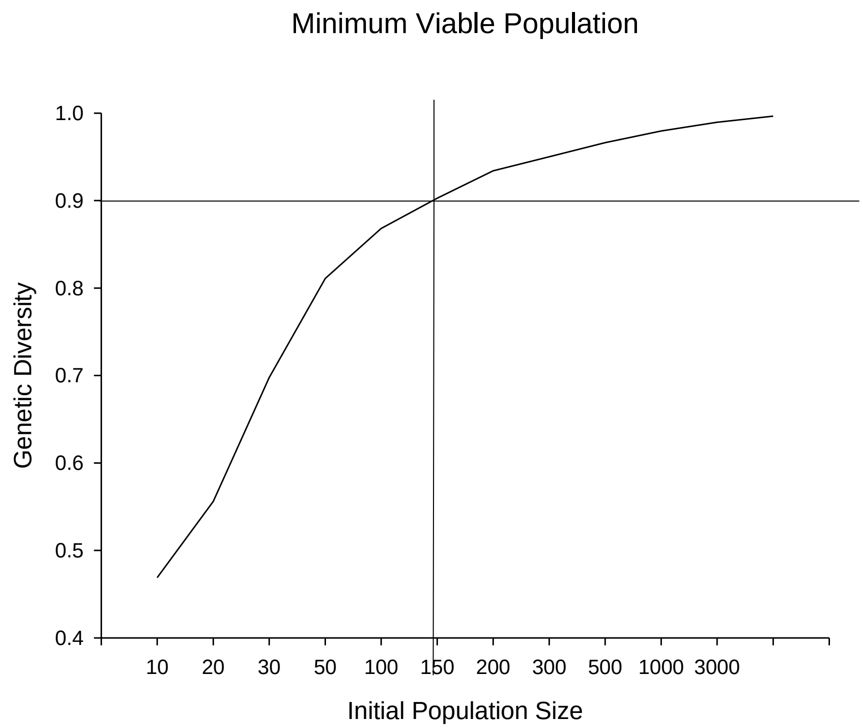



**Figure 5.3.** Measure of the Minimum Viable Population using stochastic genetic diversity as a measure.

Each one of these measures can be used to assess minimum viable population numbers, but they will yield different results. Usually a combination of these measures should be used. In particular maintenance of genetic diversity should not be ignored, as small populations may maintain themselves in the model, but suffer such loss of genetic diversity that deleterious genes will impact the population.

# 6. CASE STUDIES

During the workshop several case studies were modeled. These were presented and discussed during the plenary sessions. After the workshop, results for each case study were sent to the participants that had provided the information. Participants added information on the study area and reviewed the results which are presented here.

Results reported for each VORTEX modeling scenario include:

**$r_{stoch}$ (SD)** – The mean rate of stochastic population growth or decline and its standard deviation, calculated averaging the population growth across years and iterations, for all simulated populations. This population growth rate is calculated for each year of the simulation, prior to any truncation of the population size due to the population exceeding the carrying capacity.

**$P(E)_{100}$** – Probability that the population will go extinct. Extinction is defined in the model as no animals of one or both sexes remaining. $P(E)_{100}$ is determined by the proportion of the 500 iterations within a given scenario that go extinct within 100 years.

**MTE –** Mean time to population extinction, in years, over a 100-year period.

**$N_{100}$ (SD)** – Mean (standard deviation) population size at the end of the simulation, averaged across all simulated populations, including those that go extinct.

**$GD_{100}$** – The gene diversity or expected heterozygosity of the extant populations, expressed as a percent of the initial gene diversity of the population. Fitness of individuals usually declines proportionately with gene diversity. This measure was calculated based on gene drop simulations, not on molecular data.

One case study presented in plenary was not included here: The Yasuni National Park in Ecuador. The participant worked on the report but required more time to work on the values of certain key parameters. Please contact Victor Manuel Utreras Bucheli, Wildlife Conservation Society, Ecuador, E-mail: vutreras@wcs.org. Many participants have expressed interest in developing the models further. For more information about individual case studies please contact the participants listed for each case study. Results from these case studies are actively been used by the participants. In Ecuador the results have already been presented to the Comunidad de Sarayaku. As a consequence of this meeting the community will start a study of the density of tapirs in the reserve. In Paraguay the report is being presented to the Mbaracayú Reserve. In Brazil a publication is being prepared.

# BOLIVIA

**CASE STUDY:** Bolivia Madidi and the Tierra Comunitaria de Origen (TCO) Tacana

**Source(s) of information:**

Guido Ayala
Wildlife Biologist, Wildlife Conservation Society (WCS) - Bolivia
E-mail: gayala@wcs.org

**Biome**: Sub tropical Andes Forest

**CONSERVATION QUESTION**: What is the biggest threat to lowland tapir populations in the Madidi and TCO Tacana region?

## INTRODUCTION

Three main biomes supporting populations of tapirs are found in Bolivia. These include the Sub tropical Andes Forest, the savannas of el Beni and the dry Chaco. Populations in these three biomes are most likely connected, but each of them suffers different pressures or the different threats have distinct impact levels.

Only the populations of Madidi and the TCO Tacana region (Figure 6.1) were modeled, since this is the population with the most up to date information. This is an area of Sub tropical Andes Forest. The Madidi National Park covers an area of 18.957 $Km^2$, and it is connected to other protected areas such as the Área Natural de Manejo Integrado Apolobamba and the Biosphere reserve of the Territorio Indígena Pilón Lajas. The western area of the park is bordered by the Peruvian Reserva Nacional Bahuaja-Sonene and the eastern side by the Andes and the Amazonian region. In the higher areas of the park, communities of Quechua origin live in, while in the lower areas there are communities of Tacana, Esse Eja, Lecos y Mosetén origin. The TCO Tacana is near the border of the park, and the main communities include San Pedro, Napashi, Tumupasa, Santa Rosa de Maravilla, San Miguel, Villa Alcira, Macahua, Bella altura. Other communities a bit further from the park include Villa Alcira, Cachichira, Tequeje, Carmen de Emero. These communities are all very important for biodiversity conservation of the Madidi National park and surrounding areas.

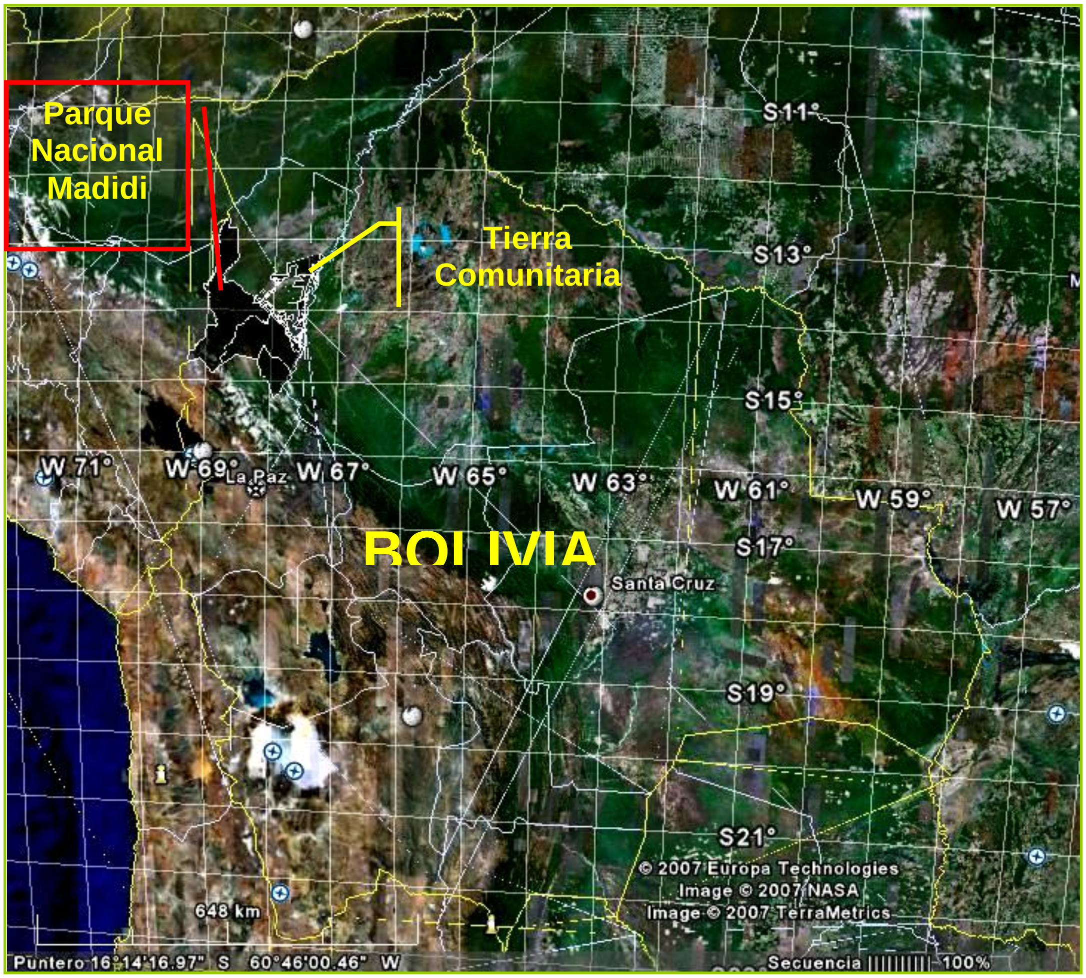



**Figure 6.1.** Areas considered in the case study.

## CURRENT SITUATION IN MADIDI and TCO TACANA

### Input values for the model parameters

To facilitate the analysis of the results, the population was modeled as a closed population. Based on estimates using camera traps, the participant estimated that there are about 2000 tapirs in the region. The carrying capacity was set to be equal to the initial population. The two major threats thought to affect populations of lowland tapir in Madidi are: habitat loss and hunting. It is estimated that between 1 and 3% of habitat will be lost every year for the next 10 years in the Madidi area, according to the participant. It is expected that after 10 years no more habitat loss will occur.

According to the participant, 18 communities live in the region, 11 of these practice hunting. In five of the communities a study on hunting practices was conducted. On average 32 tapirs are hunted in these five communities, of which 58% are adult males, 27% adult females and 15 % are juveniles. Using this data it was estimated that 66 animals are hunted each year, distributed as follows:

Adult males: 38
Adult females: 18
Juvenile males: 5
Juvenile females: 5

After reviewing the parameters used in the baseline model, the baseline model was adapted to reflect the current situation of the lowland tapir population in Madidi and TCO Tacana region (Table 6.1).

**Table 6.1.** Summary of parameter input values used to model the current situation in Madidi and TCO Tacana region.

| Parameter | Baseline value |
|---|---|
| Number of populations | 1 |
| Initial population size | 2000 |
| Carrying capacity (K) | 2000 |
| Inbreeding depression | 3.14 LE |
| % of the effect of inbreeding due to recessive lethal alleles | 50 |
| Breeding system | monogamy |
| Age of first reproduction (♀ / ♂) | 4 years |
| Maximum age of reproduction | 22 years |
| Annual % adult females reproducing (SD) | 60 (6) |
| Density dependent reproduction? | No |
| Maximum litter size | 1 |
| Overall offspring sex ratio | 50:50 |
| % adult males in breeding pool | 90 |
| % mortality from age 0-1 (SD) | 10 (2.5) |
| % mortality from age 1-2 (SD) | 15 (3.75) |
| % mortality from age 2-3 (SD) | 15 (3.75) |
| % mortality from age 3-4 (SD) | 15 (3.75) |
| % mortality from age above 4 (SD) | 8 (2) |
| Catastrophe | None |
| Harvest | 66 animals/year |
| Change in carrying capacity | YES |

## Results

According to the model, if habitat loss rates are 3% for the next 10 years, then the population of lowland tapir in the Madidi and TCO Tacana region is neither growing nor decreasing, since the mean rate of stochastic population growth, averaged across years and iterations, for all simulated populations is equal to zero (Table 6.2). However, the size of tapir populations varies due to stochastic fluctuations, and the standard deviation of mean population size at the end of 500 simulations is very high. As the initial population size shrinks due to a decrease in carrying capacity from habitat loss, stochastic variations have a bigger impact and can cause extinction of the population (Figure 6.2). There is a 33% probability that the population of tapirs in Madidi will go extinct in 100 years. The mean population size at the end of 500 simulations, averaged across all simulated populations, including those that go extinct is 823 tapirs, a decrease of over 60% from the initial population size.

If habitat loss rates are of only 1% for the next ten years, the future of the tapir population is more secure. The stochastic population growth is over 2% and the population has a probability of zero of going extinct in a hundred years. The mean population size at the end of 500 simulations is 1777.32 tapirs.

Due to the large size of the initial population in both scenarios (1% and 3% habitat loss), genetic diversity is high (99%) after 100 years.

**Table 6.2.** Results of the current situation after 100 years for lowland tapirs in Madidi and TCO Tacana.

| Bolivia Madidi | $N_{init}$ | $r_{stoch}$ | $SD(r_{stoch})$ | $P(E)_{100}$ | MTE | $N_{100}$ | $SD(N_{100})$ | $GD_{100}$ |
|---|---|---|---|---|---|---|---|---|
| Current situation 3% habitat loss | 2000 | 0.001 | 0.052 | 33.2% | 74.7 | 823.13 | 619.52 | 0.9918 |
| Current situation 1% habitat loss | 2000 | 0.023 | 0.037 | 0 | 0 | 1777.32 | 43.97 | 0.9998 |

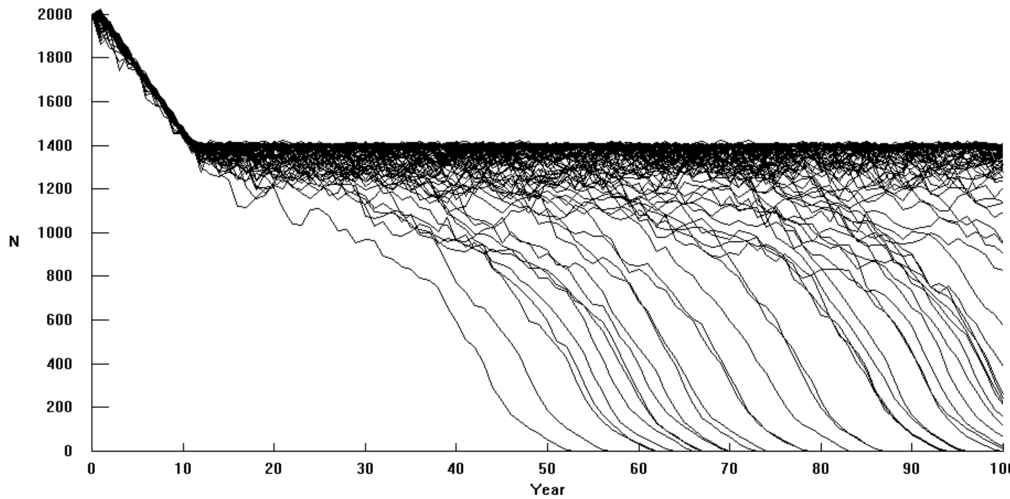



**Figure 6.2.** VORTEX simulation output of the current situation in Madidi and TCO Tacana if habitat loss rates reach 3%.

# SCENARIO MODELING
# Management Options

The participant from Bolivia decided to explore two different management options: one in which hunting was decreased and the other in which habitat loss was stopped, but hunting continued at current levels.

## Hunting decrease by 50%

Through participatory work with the communities, it is expected that current hunting of tapirs can be reduced by 50%. This means that, for the Madidi area, the following harvests of lowland tapirs would occur:

- Adult males: 19
- Adult females: 9
- Juvenile males: 3
- Juvenile females: 3

According to the model, a 50% reduction in hunting increased the probability of survival of the Madidi lowland tapir population and, in 100 years, the population is not expected to go extinct (Table 6.3). However, the mean population size at the end of 500 simulations, averaged across all simulated populations, is lower than the initial population size due to the reduction in carrying capacity because of habitat loss. The higher the rate of habitat loss, the lower the final mean population size is at the end of the simulations. The mean rate of stochastic population growth is positive and the population is expected to potentially increase by over 3% each year. Due to the large size of the initial population size, genetic diversity is high (99%) after 100 years.

**Table 6.3.** Results for lowland tapirs in Madidi after 100 years with hunting decreased by 50%.

| Bolivia Madidi | $N_{init}$ | $r_{stoch}$ | $SD(r_{stoch})$ | $P(E)_{100}$ | MTE | $N_{100}$ | $SD(N_{100})$ | $GD_{100}$ |
|---|---|---|---|---|---|---|---|---|
| Habitat loss 3 % | 2000 | 0.032 | 0.037 | 0 | 0 | 1388.63 | 27.15 | 0.9924 |
| Habitat loss 1 % | 2000 | 0.036 | 0.036 | 0 | 0 | 1794.12 | 22.70 | 0.9940 |

## No more habitat loss

Due to law enforcement and community conservation programs no more habitat is lost in Madidi. This means that the carrying capacity for lowland tapirs remains the same_after 100 years. Hunting pressures however remain the same (66 adult tapirs per year).

By preventing any habitat loss the lowland tapir population in Madidi is not expected to go extinct in 100 years (Table 6.4). According to the model the probability of extinction of the population is zero. Furthermore, the mean population size after 100 years is expected to be almost equal to the initial population size. The mean rate of stochastic population growth is positive and the population is expected to potentially increase by 2.5% each year. Due to the large size of the initial population size genetic diversity is high (99%) after 100 years.

**Table 6.4.** Results of the modeling scenario after 100 years for lowland tapirs in Madidi considering immediate stopping of habitat loss, but maintaining current hunting levels.

| Bolivia Madidi | $N_{init}$ | $r_{stoch}$ | $SD(r_{stoch})$ | $P(E)_{100}$ | MTE | $N_{100}$ | $SD(N_{100})$ | $GD_{100}$ |
|---|---|---|---|---|---|---|---|---|
| | 2000 | 0.026 | 0.037 | 0 | 0 | 1983.34 | 37.58 | 0.9944 |

# CONCLUSIONS

The current model for Madidi does not include potential dispersal and immigration of animals from and to the neighboring Beni savannas. Threats such as diseases or unforeseen catastrophes were not included in the model due to the lack of knowledge. When habitat loss was considered 3%, each management options helped secure the survival of tapir populations in Madidi. The probability of extinction went from 33% to 0% once the management option was put in place. If habitat loss is only 1%, then the impact of the management options is not as striking. Selecting the best management option depends on resources and objectives and the reality of the current situation. A reduction in hunting ensures a higher mean rate of stochastic population growth, but the prevention of habitat loss means that the population size of tapirs remains stable after 100 years. Knowledge of true habitat loss rates is necessary to determine what the best management options may be. Due to the large size of the initial population size, genetic diversity is high (99%) after 100 years.

**What is the biggest threat to lowland tapir populations in the Madidi and TCO Tacana region?** The combination of habitat loss and hunting currently threatens the population of lowland tapirs in Madidi. If habitat loss is stopped, hunting can continue at current rates. If habitat loss continues then hunting rates must be severely reduced to ensure the survival of the lowland tapir population. If habitat loss continues, the overall number of tapirs in the region in 100 years will decrease.

# BRAZIL

**CASE STUDY:** Various Atlantic Forest Fragments

**Source(s) of information:**

Kevin Flesher
Michelin, Brazil
E-mail: KevinFlesher@yahoo.com

Andressa Gatti
Secretaria Executiva & Professora de Nível Superior
Instituto de Ensino, Pesquisa e Preservação Ambiental Marcos Daniel (UNILINHARES)
E-mail: gatti.andressa@gmail.com; andressagatti@hotmail.com

Daniel Brito
Biodiversity Analyst - Species, Center for Applied Biodiversity Science, Conservation International
E-mail: d.brito@conservation.org; brito.dan@gmail.com

**Biome:** Coastal Atlantic Forest

**CONSERVATION QUESTION:** What is the potential impact that fire can have on lowland tapir populations in Coastal Atlantic Forest fragments?

## INTRODUCTION

Tropical forests are one the world's biomes with the highest levels of biodiversity (Wilson, 1988; Reed, 2004). However, human population growth and economic pressures are leading to habitat conversion of these forests into mosaics of isolated forest fragments at unprecedented rates (Gascon *et al.*, 2001). Within tropical forests, the Atlantic Forest, the second largest tropical forest of the American continent, is considered one of the most important and most threatened biomes of the world (Mittermeier *et al.*, 1982; Fonseca, 2000; Conservation International do Brasil, 2000; Myers *et al.*, 2000). According to Ab'Saber (1977) the tropical Atlantic domain can be sub-divided in two regions, based on vegetation type and geographical characteristics (Eiten, 1974; Mori *et al.*, 1981; Fonseca, 1985): the Coastal Atlantic forest and the Interior Atlantic Forest (Eiten, 1974).

The coastal Atlantic Forest occurs at low to medium elevations, with annual rainfall of 200 cm and annual average temperatures of 16–19°C (Hueck, 1972). The coastal Atlantic forest was the first region to be explored by the Portuguese after 1500. Ports and negotiation posts where established along the coast, particularly in the region of the current Bahia and Rio do Janeiro states. They provided the first routes to enter the continent. In the past, the coastal Atlantic forest covered 1,110,182 $Km^2$ with a practically continuous forest, and represented approximately 13% of the Brazilian territory (IBGE, 2004). Today it is estimated that Atlantic forest covers 99,944 $km^2$, approximately 8% of its original size (Hirota , 2003; Fonseca *et al.*, 2005).

It is therefore urgent to establish tools to help evaluate and assist management options and decisions made to protect species and their habitat in the Coastal Atlantic Forest. Population viability analysis is a promising tool not only to evaluate the persistence of populations in the long term, but also to evaluate management options (Boyce, 1992; Lindenmayer *et al.*, 1993; Brook *et al.*, 2000; 2002).

## CURRENT SITUATION IN THE COASTAL ATLANTIC FOREST

### Input values for the model parameters

In the coastal Atlantic Forest, habitat loss and hunting are not major threats anymore. The biggest threat comes from the fact that populations of lowland tapirs are isolated and fragmented into small populations. Results from the sensitivity analysis showed clearly that some populations will go extinct in less than 100 years, regardless of additional threats, only due to their small size. The other major identified threat was fire. In Espírito Santo State, a fire burned down 80% of a 2,400 hectare reserve, the Reserva Biológica do Córrego do Veado. Coastal forests are not adapted to fires and the damage can be extensive. The potential impact of fire on wildlife and, in this case, populations of lowland tapirs is of great conservation concern.

Fragments of coastal Atlantic Forest vary in size and shape. The group decided first to model a typical forest fragment of 30,000 hectares. This fragment would probably sustain a population of 180 tapirs (1 tapir/165 hectares according to Leandro Scoss, workshop participant). In this scenario, we assumed that there is no habitat loss and carrying capacity is equal to the initial population size. One tapir is hunted or accidentally killed each year. This means that every two years an adult male and an adult female are killed. Fire was modeled as a catastrophe that kills 25% of the tapirs in the population, but does not affect reproduction. A fire occurs on average once every 20 years.

After reviewing the parameters used in the baseline model, a model was adapted to reflect the current situation of the lowland tapir population in Coastal Atlantic Forest fragments (Table 6.5).

**Table 6.5.** Summary of parameter input values used in Coastal Atlantic Forest fragments model.

| Parameter | Baseline value |
|---|---|
| Number of populations | 1 |
| Initial population size | 180 |
| Carrying capacity | 180 |
| Inbreeding depression | 3.14 LE |
| % of the effect of inbreeding due to recessive lethal alleles | 50 |
| Breeding system | monogamy |
| Age of first reproduction (♀ / ♂) | 4 years |
| Maximum age of reproduction | 22 years |
| Annual % adult females reproducing (SD) | 60 (6) |
| Density dependent reproduction? | No |
| Maximum litter size | 1 |
| Overall offspring sex ratio | 50:50 |
| % adult males in breeding pool | 90 |
| % mortality from age 0-1 (SD) | 10 (2.5) |
| % mortality from age 1-2 (SD) | 15 (3.75) |
| % mortality from age 2-3 (SD) | 15 (3.75) |
| % mortality from age 3-4 (SD) | 15 (3.75) |
| % mortality from age above 4 (SD) | 8 (2) |
| Catastrophe | fire |
| Harvest | 1♀ /1♂ every 2 years |

## Results

According to the model, although fire will not cause the extinction of the lowland tapir populations in the coastal Atlantic forest fragment, it will cause the number of animals in the population to fluctuate (Table 6.6; Figure 6.3; Figure 6.4). Most importantly, the mean rate of stochastic population growth is reduced almost by 50%. The mean rate of stochastic population growth with fire is about 2% and without it almost 4%. This means that the population will be slower at recovering from other threats. Therefore, additional threats, such as disease, increase in hunting, road kill etc. can potentially cause the local extinction of the population. Fire also causes a slight reduction in genetic diversity.

**Table 6.6.** Results of the current situation after 100 years for lowland tapirs in Coastal Atlantic Forest fragments model.

| Coastal Atlantic forest | $N_{init}$ | $r_{stoch}$ | SD($r_{stoch}$) | P(E)$_{100}$ | MTE | $N_{100}$ | SD($N_{100}$) | $GD_{100}$ |
|---|---|---|---|---|---|---|---|---|
| **WITH** fire | 180 | 0.023 | 0.082 | 0.2% | 90 | 156 | 34.43 | 0.9352 |
| **WITHOUT** fire | 180 | 0.039 | 0.047 | 0 | 0 | 177.65 | 5.97 | 0.9430 |

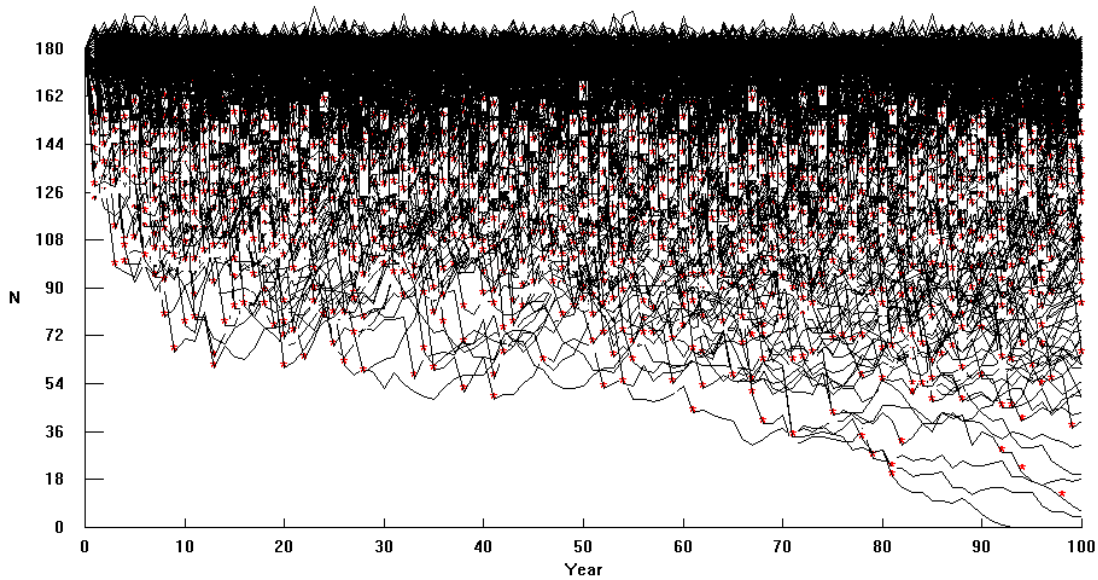



**Figure 6.3.** VORTEX simulation output of the current situation in Coastal Atlantic Forest fragments model **WITH** fire.

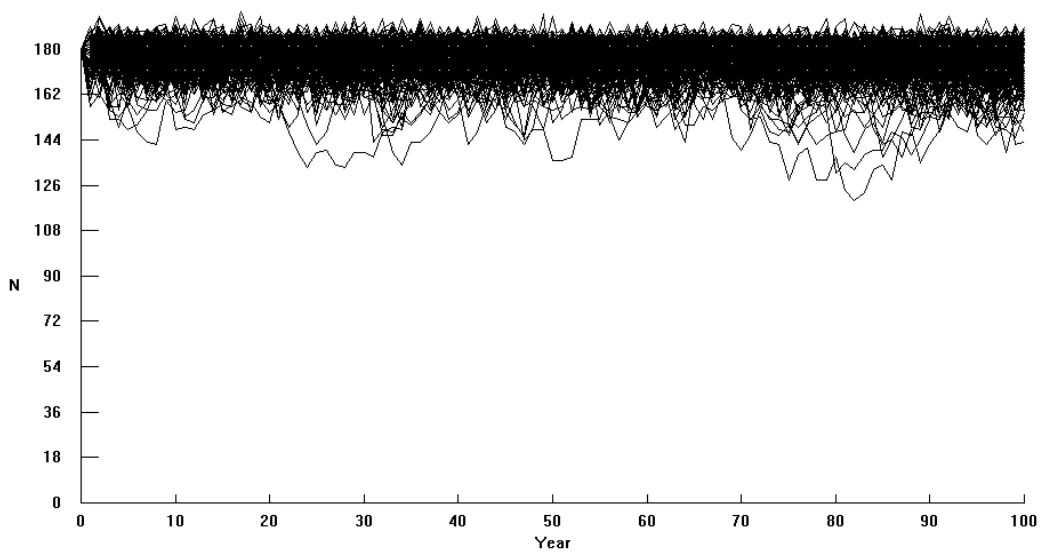



**Figure 6.4.** VORTEX simulation output of the current situation in Coastal Atlantic Forest fragments model **WITHOUT** fire.

# SCENARIO MODELING
# Impact of Fire and Fragment Size

## Input values for the model parameters

Due to the intensity and extent of forest fires in the Coastal Atlantic Forest, they are highly suspected to have a high impact on tapir populations. However the extent of this impact is unknown. Furthermore, the Coastal Atlantic forest fragments vary in shape and size, and populations of tapirs will consequently vary in size. The group decided to test the impact of forest fires on populations of different sizes, and the impact of forest fires of different severity. Populations can range from 25 to 300 animals. The impact of forest fires can range from killing 5% to 50% of the tapirs in the population.

## Results

According to the VORTEX model, the smaller the population, the higher the impact of fires on the persistence of the population (Figure 6.5). As expected, the higher the impact of the fire, the higher the probability of extinction of lowland tapirs in the forest fragments. Once again, larger populations of tapirs have lower probability of extinction and a better chance of recovering from catastrophes.

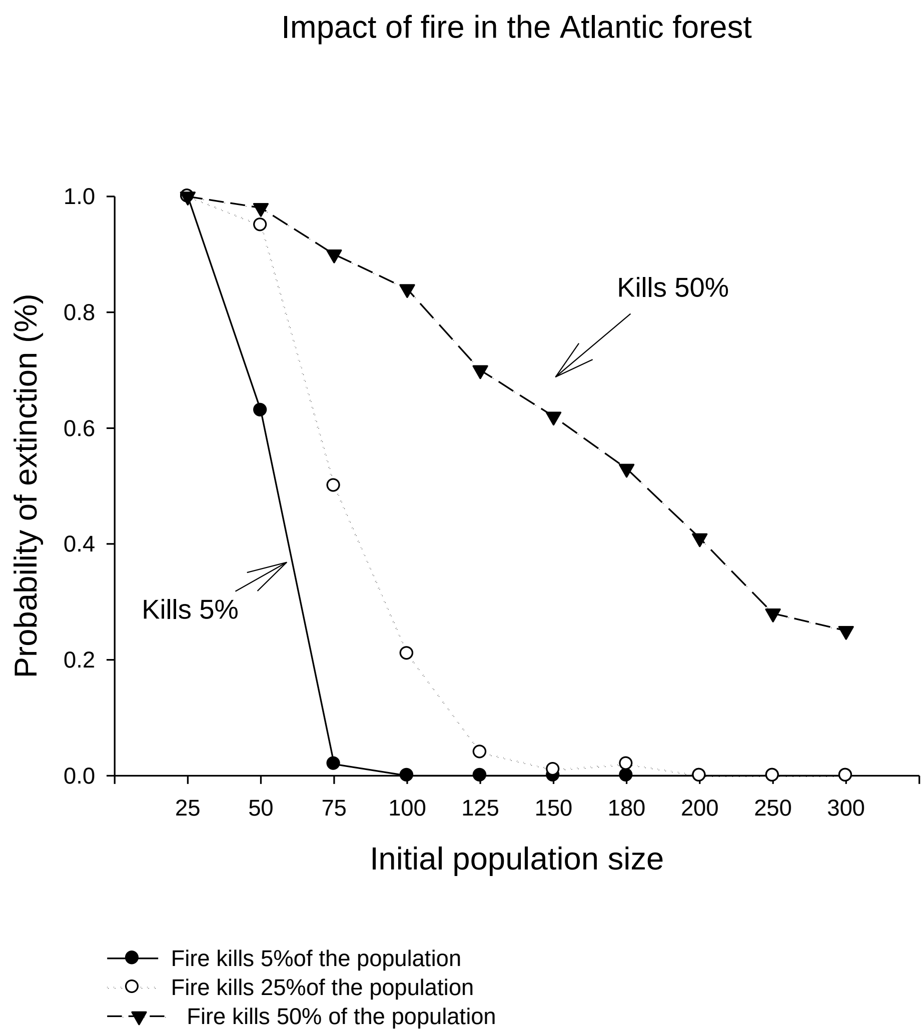



**Figure 6.5.** Probability of extinction of populations of tapirs of different sizes with fires killing 5, 25 and 50% of the population.

## CONCLUSIONS

The impact of fire on smaller fragmented populations of tapir in the Coastal Atlantic Forest can potentially lead them to extinction. The impact of fire in terms of number of tapirs killed needs to be researched. In any case, the loss of any adult tapirs in small fragmented populations can seriously jeopardize the persistence of the species. Conservation methods that minimize the frequency and occurrence of fires in forest fragments need to be implemented.

Compared to other practices, such as cattle ranching or agriculture, eucalyptus plantations are believed to minimize the impact of fire on Atlantic Forest fragments. Fire is not used as a method to clear the area of weeds when eucalyptus is planted. This alone decreases the frequency of fires in the area. Furthermore, eucalyptus plantations decrease the impact of wind on forest fragments. This can be particularly beneficial to fragments suffering from "edge effect". An integrated management plan of river basins that include eucalyptus plantations and Atlantic Forest fragments could preserve biodiversity as well as help protect the area from erosion (Hewllet, 1982)

**What is the potential impact that fire can have on lowland tapir populations in Coastal Atlantic Forest fragments?** The smaller the population, the higher the impact fire will have on the persistence of a tapir population. Smaller fragmented populations of tapir in the Coastal Atlantic Forest can potentially become extinct due to fire. Plantations of *Eucalyptus* trees can potentially mitigate this impact.

### References


Ab'Saber, A. N. (1977). Os domínios morfoclimáticos da América do Sul. Geomorfologia, 52, 1-23.

Boyce, M.S., 1992. Population viability analysis. Annu. Rev. Ecol. Syst. 23, 481-506.

Brook, B.W., O'Grady, J.J., Chapman, A.P., Burgman, M.A., Akçakaya, H.R. & Frankham F., 2000. Predictive accuracy of population viability analysis in conservation biology. Nature 404, 385-387.

Brook, B.W., Burgman, M.A., Akçakaya, H.R., O'Grady, J.J. & Frankham, R., 2002. Critiques of PVA ask the wrong questions: throwing the heuristicbaby out with the numerical bath water. Conservation Biology 16, 262–263.

Conservation International Brasil, 2000. Avaliação e Ações Prioritárias para a Conservação da Biodiversidade da Mata Atlântica e Campos Sulinos. Ministério do Meio Ambiente, Brasília, Brasil.

Eiten, G. 1974. An outline of the vegetation of South America. Symp. Congr. int. Primatol. Soc. 5th, 529-45.

Fonseca G.A.B. 1985. The Vanishing Brazilian Atlantic Forest.Biological Conservation 34, 17-34.

Fonseca G.A.B, Rylands A., Paglia A. & Mittermeier R.A. 2005. Atlantic forest. In: Mittermeier R.A., Gil P.R., Hoffmann M., Pilgrim J., Brooks T., Mittermeier C.G., Lamoreux J. & da Fonseca G.A.B (eds.), Hotspots revisited. CEMEX, Cid. México.

Gascon, C., Laurence, W.F. & Lovejoy, T.E., 2001. Fragmentação florestal e Biodiversidade na Amazônia Central. In Conservação da Biodiversidade em Ecossistemas Tropicais, Garay, I. & Dias, B. eds., pp 112-127. Petrópolis. Editora Vozes.

HIROTA, M. M. 2003. Monitoramento da cobertura da Mata Atlântica brasileira. Pp. 60-65 in Galindo-Leal, C. & Câmara, I. G. (eds.). Mata Atlântica: biodiversidade, ameaças e perspectivas. SOS Mata Atlântica & CABS/CI,Belo Horizonte..

Hueck, K. (1972). *Asflorestas da America do Sul.* Sao Paulo, Editora Poligono & Editora Universidade de Brasilia.

IBGE, 2004. Mapas de biomas e vegetação do Brasil. Disponível em: < http://www.ibge.gov.br >Capturado em: 18 de jul. 2005.

Lindenmayer, D.B., Clark, T.W., Lacy, R.C. & Thomas, V.C., 1993. Population viability analysis as a tool in wildlife conservation policy: with reference to Australia. Environmental Management 17, 745-758.

Mittermeier, R.A., Coimbra-Filho, A.F.; Constable, I.D., Rylands, A.B. & Valle, C.M., 1982. Conservation of primates in the Atlantic Forests of Brazil. Int. Zoo. Yearbook.22, 2-17.

Mori, S.A., Boon, B.M & Prance, G.T. 1981. Distribution patterns and conservation of eastern Brazilian coastal forests species. Brittonia 33, 233-245.

Myers, N., Mittermeier, R.A., Mittermeier, C.G., Fonseca, G.A.B. & Kent, J., 2000. Biodiversity hotspots for conservation priorities. Nature 403, 853-858.

Reed D.H. 2004. Extinction risk in fragmented habitats. Animal Conservation 7: 181-191.

Wilson, E.O., 1988. Biodiversity. Academic Press, Washington, D. C.

# BRAZIL

**CASE STUDY:** Morro do Diabo State Park, Pontal do Paranapanema Region, São Paulo State.

**Source(s) of information:**

Patricia Medici
IPÊ - Instituto de Pesquisas Ecológicas, Brazil
E-mail: epmedici@uol.com.br or medici@ipe.org.br

**Biome:** Interior Atlantic Forest

**CONSERVATION QUESTION:** What is the impact of the highway that crosses Morro do Diabo State Park on the population of lowland tapirs?

## INTRODUCTION

The Brazilian Atlantic Forest is one of the most threatened biomes of the planet, and is one of the Conservation International's 25 *hotspots*. In the 16$^{th}$ century, the highly diverse Atlantic Forest covered 12-13% of the Brazilian territory. Today, these forests have been reduced and fragmented to 7-8% of its original size, but they still harbor one of the greatest levels of biodiversity in the planet, containing nearly 7% of the world's species, many of which endemic and threatened with extinction. The Atlantic Forest domain is subdivided into two major regions based on the vegetation types and geographical features. The first type, classified as Tropical Evergreen Mesophytic Forest, originally covered most of the Brazilian eastern slopes extending to the adjacent coastline. The second type, classified as Tropical Semi-deciduous Mesophytic Forest, extends from the western border of the coastal hills, stretching to the *Plateau* region. Currently, most of the remaining Atlantic Forest is found on the coast. Very little forest remains in the *Plateau* region, because agricultural and industrial expansion has resulted in the loss of more than 98% of these forests. *Plateau* forests are the most fragmented and threatened biome of the Atlantic Forest domain. Most of these forest remnants are small, but they still support a very diverse flora and fauna. Nearly all of the *Plateau* forests that still exist in São Paulo state are found in the Pontal do Paranapanema Region located in the western part of the State. This region alone comprises 84% of the remaining *Plateau* forest cover in São Paulo state, including Morro do Diabo State Park (35,000 ha), one of the last remnants of significant size of this biome, and the surrounding forest fragments (12,000 ha) (Figure 6.6).


**Figure 6.6.** Map locating the Morro do Diabo State Park (plotted as Devil's Hill State Park).

## CURRENT SITUATION IN THE INTERIOR ATLANTIC FOREST

### Input values for the model parameters

A diurnal line-transect survey carried out by Cullen *et al.* (Cullen Jr *et al.*, 2001) estimated the density of tapirs in Morro do Diabo State Park at 0.41 ind./km², resulting in approximately 145 tapirs in the park. The park is managed by the Forestry Institute of São Paulo State (IF - Instituto Florestal do Estado de São Paulo, Secretaria do Meio Ambiente) and is relatively well protected, thus habitat loss and hunting are minor threats. Currently, one of the factors known to regularly kill tapirs in the park is the highway that crosses it (SP-613) (Figure 6.7; Table 6.7).

**Figure 6.7.** Tapir road kills in the highway that crosses the park (SP-613) .

**Table 6.7.** Annual mortality of lowland tapirs in the SP-613 highway in Morro do Diabo State Park due to road kills.

| Year | Number of individuals |
|---|---|
| **1998** | 8 |
| **2002** | 4 |
| **2004** | 7 |
| **2006** | 4 |

Since it is very probable that tapirs killed on the road may be removed as soon as they are killed to consume their meat, we probably do not know of all the tapirs killed on the road. An average of six tapirs killed on the road was considered. Most of the individuals killed on the road were adult animals capable of breeding. Field data from the park showed an equal sex ratio in the population, therefore, it was considered that 3 adult males and 3 adult females are killed every year. After reviewing the parameters used in the baseline model, a model was created to reflect the current situation of the lowland tapir population in Morro do Diabo State Park (Table 6.8).

**Table 6.8.** Summary of parameter input values used in Morro do Diabo State Park model.

| Parameter | Baseline value |
|---|---|
| Number of populations | 1 |
| Initial population size | 200 |
| Carrying capacity | 200 |
| Inbreeding depression | 3.14 LE |
| % of the effect of inbreeding due to recessive lethal alleles | 50 |
| Breeding system | monogamy |
| Age of first reproduction (♀ / ♂) | 4 years |
| Maximum age of reproduction | 22 years |
| Annual % adult females reproducing (SD) | 60 (6) |
| Density dependent reproduction? | No |
| Maximum litter size | 1 |
| Overall offspring sex ratio | 50:50 |
| % adult males in breeding pool | 90 |
| % mortality from age 0-1 (SD) | 10 (2.5) |
| % mortality from age 1-2 (SD) | 15 (3.75) |
| % mortality from age 2-3 (SD) | 15 (3.75) |
| % mortality from age 3-4 (SD) | 15 (3.75) |
| % mortality from age above 4 (SD) | 8 (2) |
| Catastrophe | None |
| Harvest: Road kill | 3♀ / 3♂ |
| Supplementation | None |

## Results

The highway has a major impact on the population of lowland tapirs in Morro do Diabo State Park (Table 6.9). Most importantly, it reduces the mean rate of stochastic population growth from 4.5% to 0.2%. This means that it will be much harder for the tapir population to recover from unforeseen events, such as an epidemic outbreak, a fire or any threat that suddenly reduces tapir numbers. Due to the highway, the probability of extinction of the tapir population is almost 20%. Urgent conservation action is needed to decrease the impact of the highway on the population of tapirs.

**Table 6.9.** Results for lowland tapirs in the Morro do Diabo State Park in 100 years **WITH** and **WITHOUT** the highway.

| Morro do Diabo State Park | $N_{init}$ | $r_{stoch}$ | $SD(r_{stoch})$ | $P(E)_{100}$ | MTE | $N_{100}$ | $SD(N_{100})$ | $GD_{100}$ |
|---|---|---|---|---|---|---|---|---|
| **WITHOUT** the highway | 200 | 0.045 | 0.046 | 0 | 0 | 197.73 | 5.19 | 0.9497 |
| **WITH** the highway | 200 | 0.002 | 0.068 | 19.6% | 76.7 | 129.18 | 77.23 | 0.9411 |

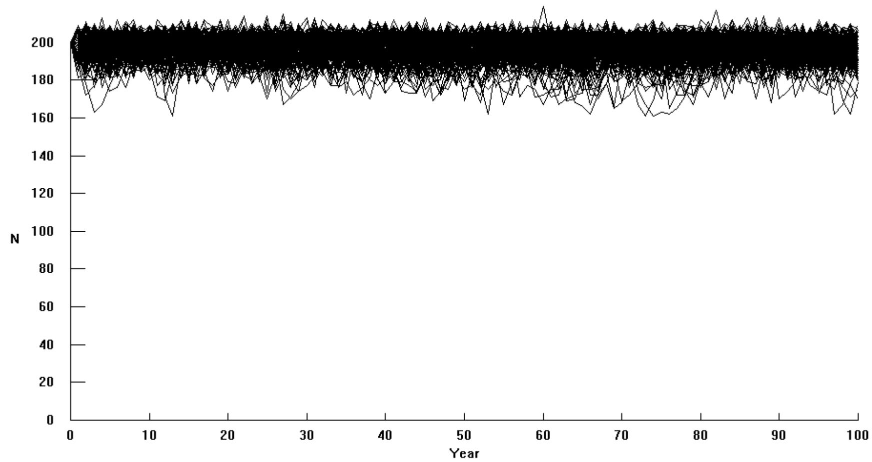



**Figure 6.8.** VORTEX simulation output for 100 years of Morro do Diabo State Park **WITHOUT** the highway.

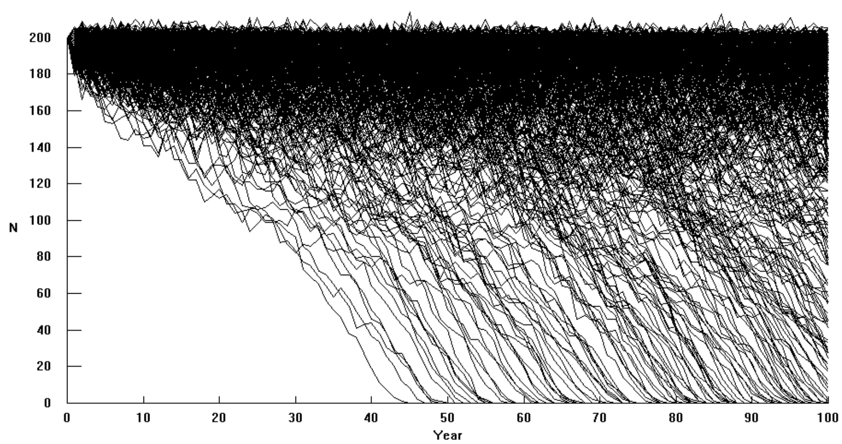



**Figure 6.9.** VORTEX simulation output for 100 years of Morro do Diabo State Park **WITH** the highway.

# CONCLUSIONS

**What is the impact of the highway that crosses Morro do Diabo State Park on the population of lowland tapirs?** The highway threatens the persistence of the tapir population in Morro do Diabo and urgent conservation measures are needed to reduce its impact.

## References

Cullen Jr, L., Bodmer, E.R., & Valladares-Padua, C. (2001) Ecological consequences of hunting in Atlantic forest patches, Sao Paulo, Brazil. *Oryx*, **35**, 137-144.

# COLOMBIA

**CASE STUDY:** Northern Colombia

**Source(s) of information:**

Carlos Alberto Pedraza Penalosa
Instituto de Investigación de Recursos Biológicos "Alexander von Humboldt"
E-mail: cpedraz@gmail.com

Olga Lucia Montenegro
Professor, Universidad Nacional de Colombia (UNAL)
E-mail: olmdco@yahoo.com

Juliana Rodriguez Ortiz
Instituto de Ciencias Naturales, Universidad Nacional de Colombia (UNAL)
E-mail: mjuli2@gmail.com

Carolina Maria Lozano Barrero
Docente de Cátedra, Facultad de Medio Ambiente y Recursos Naturales
E-mail: carolina_lozano_b@yahoo.com; alozano@multiphone.net.co

Andres Arias Alzate
Biológo, Laboratorio de Ecología Evolutiva de Mamíferos
E-mail: andresarias3@yahoo.es

Jose Sinisterra Santana
Manejo y Conservación de Vida Silvestre & Investigación Científica en Diversidad Biológica,
E-mail: jsinisterra@parquesnacionales.gov.co

**Biome:** Sub-andean Forest

**CONSERVATION QUESTION:** What is the biggest threat to lowland tapir populations in Northern Colombia?

# INTRODUCTION

The *Tapirus terrestris colombianus* populations are present in 18 natural biomes, from savannas to mature forests, belonging to 9 general biomes (Orobiomes, Helobiomes, Peinobiomes, Pedobiomes, Xerophitic formations and humid forest) (Etter 1998). The northern region of Colombia is characterized by a high grade of transformation linked to human activities that reduced the area of natural biomes and replaced them by areas for cattle, and rice and soya bean production.

The *T. terrestris colombianus* populations are distributed over a 4,994 $Km^2$ in the area in the region of the following National Natural Parks (UAESPNN): PNN Tayrona, PNN Sierra Nevada de Santa Marta, PNN Orquideas and PNN Paramillo. The species can also be found in the Reserva Nacional Cachalú from Civil Society Reserves Network (Red de Reservas de la Sociedad Civil); in four reserves of the system of National Protective Forest Reserves (Reserva Forestal Protectora Nacional) with a total area of 194 $Km^2$. Besides, in the distribution area of *T. terrestris colombianus*, there are 8 different ethnic groups, occupying an area of 4,900 $Km^2$.

The case study population of *Tapirus terrestris colombianus* (Hershkovittz, 1954) is found in northern of Colombia, in an area of with 5,730 $Km^2$, which corresponds to the largest patch of the potential distribution and represents 22% of the total potential distribution of the subspecies (25,466 $Km^2$). The distribution was estimated with GIS methods, from the integration of results from modeling the potential distribution and the biomes map of Colombia (Etter, 1998). The areas of transformed biomes identified were eliminated from the potential distribution generated using a maximum entropy approach (Phillips *et al.* 2004). For the MaxEnt model, 92 confirmed presence records and eco-geographical variables (mean annual temperature, mean annual precipitation, altitude, aspect and slope) were introduced with 1,000,000 maximum iterations.

The case study population is distributed exclusively in the Orobiomes of the Serrania de San Lucas, which encompasses the following biomes: sub-andean humid forest, Andean humid forest and the high dense forest from sedimentary plain lightly wavy from the north of Colombia. The major threat for tapirs in the area is the habitat lost for cattle ranching and illegal crops (IAvH unpublished).

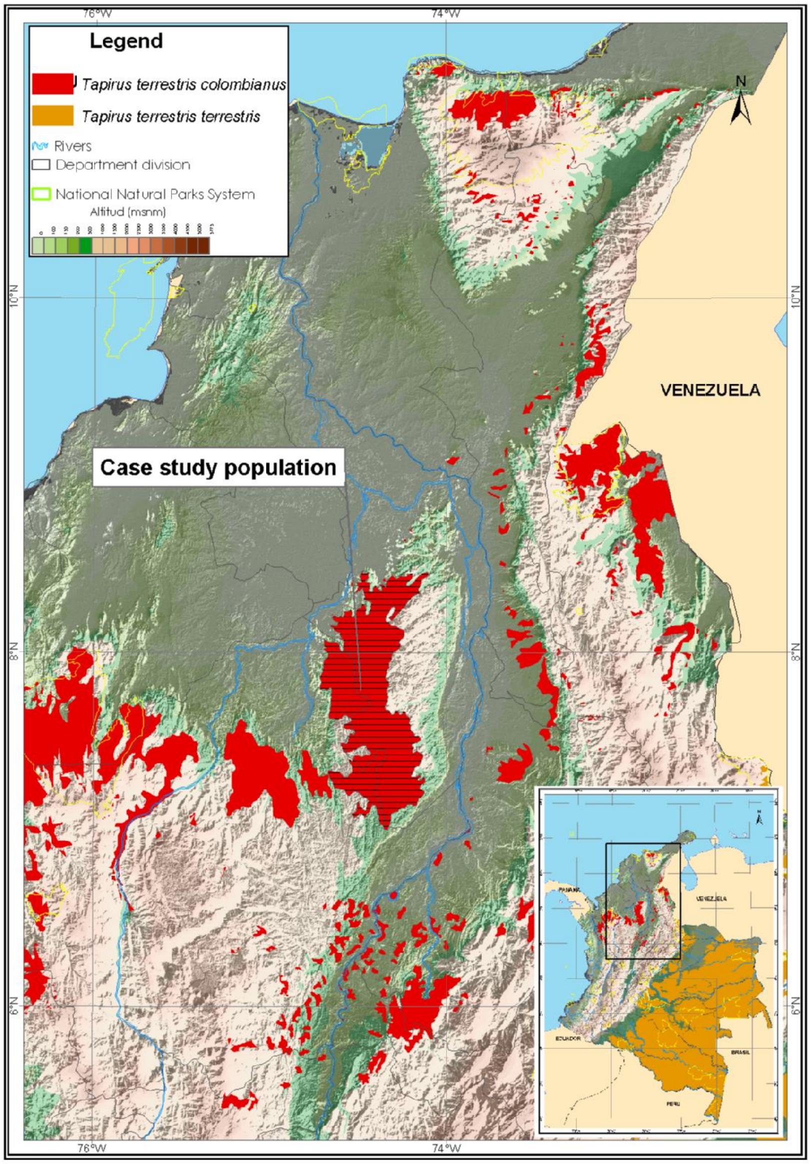



**Figure 6.10**. Distribution map of case study population.

# CURRENT SITUATION IN NORTHERN COLOMBIA

## Input values for the model parameters

A lot of discussion about how to model and what to model took place. Hunting in Northern Colombia occurs in some areas more intensively than in others and is frequently associated with habitat destruction due to wood extraction. Some areas act as a source of animals while others act as a sink. Threats and impact of threats vary between areas of the same biome and the overall population is much higher than VORTEX can model. Thus, due to time constraints and because VORTEX is not spatially explicit, the group decided to model a closed population to evaluate what the biggest threat to lowland tapir populations in Northern Colombia currently is. Population size, threats and impacts were proportionally reduced. Participants from Colombia discussed parameter inputs together and finally decided to model a population of 970 animals based on the area from the potential distribution map and on density data from an Amazon population of Bolivia (0.16928447 ind./$Km^2$) (Montenegro, pers. comm.), with carrying capacity being set as equal to the initial population size. The two main threats are hunting and habitat loss. Each year 10 adult male and 10 adult females are killed and 2% of the habitat is lost each year for the next 20 years, stopping afterwards.

After reviewing the parameters used in the baseline model, a model was adapted to reflect the current situation of the lowland tapir population in Northern Colombia (Table 6.10).

**Table 6.10.** Summary of parameter input values used in the model for Northern Colombia.

| Parameter | Baseline value |
|---|---|
| Number of populations | 1 |
| Initial population size | 970 |
| Carrying capacity | 970 |
| Inbreeding depression | 3.14 LE |
| % of the effect of inbreeding due to recessive lethal alleles | 50 |
| Breeding system | polygamy |
| Age of first reproduction (♀ / ♂) | 4 years |
| Maximum age of reproduction | 22 years |
| Annual % adult females reproducing (SD) | 60 (6) |
| Density dependent reproduction? | No |
| Maximum litter size | 1 |
| Overall offspring sex ratio | 50:50 |
| % adult males in breeding pool | 90 |
| % mortality from age 0-1 (SD) | 10 (2.5) |
| % mortality from age 1-2 (SD) | 15 (3.75) |
| % mortality from age 2-3 (SD) | 15 (3.75) |
| % mortality from age 3-4 (SD) | 15 (3.75) |
| % mortality from age above 4 (SD) | 8 (2) |
| Catastrophe | None |
| Harvest | 10♀ /10 ♂ |

## Results

Since we are modeling a fictitious closed population, the probability of extinction does not reflect the reality of the population (animals from neighboring populations will immigrate). What the model does show is that the major threat to the population is habitat loss (Figure 6.11). Once the population size is reduced due to habitat loss, hunting becomes a major threat and can cause a severe decline of the population. Overall, the mean rate of stochastic population growth is very low, meaning that stochastic changes in population growth or unknown catastrophes can potentially cause a severe decline in the population from which it will be difficult to recover (Table 6.11).

**Table 6.11.** Results of the current situation after 100 years for lowland tapirs in Northern Colombia.

| Northern Colombia | $N_{init}$ | $r_{stoch}$ | $SD(r_{stoch})$ | $P(E)_{100}$ | MTE | $N_{100}$ | $SD(N_{100})$ | $GD_{100}$ |
|---|---|---|---|---|---|---|---|---|
| Current situation | 970 | 0.004 | 0.067 | 11.0% | 85.2 | 436.01 | 197.97 | 0.9791 |

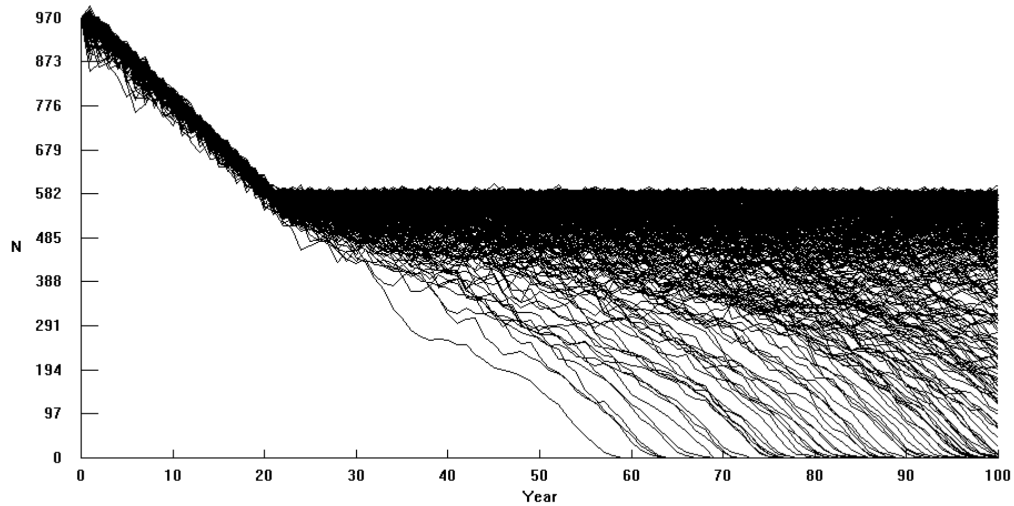



**Figure 6.11.** VORTEX simulation output of the current situation in Northern Colombia.

# CONCLUSIONS

Participants found it difficult to create the model due to the uncertainty of the parameters and to the fact that the lowland tapirs' distribution is not well known in northern Colombia. Nonetheless, the exercise was useful as it stressed areas where basic knowledge lacked, especially demographic information (such as densities) used to estimate the population size. Information on population density, hunting pressure and habitat loss rates are needed. The participants agreed that, as showed by the model, habitat loss is currently the biggest threat to populations of lowland tapirs in Northern Colombia.

**What is the biggest threat to lowland tapir populations in Northern Colombia?**
According to the model, habitat loss is currently the major threat to populations of lowland tapir in Northern Colombia.

# COLOMBIA

**CASE STUDY:** Llanos of Colombia

**Source(s) of information:**

Carlos Alberto Pedraza Penalosa
Instituto de Investigación de Recursos Biológicos "Alexander von Humboldt"
E-mail: cpedraz@gmail.com

Olga Lucia Montenegro
Professor, Universidad Nacional de Colombia (UNAL)
E-mail: olmdco@yahoo.com

Juliana Rodriguez Ortiz
Instituto de Ciencias Naturales, Universidad Nacional de Colombia (UNAL)
E-mail: mjuli2@gmail.com

Carolina Maria Lozano Barrero
Docente de Cátedra, Facultad de Medio Ambiente y Recursos Naturales
E-mail: carolina_lozano_b@yahoo.com; alozano@multiphone.net.co

Andres Arias Alzate
Biológo, Laboratorio de Ecología Evolutiva de Mamíferos
E-mail: andresarias3@yahoo.es

Jose Sinisterra Santana
Manejo y Conservación de Vida Silvestre & Investigación Científica en Diversidad Biológica,
E-mail: jsinisterra@parquesnacionales.gov.co

**Biome:** East Llanos from Colombia

**CONSERVATION QUESTION:** What is the biggest threat to lowland tapir populations in llanos of Colombia?

# INTRODUCTION

Romero *et al.* (2004) reported 4 general biomes, 21 biomes and 154 ecosystems for the Orinoco basin region, where the pedobiome of the tropical humid zonobiome has the major extension, with 53.9%, and the natural biomes comprise 79.1% of the total Orinoco area. The introduction of cattle and pastures in different biomes, climates and physiographic positions has been the most significant element of landscape transformation (33,818 $Km^2$, Romero *et al.* 2004). Other ways of transformation are related to agro-ecosystems, represented by palms, with 746 $Km^2$ (*Elaeis guianeensis*), rice, with 1,109 $Km^2$, (*Oryza sativa*), coffee, with 117 $Km^2$, and mixed agro-ecosystems with 72,221 $Km^2$ (Romero *et al.* 2004).

The *Tapirus terrestris terrestris* populations (504,342 $Km^2$), including the Amazon populations, are represented in the National Natural Parks System (UAESPNN) with 68,237 $Km^2$ distributed in 16 parks; in 12 areas from the Civil Society Reserves Network with 186 $Km^2$; 4 areas from the National Protective Forest Reserves with a total area of 316 $Km^2$ and 238,731 $Km^2$ in areas of several ethnic groups.

The populations distributed in the basin region of the Orinoco river in Colombia have a total area of 137,076 $Km^2$, which corresponds to 36.6% of the total area of the Orinoco basin.

The case study population (121,594 $Km^2$) corresponds to the largest continuous population out of the Orinoco populations (Figure 6.12). The distribution was estimated with GIS methods from the integration of results from modeling the potential distribution and the biomes map of Colombia (Etter, 1998), employing the maximum entropy method (Phillips *et al.* 2004). The areas of transformed biomes that were identified were eliminated from the potential distribution generated. For the MaxEnt (Phillips *et al.* 2004) model, 92 confirmed presence records and eco-geographical variables (mean annual temperature, mean annual precipitation, altitude, aspect and slope) were introduced with a maximum of 1,000,000 iterations

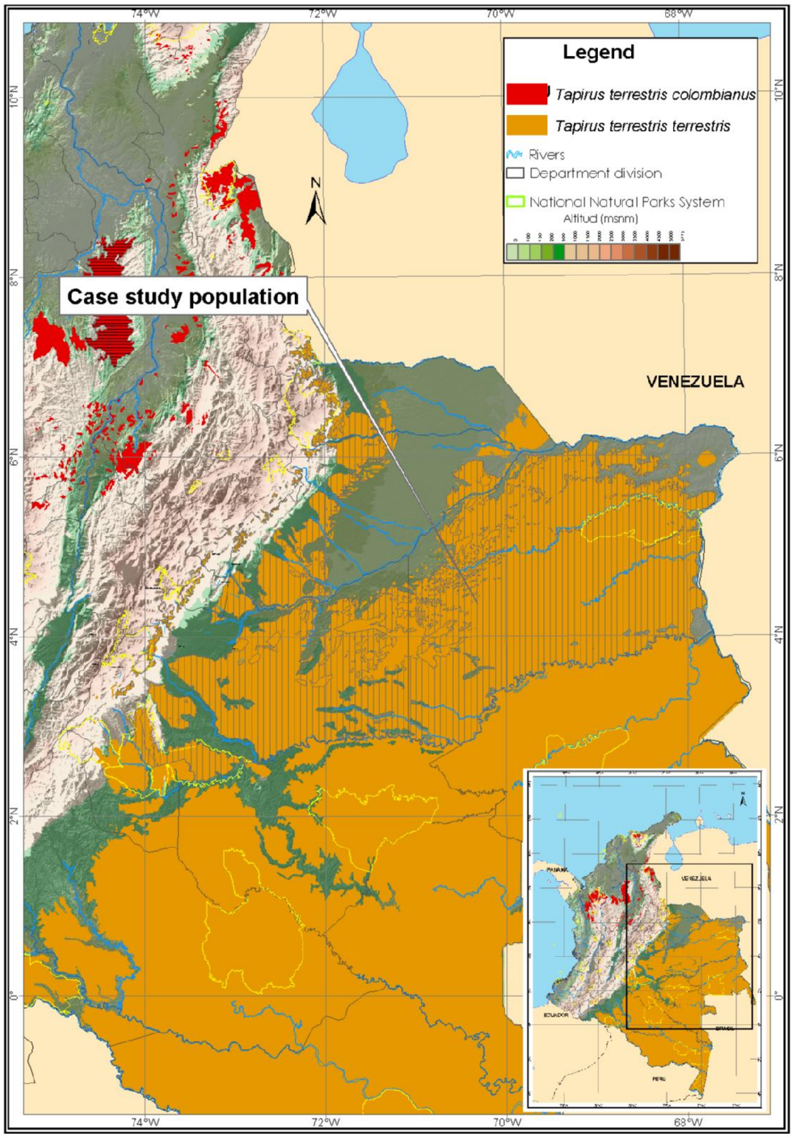



**Figure 6.12.** Distribution map of case study population.

## CURRENT SITUATION IN THE LLANOS OF EASTERN COLOMBIA

### Input values for the model parameters

As in Northern Colombia, populations of the llanos cover a large area and are continuous, threats and impact of threats vary between areas of the same biome and the overall population is much higher than VORTEX can model. As in Northern Colombia, the group decided to model a closed population to evaluate what the biggest threat to lowland tapir populations in llanos of Colombia currently is. Population size, threats and impacts were proportionally reduced. An initial population of 3,000, with carrying capacity set as equal to the initial population size, was modeled. The main threats considered were habitat loss, disease from cattle and hunting. Each year, 1% of the adult males and 1% of the adult females are hunted and 1.5% of the habitat is lost each year for the next 20 years. As for the diseases, there is no information on its impact, but the group guessed that twice every 100 years, an epidemic due to cattle presence would strike and kill 25 % of the population and decrease reproduction by 25%. Large fire outbreaks may also occur on average 3 times every 100 years and kill 2% of the adult population.

After reviewing the parameters used in the baseline model, a model was adapted to reflect the current situation of the lowland tapir population in the llanos of Colombia (Table 6.12).

**Table 6.12.** Summary of parameter input values used in the model for the llanos of Colombia.

| Parameter | Baseline value |
|---|---|
| Number of populations | 1 |
| Initial population size | 3000 |
| Carrying capacity | 3000 |
| Inbreeding depression | 3.14 LE |
| % of the effect of inbreeding due to recessive lethal alleles | 50 |
| Breeding system | polygamy |
| Age of first reproduction (♀ / ♂) | 4 years |
| Maximum age of reproduction | 22 years |
| Annual % adult females reproducing (SD) | 60 (6) |
| Density dependent reproduction? | No |
| Maximum litter size | 1 |
| Overall offspring sex ratio | 50:50 |
| % adult males in breeding pool | 90 |
| % mortality from age 0-1 (SD) | 10 (2.5) |
| % mortality from age 1-2 (SD) | 15 (3.75) |
| % mortality from age 2-3 (SD) | 15 (3.75) |
| % mortality from age 3-4 (SD) | 15 (3.75) |
| % mortality from age above 4 (SD) | 8 (2) |
| Catastrophe | Disease and fire |
| Harvest | 1%♀ /1% ♂ |

## Results

Since the group chose to model a large population, and the mean rate of stochastic population growth is 3.5%, the population can recover from the impact of disease and maintain itself relatively close to carrying capacity. However if the population size is severely decreased, an epidemic can wipe it out (Table 6.13).

**Table 6.13.** Results of the current situation after 100 years for lowland tapirs in the llanos of Colombia.

| Llanos of Colombia | $N_{init}$ | $r_{stoch}$ | $SD(r_{stoch})$ | $P(E)_{100}$ | MTE | $N_{100}$ | $SD(N_{100})$ | $GD_{100}$ |
|---|---|---|---|---|---|---|---|---|
| Current situation | 3000 | 0.035 | 0.058 | 0 | 0 | 2046.54 | 136.68 | 0.9951 |

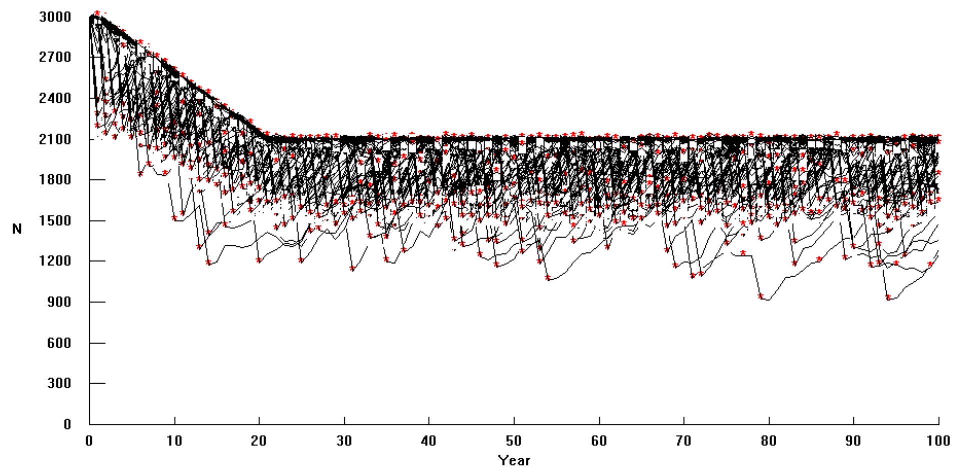



**Figure 6.13.** VORTEX simulation output of the current situation in the llanos of Colombia.

# CONCLUSIONS

Uncertainty on the real impact of diseases which are thought to be transmitted by cattle made modeling difficult. This exercise helped the group formulate hypotheses and orient future research rather than give an accurate prediction of trends. Habitat loss is again a major threat to populations of lowland tapir, but disease can potentially cause local extinctions. Knowledge on the impact and consequence of diseases, particularly those transmitted by cattle, need to be researched. Again, it was discussed how important it was for tapir populations to remain continuous and connected in order to recover from the impact of different threats. Questions on whether ranching practices can fragment tapir populations also need to be addressed.

**What is the biggest threat to lowland tapir populations in llanos of Colombia?**
Habitat loss and disease are potential major threats to tapirs in the llanos.

## References

Romero, M., Galindo, G., Otero, J. & Armenteras, D. 2004. Ecosistemas de la cuenca del Orinoco colombiano. Instituto de Investigación de Recursos Biológicos Alexander von Humboldt. Bogota. Colombia. 189 p.

Etter, A. 1998. Mapa general de ecosistemas de Colombia. En: Cháves, M.E. y Arango, N. (eds) 1998. Instituto de Investigación de Recursos Biológicos Alexander von Humboldt. Informe nacional sobre el estado de la biodiversidad- Colombia. Tomo I. Causas de pérdiad de la biodiversidad. Instituto Humboldt, PNUMA, Ministerio del Medio Ambiente. Bogota – Colombia.

Phillips, S. J, Dudík, M. & Schapire, R. E. 2004. A maximum entropy approach to species distribution modeling. Proceedings of the Twenty-First International Conference on Machina Learning. 655- 666.

# ECUADOR

**CASE STUDY: Reserva** Comunitaria en la Comunidad de Sarayaku, Ecuador

**Source(s) of information:**

Andres Tapia
Centro Tecnológico de Recursos Amazónicos de la Organización de Pueblos Indígenas de Pastaza
CENTRO FÁTIMA
E-mail: centrofati@panchonet.net

Jose Dionicio Machoa Santi
Proyecto de Manejo y Reintroducción de Dantas en el Nororiente del Ecuador
Dirigente de Recursos Naturales de Sarayaku Tayjasaruta, Organización de Pueblos Indígenas de Pastaza, Proyecto para la Conservación de los Tapires en el Territorio de Sarayaku, Manejo de la Biodiversidad en el Territorio de Sarayaku
E-mail: josemachoa@yahoo.es

**Biome:** Upper Amazon

**CONSERVATION QUESTION:** What is the impact of the recently implemented lowland tapir community management plan?

## INTRODUCTION

The Sarayaku community is a territory of 1,400 km$^2$, located at 450 m.o.s.l in the Middle Eastern Amazon region of Ecuador. It is inhabited by indigenous groups of kichwa nationality (total population is estimated to be 1,500-2,000 inhabitants). The biome can be characterized as Upper Amazon biome, according to the classification used in the workshop. The annual precipitation is 3,000-4,000 mm., average temperature is 25ºC and average humidity is 80-90%.

As a strategy to ensure the conservation of natural resources in the long term, the community organized itself and created two communitarian natural reserves representing 10% of the whole area. One of the main purposes of this strategy was also to prevent the entrance of oil foraging operations.

Tapirs represent an important source of meat for local people, but hunting pressure lead tapir populations to be severely threatened in the area. Commercial hunting was also becoming an illegal activity in Ecuador. The community therefore created the reserves. Two reserves and one monitoring station were created and several park rangers were capacitated to conduct the project. Three tapirs were also re-introduced in the reserves and hunting was forbidden in these areas. According to the register of the park rangers, before the implementation of the reserves, 24 tapirs were hunted every year. Nowadays this situation has changed, and the figures do not go over 7 tapirs hunted on each year.

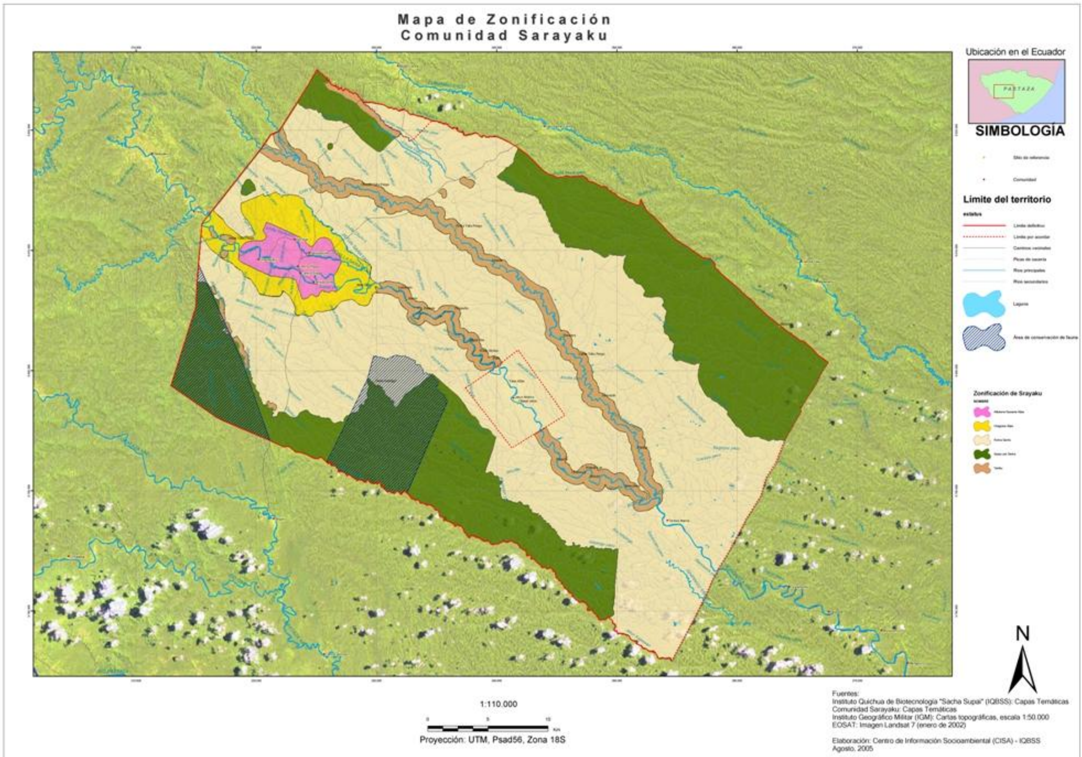



**Figure 6.14.** Map of the Reserva Comunitaria of the Sarayaku community, Ecuador.

## CURRENT SITUATION IN RESERVA COMUNAL DE SARAYAKU

### Input values for the model parameters

In the Sarayaku community there is no habitat loss and a management plan has been implemented to control the impact of hunting. A community conservation management plan was implemented in 2001. Before the implementation of the management plan, 24 adult tapirs were hunted each year on average (12 males and 12 females). After the implementation only 7 adult tapirs were hunted each year on average (3 females and 4 males). Other threats include a curse (which could also be explained as a disease) which has been documented in the area to kill many tapirs. According to the participant from the community, one day a tapir bit a dog belonging to the local shaman. Furious, the shaman put a curse on the tapirs and killed many of them. It now appears that this curse can occur every 20 years, killing 5% of the tapirs, but has no effect on reproduction. This curse can also be interpreted as a re-occurring epidemic in the area. According to the participant, there are about 1000 tapirs in the reserve. The carrying capacity was considered to be equal to the initial population size.

After reviewing the parameters used in the baseline model, a model was adapted to reflect the current situation of the lowland tapir population in the Reserva Comunitaria de Sarayaku (Table 6.14). Results from the model before and after the communal management plan were tested to evaluate its the impact on the preservation of lowland tapirs in the Reserva Comunitaria de Sarayaku.

**Table 6.14.** Summary of parameter input values used in the Reserva Comunitaria de Sarayaku model.

| Parameter | Baseline value |
|---|---|
| Number of populations | 1 |
| Initial population size | 1000 |
| Carrying capacity | 1000 |
| Inbreeding depression | 3.14 LE |
| % of the effect of inbreeding due to recessive lethal alleles | 50 |
| Breeding system | monogamy |
| Age of first reproduction (♀ / ♂) | 4 years |
| Maximum age of reproduction | 22 years |
| Annual % adult females reproducing (SD) | 60 (6) |
| Density dependent reproduction? | No |
| Maximum litter size | 1 |
| Overall offspring sex ratio | 50:50 |
| % adult males in breeding pool | 100 |
| % mortality from age 0-1 (SD) | 10 (2.5) |
| % mortality from age 1-2 (SD) | 15 (3.75) |
| % mortality from age 2-3 (SD) | 15 (3.75) |
| % mortality from age 3-4 (SD) | 15 (3.75) |
| % mortality from age above 4 (SD) | 8 (2) |
| Catastrophe | YES |
| Harvest | Before and after management plan |
| Habitat loss | No |

## Results (N=1000)

According to the VORTEX model, the communal management plan and the reduction of hunting had no impact on the persistence of lowland tapir in the Reserva Comunitaria de Sarayaku (Table 6.15). In both cases, the probability of extinction of the population is zero, the mean population sizes at the end of both simulations are quite similar, and in both cases genetic diversity is high. The communal management plan did have a positive impact on the mean rate of stochastic population growth. With the management plan, the mean rate of stochastic population growth was nearly doubled. This means that the population of tapirs will be more resilient and capable of recovering from factors that decrease its numbers.

**Table 6.15.** Results for lowland tapirs in the Reserva Comunitaria de Sarayaku in 100 years before and after the communal management plan adopted in 2001. The initial population size is 1000 individuals.

| Reserva Sarayaku | $N_{init}$ | $r_{stoch}$ | SD($r_{stoch}$) | $P(E)_{100}$ | MTE | $N_{100}$ | SD($N_{100}$) | $GD_{100}$ |
|---|---|---|---|---|---|---|---|---|
| **BEFORE** management plan | 1000 | 0.021 | 0.040 | 0 | 0 | 976.37 | 66.66 | 0.9893 |
| **AFTER** Management plan | 1000 | 0.040 | 0.039 | 0 | 0 | 993.91 | 16.25 | 0.9895 |

# SCENARIO MODELING
# Reduction of Initial Population Size

## Change in population estimate (N=500)

Due to the uncertainty of the initial population size, the model and tests were run with an initial population size of 500 tapirs (this is equivalent to a density of tapirs similar to the Parque Nacional de Yasuni). The impact of the communal management plan was then re-evaluated.

## Results

According to the model, with an initial population size of 500 tapirs the communal management plan adopted has a very high impact on the persistence of lowland tapir populations in the reserve (Table 6.16; Figure 6.15 and Figure 6.16). Simply put, without the communal management plan, tapirs in the reserve will go extinct. The implementation of the management in the Reserva Comunitaria de Sarayaku de Sarayaku plan secures the future of lowland tapirs.

**Table 6.16.** Results for lowland tapirs in the Reserva Comunitaria de Sarayaku in 100 years before and after the communal management plan adopted in 2001. The initial population size is 500 individuals.

| Reserva Sarayaku | $N_{init}$ | $r_{stoch}$ | $SD(r_{stoch})$ | $P(E)_{100}$ | MTE | $N_{100}$ | $SD(N_{100})$ | $GD_{100}$ |
|---|---|---|---|---|---|---|---|---|
| **BEFORE** management plan | 500 | -0.106 | 0.232 | 99.8 | 42.8 | 0.01 | 0.13 | 0.833 |
| **AFTER** Management plan | 500 | 0.033 | 0.042 | 0 | 0 | 494.15 | 12.59 | 0.978 |

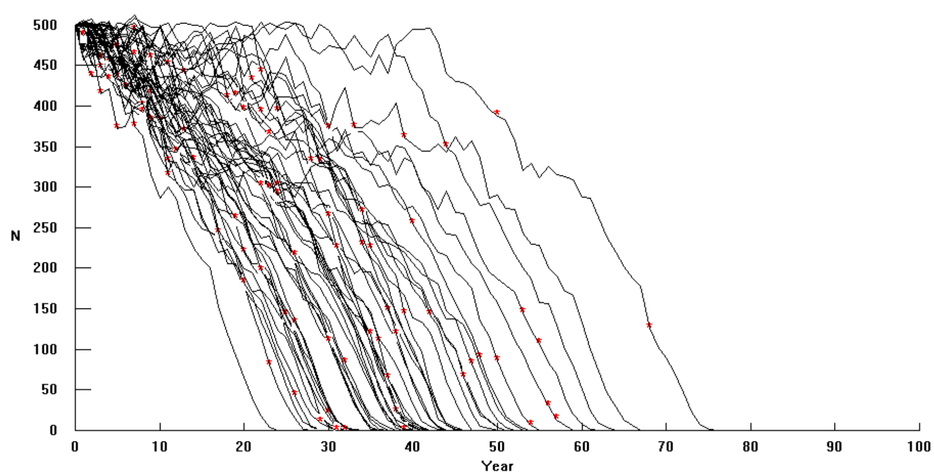



**Figure 6.15.** VORTEX simulation output of the Reserva Comunitaria de Sarayaku in 100 years **WITHOUT** the communal management plan adopted in 2001. The initial population size is **500** individuals.

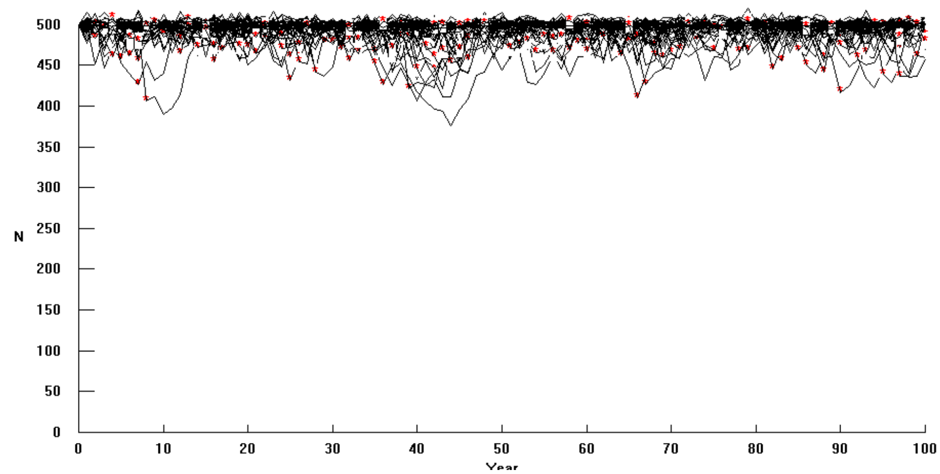



**Figure 6.16.** VORTEX simulation output of the Reserva Comunitaria de Sarayaku in 100 years **WITH** the communal management plan adopted in 2001. The initial population size is **500** individuals.

# CONCLUSIONS

Knowledge on tapir populations is essential to measure the impact of any change in the threats. This information is key for the implementation and evaluation of any conservation measure. In this case, the communal management plan was necessary to save the tapir population when the initial population size was 500 animals, while it was not as important if the population was of 1000 individuals. In both cases the management plan did increase the stochastic population growth, meaning that the population will be able to better recover from any threat.

These results were presented to the community immediately after the workshop. During the meeting as a result of this work, it was decided that population densities of tapirs will be determined in the near future on a regular basis.

**What is the impact of the recently implemented lowland tapir community management plan?** The impact of the management plan depends on the initial population size of lowland tapirs in the Reserva Comunitaria de Sarayaku. If the initial population is 1000 tapirs, then the communal management plan does not have a very high impact. If the initial population size of the tapir population is 500, then the communal management plan secures the population and without it the population would go extinct.

# PARAGUAY

**CASE STUDY**: Mbaracayú Forest Nature Reserve, Paraguay

**Source(s) of information:**

Miguel A. Morales
Protected Areas Management Advisor
People, Protected Areas and Conservation Corridors - Conservation International (CI)
E-mail: mamorales@conservation.org

**Biome:** Atlantic Forest of the Interior

**CONSERVATION QUEStion**: What is the future of tapir (*Tapirus terrestris*) populations in the Mbaracayú Forest Nature Reserve?

## INTRODUCTION

The Mbaracayú Forest Natural Reserve, a private nature reserve of 664 $km^2$, is located in the Department of Canindeyú, near the border with Brazil. Almost the entire reserve lies within the upper Jejuí river watershed, the second major tributary of the Paraguay River in the eastern region of the country (Figure 1). The reserve is well protected and no major habitat loss is foreseeable in the near future.

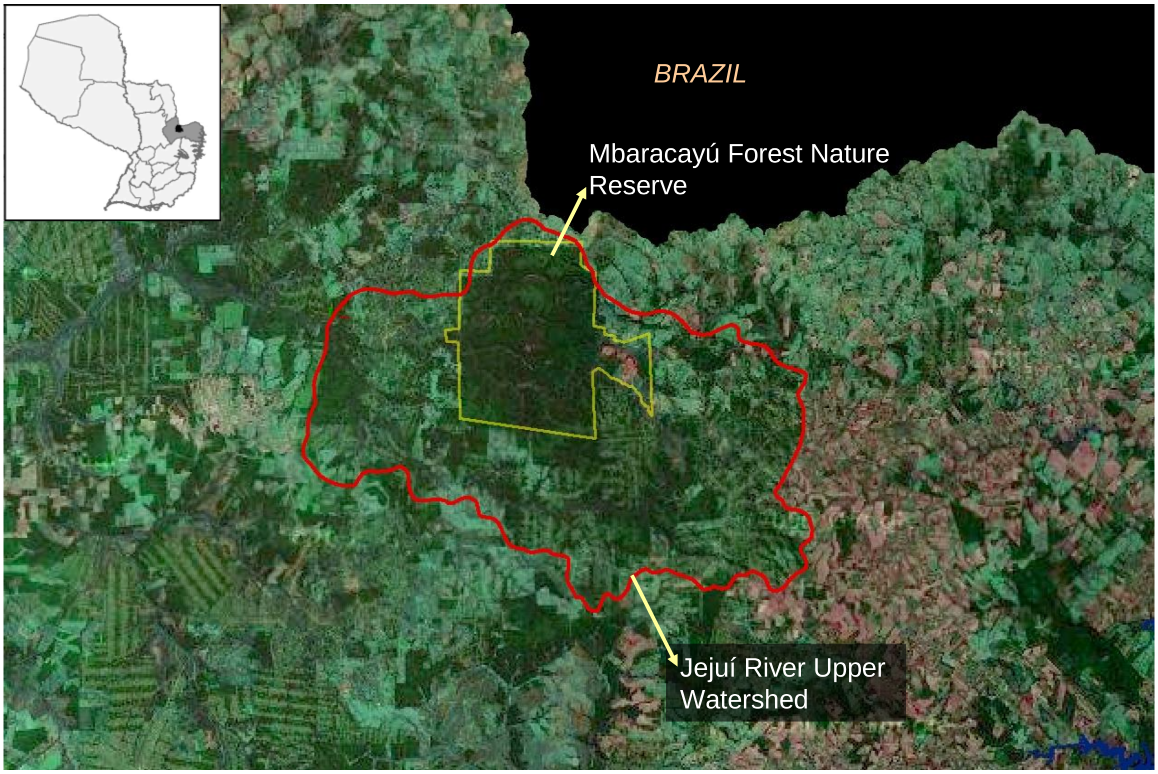



**Figure 6.17.** Location of the Mbaracayú Forest Nature Reserve.

# CURRENT SITUATION IN THE MBARACAYÚ FOREST NATURE RESERVE

## Input values for the model parameters

It is estimated that about 10 tapirs (5 adult males and 5 adult females) are hunted each year (Morales 2006). A tapir density of 1.09 individuals/km$^2$ (Hill, McMillan, and Farina 2003) has been estimated in the reserve, meaning that approximately 700 tapirs may live in the reserve. It is thought, however, that the reserve may actually support a population of 800 tapirs[1] (Morales 2006).

After reviewing the parameters used in the baseline model, the baseline model was adapted to reflect the current situation of the lowland tapir population in Mbaracayú Forest Nature Reserve (Table 6.17).

**Table 6.17.** Summary of parameter input values used in the model for the Mbaracayú Forest Nature Reserve.

| Parameter | Baseline value |
|---|---|
| Number of populations | 1 |
| Initial population size | 700 |
| Carrying capacity | 800 |
| Inbreeding depression | 3.14 LE |
| % of the effect of inbreeding due to recessive lethal alleles | 50 |
| Breeding system | monogamy |
| Age of first reproduction (♀ / ♂) | 4 years |
| Maximum age of reproduction | 22 years |
| Annual % adult females reproducing (SD) | 60 (6) |
| Density dependent reproduction? | No |
| Maximum litter size | 1 |
| Overall offspring sex ratio | 50:50 |
| % adult males in breeding pool | 90 |
| % mortality from age 0-1 (SD) | 10 (2.5) |
| % mortality from age 1-2 (SD) | 15 (3.75) |
| % mortality from age 2-3 (SD) | 15 (3.75) |
| % mortality from age 3-4 (SD) | 15 (3.75) |
| % mortality from age above 4 (SD) | 8 (2) |
| Catastrophe | None |
| Harvest | 5♀ and 5 ♂ |

[1] Estimation based on body size and diet, using the equation proposed by Robinson and Redford (Robinson and Redford 1986) and field data (Morales 2006)

## Results

Currently, and according to the model, the future of lowland tapirs in the Mbaracayú Reserve appears secure. Keeping in mind that threats such as disease, fire, or other catastrophes were not included in the model, it seems that the current hunting rate is sustainable (Table 6.18, Figure 6.18). The mean rate of stochastic population growth is over 3% and the mean population size at the end of the simulation, averaged across all simulated populations, is close to the carrying capacity of the reserve. Genetic diversity in the population after 100 years remains high.

**Table 6.18.** Results for lowland tapirs in the Reserva Natural Bosque Mbaracayú in 100 years under current management.

| Reserva Mbaracayú | $N_{init}$ | $r_{stoch}$ | $SD(r_{stoch})$ | $P(E)_{100}$ | MTE | $N_{100}$ | $SD(N_{100})$ | $GD_{100}$ |
|---|---|---|---|---|---|---|---|---|
| Current situation | 700 | 0.036 | 0.038 | 0 | 0 | 795.29 | 10.16 | 0.9868 |

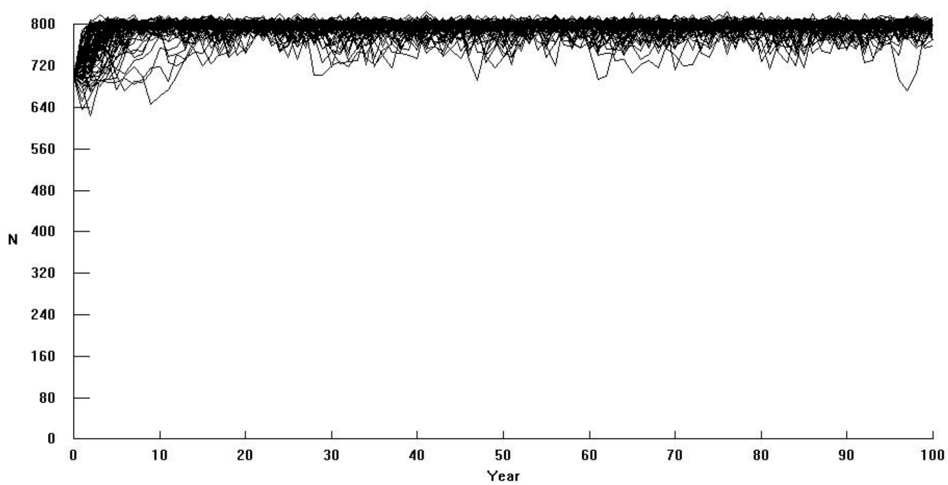



**Figure 6.18.** VORTEX simulation output of the current situation in the Mbaracayú Forest Nature Reserve.

# SCENARIO MODELING
## Increase in Hunting Level

The main immediate and identifiable threat to lowland tapirs in the reserve is hunting, and according to the model the current levels of hunting do not appear to be affecting the overall population of tapirs in the reserve. What would happen if hunting levels tripled?

If the hunting level in the reserve increases from 10 to 30 animals (15 males and 15 females) per year, the future of the lowland tapir population in the Mbaracayú Forest Nature Reserve becomes uncertain (Table 6.19; Figure 6.19). There is an almost 50% chance that the population will go extinct. The mean time to population extinction over a 100-year period is 65 years. The mean rate of stochastic population growth becomes negative and the population declines each year. If the population survives after 100 years, genetic diversity remains high, but the number of animals actually left in the population is lower than the initial population size.

**Table 6.19.** Results for lowland tapirs in the Mbaracayú Forest Nature Reserve after 100 years with a three-fold increase in hunting.

| Reserva Mbaracayú | $N_{init}$ | $r_{stoch}$ | $SD(r_{stoch})$ | $P(E)_{100}$ | MTE | $N_{100}$ | $SD(N_{100})$ | $GD_{100}$ |
|---|---|---|---|---|---|---|---|---|
| Hunting increase | 700 | -0.026 | 0.137 | 49.0 | 64.2 | 312.10 | 349.18 | 0.9809 |

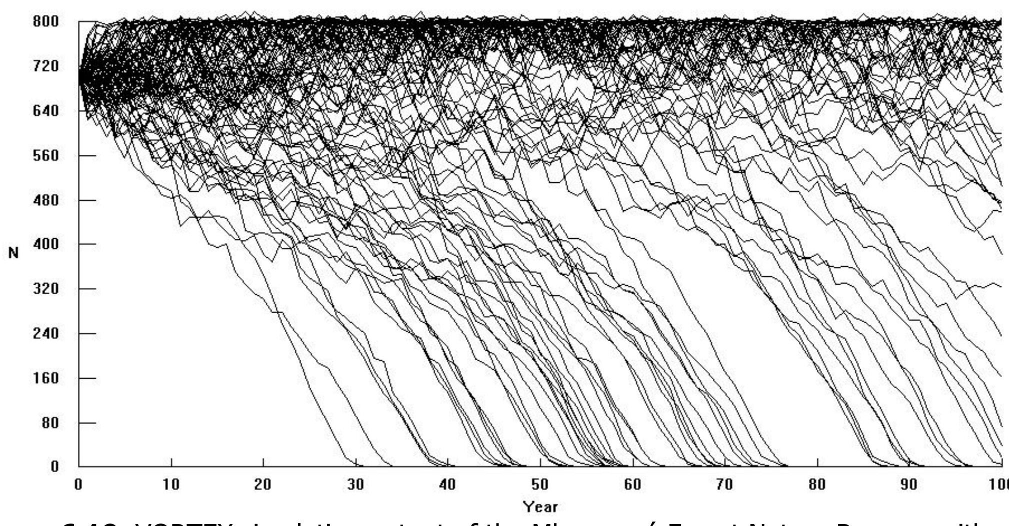



**Figure 6.19.** VORTEX simulation output of the Mbaracayú Forest Nature Reserve with a three-fold increase in harvest rate

# CONCLUSIONS

According to the model, an increase in hunting levels will have a dramatic effect on the survival of lowland tapir populations in the Mbaracayú Forest Nature Reserve. Therefore, it is important for the reserve managers to continue to work closely with the local communities to make sure that harvest levels of lowland tapirs remain low.

**What is the future of tapir populations in the Mbaracayú Forest Nature Reserve?** According to the VORTEX model, unless hunting increases or unforeseen threats occur, the future of the lowland tapir population in the Mbaracayú Forest Nature Reserve appears secure.

## References


Hill, K., G. McMillan, and R. Farina. 2003. Hunting-Related Changes in Game Encounter Rates from 1994 to 2001 in the Mbaracayú Reserve, Paraguay. *Conservation Biology* 17, no. 5: 1312-23.

Morales, M. 2006. Hunting at soil licks in the Mbaracayú Forest Reserve. Unpublished data. Dissertation research.

Robinson, J. G., and K. H. Redford. 1986. Body Size, Diet, and Population-Density of Neotropical Forest Mammals. American Naturalist 128, no. 5: 665-80.

# General

**CASE STUDY:** Fragmented forest

**Source(s) of information:** Hypothetical case study (from section 4.)

**Biome:** any biome where tapir habitat becomes fragmented

**CONSERVATION QUESTION:** Are establishing corridors a good strategy to prevent extinction of tapirs from fragmented populations?

## INTRODUCTION

Management strategies for the forest fragments were examined in section 4 (Figure 4.2). The baseline model was used here, without any additional threats. Without fragmentation, the genetic diversity of the tapir population (N initial =200) remains high in 100 years and the population is expected to survive in the absence of any extra threats. When the population is fragmented, however, , the loss of genetic diversity of the two smaller fragments is very high in 100 years, what can lead, among other effects, to demographic instability, and increase the probability of extinction of these populations. However, it is important to remember that the populations hereby being tested are closed ones (something not uncommon when there is isolation and fragmentation), something that prevents the adition of genetic variation, be it by gene flow or mutation.

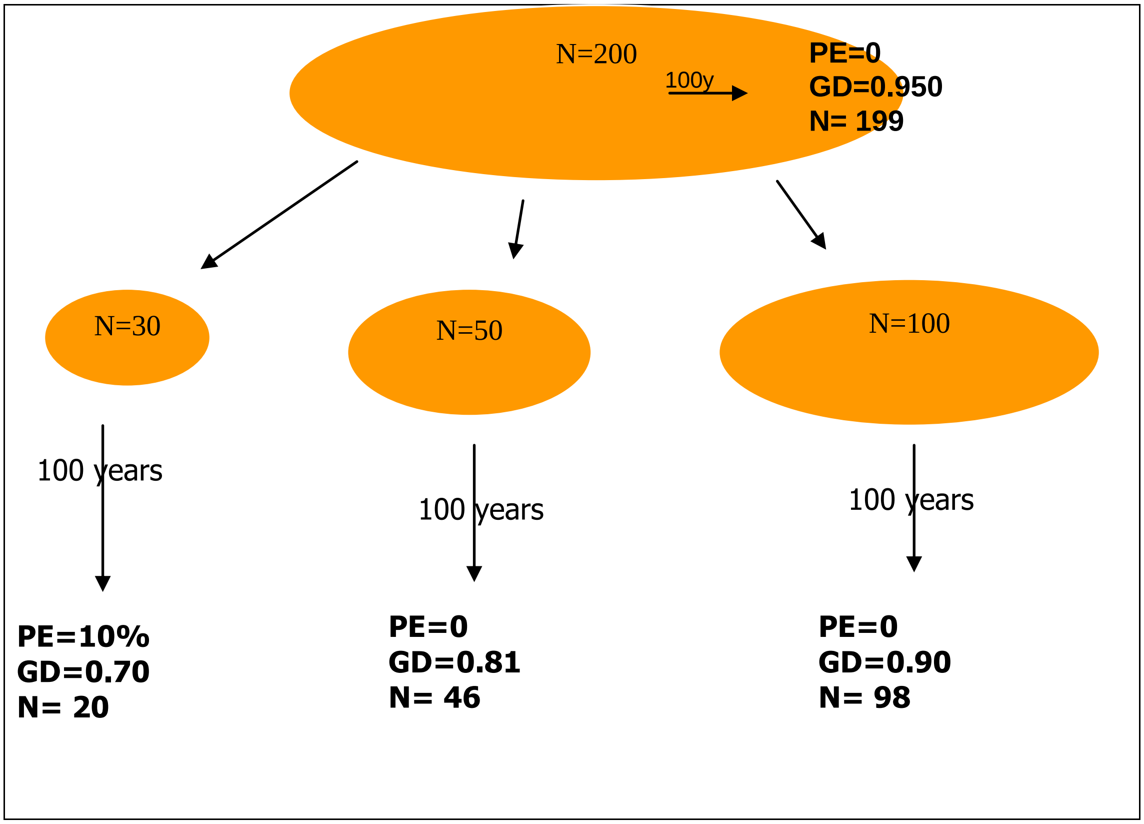



**Figure 6.20.** Impact of fragmentation on a population of lowland tapirs. A population of N=200 is fragmented into three unconnected population. Results from VORTEX simulation given include: Probability of Extinction (PE), Genetic Diversity (GD), and mean number of animals N in 100 years.

# SCENARIO MODELING
# Management Options

## Biological corridors between fragments

To increase the genetic diversity of the forest fragments and to maintain healthy stable populations of lowland tapirs, corridors can be created to link the fragments together. These corridors enable 10% of males and females between 3 and 6 years old to disperse to neighboring fragments. Two different scenarios were modeled. One in which the corridor did not cause any mortality to dispersing animals, and one in which 50% of the dispersing animals died.

Depending on the mortality rate, the impact of corridors can be very different. If there is no mortality during dispersal (Figure 6.21) then corridors are a great strategy to maintain high levels of genetic diversity in the fragments. Once implemented, the smaller fragments maintained levels of genetic diversity of at least 90% after 100 years. Without the corridors, genetic diversity levels after 100 years were below 80%.

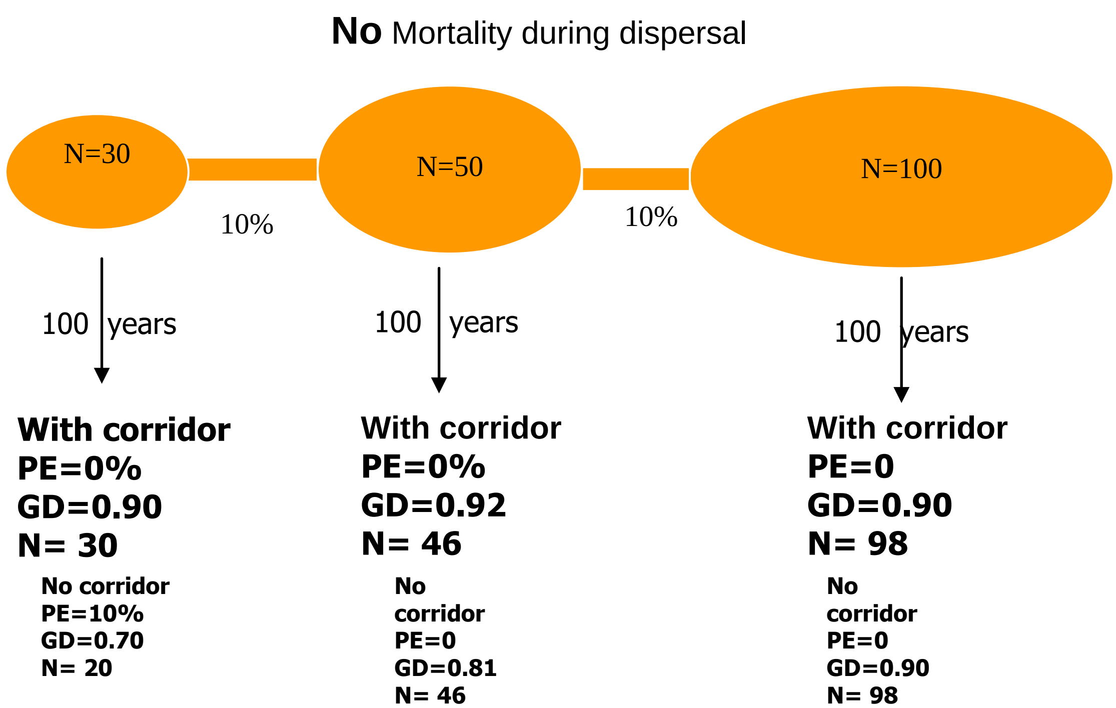



**Figure 6.21.** Impact of corridor between fragments lowland tapirs. Each year 10% of tapirs aged 2 to 6 years old can disperse to a neighboring population. Dispersing tapirs do not get killed while dispersing. Results from VORTEX simulation are: Probability of Extinction (PE), Genetic Diversity (GD), and mean number of animals N in 100 years.

However, if dispersing animals have higher mortality rates, then the impact of corridors will be quite different. If, for example, dispersing tapirs have to cross a road, or become an easier target for hunters, then mortality rates of dispersing animals will increase. A model where dispersing tapirs have a 50% chance of survival was tested (Figure 6.22). In this case, according to the model, the effects of corridors will be negative overall. Due to the corridors, tapirs in the three populations have over 70% chance of becoming extinct.

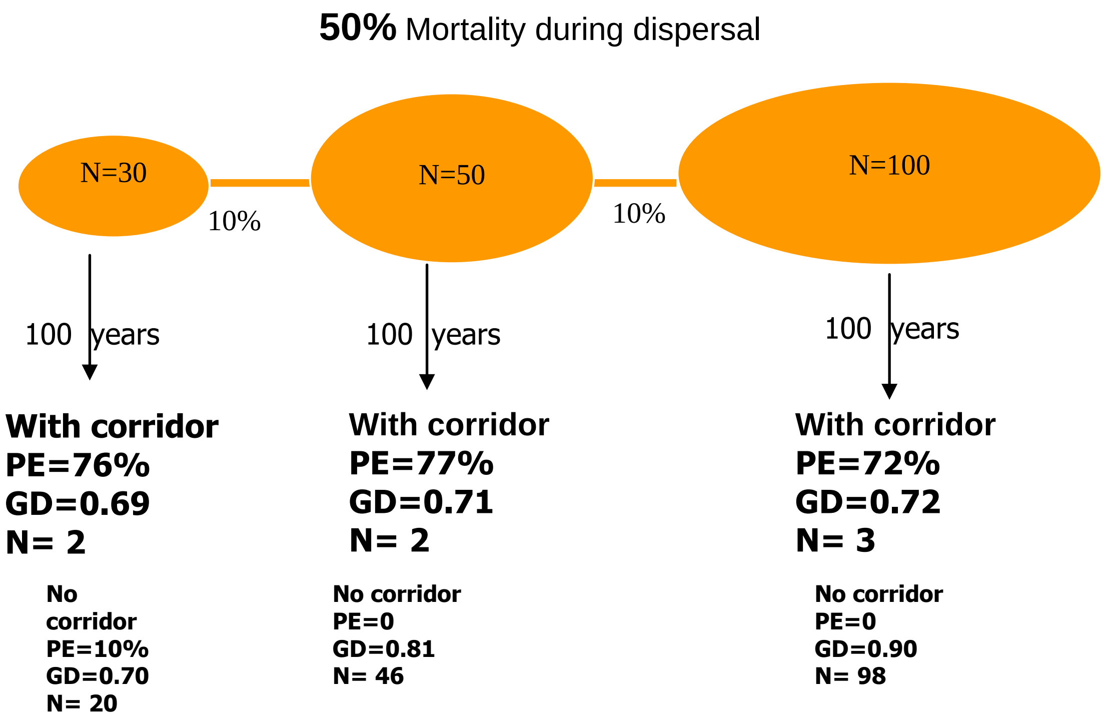



**Figure 6.22.** Impact of corridor between fragments lowland tapirs. Each year 10% of tapirs aged 2 to 6 years old can disperse to a neighboring population. Dispersing tapirs have a **50%** chance of getting killed while dispersing. Results from VORTEX simulation are: Probability of Extinction (PE), Genetic Diversity (GD), and mean number of animals N in 100 years.

## CONCLUSIONS

The creation of biological corridors between fragments may not always be the best conservation action. Linking populations of lowland tapirs between forest fragments can in fact cause the extinction of the meta-population. Dangers such as exposure to disease, increase in hunting, road kill or other dangers must be taken into account. If animals that use the corridors do not experience increased mortality rates, corridors can be important tools for maintaining long term genetically viable populations of lowland tapirs in smaller forest fragments.

**Are establishing corridors a good strategy to prevent extinction of tapirs from fragmented populations?** Corridors can prevent or cause the extinction of tapir populations in fragments depending on the mortality rates of dispersing individuals.

**References:** The references for section 6 are included at the end of each case study.


Baker, A.B. (1920) Breeding of the Brazilian Tapir. *Journal of Mammalogy*, 1, 143-144.

Barongi, R.A. (1993) Husbandry and conservation of tapirs. *International Zoo Year Book*, 32, 7-15.

Bodmer, R.E., Eisenberg, J.F., & Redford, K.H. (1997) Hunting and the likelihood of extinction of Amazonian mammals. *Conservation Biology*, 11, 460-466.

Cullen Jr, L., Bodmer, E.R., & Valladares-Padua, C. (2001) Ecological consequences of hunting in Atlantic forest patches, Sao Paulo, Brazil. *Oryx*, 35, 137-144.

Cullen Jr., L., Bodmer, R.E., & Padua, C.V. (2000) Effects of hunting in habitat fragments of the Atlantic forests, Brazil. *Biological Conservation*, 95, 45-56.

Gavin, M.C. (2007) Foraging in the fallows: hunting patterns across a successional continuum in the Peruvian Amazon. *Biological Conservation*, 134, 64-72.

Lacy, R.C. (1993) Vortex: a computer simulation model for population viability analysis. *Wildlife Research*, 20, 45-65.

Lacy, R.C. (2000) Structure of the Vortex simulation model for population viability analysis. *Ecological Bulletins*, 48, 191-203.

Lizcano, D., Medici, E.P., Montenegro, O., Carrillo, L., Camacho, A., & Miller, P. (2005). Taller de Conservacion de Danta de Montana. Reporte Final. IUCN/SSC Conservation Breeding Specialist Group, Apple Valley, MN, USA.

Medici, E.P., Carrillo, L., Montenegro, O.L., Miller, P.S., Carbonell, F., Chassot, O., Cruz-Aldán, E., García, M., Estrada-Andino, N., Shoemaker, A.H., & Mendoza, A. (2006). Taller de Conservación de la Danta Centroamericana: Reporte Final. IUCN/SSC Tapir Specialist Group (TSG) & IUCN/SSC Conservation Breeding Specialist Group (CBSG), Apple Valley, MN, USA.

Medici, E.P., Lynam, A., Boonratana, R., Kawanishi, K., Hawa Yatim, S., Traeholt, C., Holst, B., & Miller, P.S. (2003). Malay Tapir Conservation Work. Final Report. IUCN/SSC Conservation Breeding Specialist Group, Apple Valley, MN, USA.

Miller, P.S. & Lacy, R.C. (2003). Vortex: a stochastic simulation of the extinction process. Version 9 User's Manual. Conservation Breeding Specialist Group (SSC/IUCN), Apple Valley, MN.

Milner-Gulland, E.J., Bennett, E.L., Abernethy, K., Bakarr, M., Bodmer, R.E., Brashares, J., Cowlishaw, G., Elkan, P., Eves, H., Fa, J., Peres, C., Roberts, C., Robinson, J., Rowcliffe, M., & Wilkie, D. (2003) Wild meat: the bigger picture. *Trends in Ecology and Evolution*, 18.

Oli, M.K. & Dobson, F.S. (2003) The relative importance of life-history variables to population growth rate in mammals:. *The American Naturalist*, 161, 422-440.

Peres, C.A. (2000) Effects of subsistence hunting on vertebrate community structure in Amazonian forest. *Conservation Biology*, 14, 240-253.

Ralls, K., Ballou, J.D., & Templeton, A.R. (1988) Estimates of lethal equivalents and the cost of inbreeding in mammals. *Conservation Biology*, 10, 769-775.

Robinson, J.G. & Eisenberg, J.F. (1985) Group size and foraging habits of the collared peccaries *Tayassu tajacu*. *Journal of Mammalogy*, 66, 153-155.

Robinson, J.G. & Redford, K.H. (1986) Body size, diet, and population density of Neotropical forest mammals. *American Naturalist*, 128, 665.

# Lowland Tapir (*Tapirus terrestris*) Conservation Workshop

## Population and Habitat Viability Assessment (PHVA)

### Sorocaba, São Paulo, Brazil
### 15 to 19 April, 2007

# LIST OF PARTICIPANTS

# CBSG FACILITATORS AND MODELERES


## LEANDRO JERUSALINSKY

Chico Mendes Institute for the Conservation of Biodiversity (ICMBio), Center for the Protection of Brazilian Primates (CPB)
Ph.D. Student, Department of Zoology, Federal University of the State of Paraíba (UFPB), Brazil
Facilitator, IUCN/SSC Conservation Breeding Specialist Group (CBSG) - Brazilian Network
Praça Anthenor Navarro, 05, Varadouro, João Pessoa, CEP: 58.010-480, Paraíba, Brasil
E-mail: leandro.jerusalinsky@ibama.gov.br

## ANDERS GONÇALVES DA SILVA

Ph.D. Post-Doctoral Student, University of British Columbia (UBC), Canada
Coordinator, Genetics Committee, IUCN/SSC Tapir Specialist Group (TSG)
Modeler, IUCN/SSC Conservation Breeding Specialist Group (CBSG) - Brazilian Network
E-mail: anders.goncalvesdasilva@ubc.ca

## ARNAUD DESBIEZ

Ph.D. Royal Zoological Society of Scotland (RZSS), Edinburgh Zoo
Associate Researcher, EMBRAPA Pantanal, Brazil
Modeler, IUCN/SSC Conservation Breeding Specialist Group (CBSG) - Brazilian Network
Rua América, 1.090, Centro, Corumbá CEP: 79300-070, Mato Grosso do Sul, Brasil
Tel. & Fax: +55-67-3232-5842 / E-mail: adesbiez@hotmail.com

## BOB LACY

Ph.D. President, IUCN/SSC Conservation Breeding Specialist Group (CBSG) - Headquarters
12101 Johnny Cake Ridge Road, Apple Valley, MN 55124-8151, United States
E-mail: rlacy@ix.netcom.com

## ONNIE BYERS

Ph.D. Executive Director, IUCN/SSC Conservation Breeding Specialist Group (CBSG) - Headquarters
12101 Johnny Cake Ridge Road, Apple Valley, MN 55124-8151, United States
E-mail: onnie@cbsg.org

## ARGENTINA (4)


### VIVIANA BEATRIZ QUSE
D.V.M. Senior Veterinarian, Temaikén Foundation
Species Coordinator, Lowland Tapir, IUCN/SSC Tapir Specialist Group (TSG)
Zoo Committee Coordinator, IUCN/SSC Tapir Specialist Group (TSG)
Ruta 25 y km 0.700, Escobar, 1625, Buenos Aires, Argentina
Tel. & Fax: +54-3488-436805 / E-mail: vquse@temaiken.com.ar

### AGUSTÍN PAVIOLO
Ph.D. Student, CONICET- LIEY, National University of Tucumán
Member, IUCN/SSC Tapir Specialist Group (TSG)
Av. Córdoba 464 CP 3370 Puerto Iguazú Misiones, Argentina
Tel.: +54-3757-423176 / Fax: +54-3757-422370 / E-mail: paviolo4@arnet.com.ar

### DIEGO VARELA
Ph.D. Student, University of Buenos Aires / Conservation Argentina
Member, IUCN/SSC Tapir Specialist Group (TSG)
Salta 117, Puerto Iguazú, Misiones, N3370FSC, Argentina
Tel.: +54-3757-422964 / E-mail: diegomv@arnet.com.ar

### FLAVIO MOSCHIONI
Biologist, Administration of National Parks, Northwest Regional Delegation
Santa Fé 23 (CP 4400), Salta, Argentina
Tel.: +54-387-431-0255 / E-mail: calancate@yahoo.com.ar


## BOLIVIA (1)


### GUIDO AYALA
Wildlife Biologist, WCS - Wildlife Conservation Society – Bolivia, Northern La Paz Living Landscape Program
Member, IUCN/SSC Tapir Specialist Group (TSG)
Calle 13 Obrajes, No. 594, Correo Postal 3-35181 S.M., La Paz, Bolivia
Tel.: +591-2-211-7969 / Fax: +591-2-278-6642 / E-mail: gayala@wcs.org

## BRAZIL (33)

### PATRÍCIA MEDICI

M.Sc. Research Coordinator, Lowland Tapir Conservation Initiative, IPÊ - Institute for Ecological Research, Brazil
Ph.D. Student, Durrell Institute of Conservation and Ecology (DICE), University of Kent, United Kingdom
President, IUCN/SSC Tapir Specialist Group (TSG)
Coordinator, IUCN/SSC Conservation Breeding Specialist Group (CBSG) - Brazilian Network
Rua América, 1.090, Centro, Corumbá CEP: 79300-070, Mato Grosso do Sul, Brazil
Tel. & Fax: +55-67-3232-5842 / Celular: +55-18-8119-3839 / E-mail: epmedici@uol.com.br; medici@ipe.org.br

### PAULO ROGERIO MANGINI

D.V.M. M.Sc. Associate Researcher, IPÊ - Institute for Ecological Research, Brazil
Associate Researcher, TRÍADE – Brazilian Institute for Conservation Medicine
Ph.D. Student, Environment and Development, Federal University of Paraná (UFPR)
Member, IUCN/SSC - Tapir Specialist Group (TSG)
Member, IUCN/SSC - Veterinary Specialist Group (VSG)
R. Prof. Álvaro Jorge, 795, Apto. 15C BL 3, Curitiba CEP: 80320-040, Paraná, Brazil
Tel.: +55-41-3244-2454 / Celular: +55-41-9996-5138 / E-mail: pmangini@ipe.org.br; pmangini@uol.com.br

### JOARES A. MAY JR.

D.V.M. Maned Wolf Project at Serra da Canastra, Pró-Carnívoros Institution, Brazil
Associate Researcher, Lowland Tapir Conservation Initiative, IPÊ - Institute for Ecological Research, Brazil
E-mail: canastra.joares@procarnivoros.org.br

### JOSÉ MARIA DE ARAGÃO

Field Assistant, Lowland Tapir Conservation Initiative, IPÊ - Institute for Ecological Research, Brazil
E-mail: epmedici@uol.com.br

### ADAUTO NUNES VELOSO

D.V.M. Director, Municipal Zoological Park "Quinzinho de Barros"
Rua Teodoro Kaisel, 883, Sorocaba, São Paulo, Brazil
Tel. & Fax: +55-15-3227-5454 Ext. 26/27 / E-mail: anunes@directnet.com.br

### RODRIGO TEIXEIRA

D.V.M. Veterinarian, Municipal Zoological Park "Quinzinho de Barros"
Rua Teodoro Kaisel, 883, Sorocaba, São Paulo, Brazil
Tel. & Fax: +55-15-3227-5454 Ext. 26/27 / E-mail: rhftzoo@hotmail.com

### CECÍLIA PESSUTTI

Biologist, Responsible for the Mammal Sector, Municipal Zoological Park "Quinzinho de Barros"
Rua Teodoro Kaisel, 883, Sorocaba, São Paulo, Brazil
Tel. & Fax: +55-15-3227-5454 Ext. 26/27 / E-mail: cpessutti@ig.com.br; c_pessutti@yahoo.com.br

### VALDIR DE ALMEIDA RAMOS JR.

Biologist, Sub-manager of the Mammal and Reptile Sector, RIOZOO Foundation, Rio de Janeiro, Brazil
Tel. & Fax: +55-21-3878-4243; +55-21-2204-3475 / Celular: +55-21-9104-4241 / E-mail: vramosjr@gmail.com

### GABRIELLA LANDAU-REMY

Biologist, Responsible for Animal Welfare Program, RIOZOO Foundation, Rio de Janeiro, Brazil
Tel. & Fax: +55-21-3878-4243; +55-21-2204-3475 / Celular: +55-21-9989-1067 / E-mail: gabiremy@gmail.com

### CATIA DEJUSTE DE PAULA

D.V.M. Chief of the Veterinary Sector, CEMAS - São Paulo Zoological Park Foundation
Tríade - Brazilian Institute for Conservation Medicine
Alameda Joaquim Eugênio de Lima, 712, AP. 807, Jardim Paulista, CEP: 01403-000, São Paulo, São Paulo, Brazil
Tel.: +55-11-3285-2731; +55-11-6952-0105 / Celular: +55-11-9968-0950 / E-mail: catiadp@hotmail.com

**MARCELO DA SILVA GOMES**
D.V.M. Director, São Bernardo do Campo Zoo, São Paulo, Brazil
Tel.: +55-11-4354-9087 / Celular: +55-11-9617-9367 / E-mail: zoosbc.marcelo@gmail.com

**LUIZ ANTÔNIO DA SILVA PIRES**
Director, Zoological Park of Bauru Municipal Administration, São Paulo, Brazil
Tel.: +55-14-3203-5229 / E-mail: luizpires202@hotmail.com; luiz.pires@terra.com.br

**TÂNIA RIBEIRO JUNQUEIRA BORGES**
Director for Conservation and Research, Brasília Zoological Gardens, Brasília, Distrito Federal, Brazil
E-mail: dicon@zoo.df.gov.br

**CASSIANA JAVESSINE**
D.V.M. Antapaca Breeding Center
Rua Jataí, 1150, Uberlândia, CEP: 38.400-632, Minas Gerais, Brazil
Tel.: +55-34-3218-1232 / E-mail: cassianajavessine@yahoo.com.br

**KEVIN FLESHER**
Member, IUCN/SSC Tapir Specialist Group (TSG)
Rua Rui Barbosa, 47, Ituberá, CEP: 45435-000, Bahia, Brazil
Tel.: +55-73-3256-2252 / E-mail: KevinFlesher@yahoo.com

**ANDRESSA GATTI**
Professor, Faculty of Applied Sciences "Sagrado Coração" - UNILINHARES
Researcher, Institute of Teaching, Research and Environmental Preservation Marcos Daniel - IMD
R. Fortunato Ramos, 123, Santa Lucia, Vitória, Espírito Santo, CEP: 29055-290, Brazil
Tel.: +55-27-9853-9559 / Fax: +55-27-3041-3737 / E-mail: gatti.andressa@gmail.com; andressagatti@hotmail.com

**EDSEL AMORIM MORAES JÚNIOR**
Coordinator of General Programs, BIOTRÓPICOS – Wildlife Research Institute
Rua Zito Soares 22, Bairro Camargos, Belo Horizonte, Minas Gerais, CEP: 30532-260, Brazil
Tel. & Fax: +55-31-9212-6802; +55-31-3362-1723/ E-mail: edsel@biotropicos.org.br; edsel.bhz@terra.com.br

**JOSÉ LUIS PASSOS CORDEIRO**
Researcher of the Institutional Program on Biodiversity and Health, Oswaldo Cruz Foundation (FIOCRUZ)
Rua Timbiras, 210, São Francisco, Niterói, CEP 24360-250, Rio de Janeiro, Brazil
Tel.: +55-21-2704-9570; +55-21-2598-2666 / E-mail: zeluis@fiocruz.br

**RENATO DE OLIVEIRA AFFONSO**
Assistant Professor, Laboratory of Vertebrates, Department of Biological Sciences
State University of the Southwest of Bahia (UESB) - Jequié Campus, Bahia
Caixa Postal 111, Jequié, Bahia, CEP: 45206-190, Brazil
Tel.: +55-73-3528-9657 / E-mail: renato.tapirus@bol.com.br

**EDUARDO MARTINS VENTICINQUE**
Wildlife Conservation Society, Andes Amazon Conservation Program
Rua dos Jatobas, 274 - Coroado III, Manaus, CEP: 69085-380, Amazonas, Brazil
Tel.: +55-92-3249-1522 / E-mail: eventicinque@wcs.org

**LEANDRO M. SCOSS**
BIOTRÓPICOS - Wildlife Research Institute
Rua Zito Soares, 22, Bairro Camargos, Belo Horizonte, CEP: 30532-260, Minas Gerais, Brazil
Celular: +55-31-9619-7530 / E-mail: leandroscoss@gmail.com

**DANIEL BRITO**
Biodiversity Analyst - Species, Center for Applied Biodiversity Science, Conservation International
2011 Crystal Drive, Suite 500, Arlington, VA 22202, United States
Tel: +1-703-341-2459 / E-mail: d.brito@conservation.org; brito.dan@gmail.com

**ELIAS SADALLA FILHO**
President, KASA - Kouprey Animal's Sanctuaries Friends
Avenida Iraí, 1423, São Paulo, São Paulo, CEP: 04082-004, Brazil
Tel.: +55-11-5054-3189 / Celular: +55-11-9986-9823 / E-mail: esadalla@uol.com.br; elias@kasa.org.br

**ANDRÉA SOARES PIRES**
Director, Morro do Diabo State Park, SMA/IF – Forest Institute of São Paulo State
Caixa Postal 091, CEP 19280-000, Teodoro Sampaio, São Paulo, Brazil
Tel.: +55-18-3282-1599; +55-18-3282-4011 / E-mail: deapires@yahoo.com.br

**MARCOS ADRIANO TORTATO**
Sub-Coordinator of the Visitors Centre, Serra do Tabuleiro State Park
CAIPORA – Cooperative for the Conservation of Nature
R. Luiz Oscar de Carvalho, 75, Res. Itambé B16-01, Bairro Trindade, Florianópolis, Santa Catarina, 88036-400, Brazil
Tel.: +55-48-9982-1350 / E-mail: marcostortato@hotmail.com

**MARCELO LIMA REIS**
Specialized Technician, Coordination of Protection of Fauna Species (COFAU) / IBAMA
Edifício Sede do IBAMA, Bloco A / Sub-Solo DIFAP/CGFAU/COFAU, Brasília, Distrito Federal, CEP: 70800-900, Brazil
Tel.: +55-61-3316-1270 / E-mail: Marcelo-Lima.Reis@ibama.gov.br

**ALEXANDRE DE MATOS MARTINS PEREIRA**
Environmental Analyst, Serra da Bodoquena National Park- IBAMA, Mato Grosso do Sul
Rua Olívio Jacques, 795, Vila Donária, Bonito, Mato Grosso do Sul, CEP: 79290-000, Brazil
Tel.: +55-67-3255-1765 / Fax: +55-67-3255-2434 / E-mail: alexandre.pereira@ibama.gov.br

**OSWALDO DE CARVALHO JR**
Researcher, IPAM – Institute of Environmental Research of the Amazonia
Ph.D. Student, Durrell Institute of Conservation and Ecology (DICE), University of Kent, United Kingdom
Av. Nazarre 669, Belém, Pará, CEP: 66035-170, Brazil
Tel. & Fax: +55-91-276-3576 / E-mail: oswaldo@ipam.org.br; oc27@kent.ac.uk

**CLAUDIA REGINA SILVA**
Institute of Technological and Scientific Research of the Amapá State (IEPA)
Rodovia JK KM 10, S/N, Fazendinha, Macapá, CEP: 68912-250, Amapá, Brazil
Tel.: +55-96-9902-7039 / E-mail: paakram@yahoo.com.br; claudia.silva@iepa.ap.gov.br

**RALPH ERIC THIJL VANSTREELS**
Veterinarian Student, Faculty of Veterinary Medicine and animal Science, University of São Paulo (USP), Brazil
Rua Joana Vicente de Jesus, 227, Jd. Esther, São Paulo, SP, CEP: 05373-020, Brazil
Tel.: +55-11-3781-2147 / Celular: +55-11-9917-3082 / E-mail: ralph_vanstreels@yahoo.com.br

**LUIZ GUSTAVO RODRIGUES OLIVEIRA SANTOS**
Master's student in Ecology and Conservation, Federal University of Mato Grosso do Sul (UFMS)
EMBRAPA-Pantanal, Corumbá, Mato Grosso do Sul
Rua Candelária, 768, Casa 3, Vila Olinda, Campo Grande, Mato Grosso do Sul, Brazil
Tel.: +55-48-3234-7891; +55-48-9928-4552 / E-mail: gu_tapirus@hotmail.com

**MAURÍCIO TALEBI GOMES**
Pró-Muriqui Association, São Paulo, Brazil
E-mail: talebi@promuriqui.org.br; talebi40@hotmail.com; talebi40@gmail.com

**ADRIANE APARECIDA DE MORAIS**
CNPq / CT – Amazônia Scholarship Holder, National Institute of Amazonian Research (INPA)
Rua das Papoulas, 284, Conjunto Tiradentes, Bairro Aleixo, CEP: 69083-300, Manaus, Amazonas, Brazil
Tel.: +55-92-3248-5452; +55-92-8118-6582 / E-mail: adriane.morais@pq.cnpq.br; adriane_masto@yahoo.com.br

## COLOMBIA (6)

**OLGA LUCÍA MONTENEGRO**
Professor, National University of Colombia (UNAL)
Country Coordinator, Colombia, IUCN/SSC Tapir Specialist Group (TSG)
Av. 1 de Mayo, No. 39-49 Sur, Bogotá, Cundinamarca, Colombia
Tel.: +57-1-203-5582 / E-mail: olmdco@yahoo.com

**JULIANA RODRÍGUEZ ORTIZ**
Institute of Natural Sciences, National University of Colombia (UNAL)
Country Coordinator, Colombia, IUCN/SSC Tapir Specialist Group (TSG)
Cra 25, No. 139-36, Bogotá, Colombia
Tel.: +57-1-615-5237 / E-mail: mjuli2@gmail.com

**CARLOS ALBERTO PEDRAZA**
Institute of Research on Biological Resources "Alexander von Humboldt"
Member, IUCN/SSC Tapir Specialist Group (TSG)
Calle 138 Bis # 25-37, Bogotá, Cundinamarca, Colombia
Tel.: +57-1-626-1098 / E-mail: cpedraz@gmail.com

**CAROLINA MARIA LOZANO BARRERO**
Professor, Faculty of Environment and Natural Resources, District University Francisco Jose de Caldas
Member, IUCN/SSC Tapir Specialist Group (TSG)
Calle 24 D Bis No. 72-42, Bogotá, Colombia
E-mail: carolina_lozano_b@yahoo.com; alozano@multiphone.net.co

**ANDRÉS ARIAS ALZATE**
Biologist, Laboratory of Mammal Evolutionary Ecology, Institute of Biology, University of Antioquia, Colombia
Member, IUCN/SSC Tapir Specialist Group (TSG)
E-mail: andresarias3@yahoo.es

**JOSE SINISTERRA SANTANA**
Wildlife Management and Conservation & Scientific Research on Biological Diversity, Technical Sub-direction
Special Administrative Unit of the System of Natural National Parks of Colombia (UAESPNN)
Carrera 10 No. 20-30, Piso 3, Bogotá, Cundinamarca, Colombia
Tel.: +57-1-341-0265; +57-1-243-1850 / E-mail: jsinisterra@parquesnacionales.gov.co

# ECUADOR (5)


### ANDRÉS TAPIA
Technological Center of Amazonian Resources of the Organization of Indigenous Villages of Pastaza (OPIP) - CENTRO FÁTIMA
Member, IUCN/SSC Tapir Specialist Group (TSG)
Km 9 de la vía Puyo hacia Tena, Puyo, Pastaza, Casilla Postal 16-01-800, Ecuador
Tel.: +593-03-288-7399; +593-02-254-4799 / E-mail: centrofatima@andinanet.net; centrofati@panchonet.net

### VICTOR MANUEL UTRERAS BUCHELI
Biologist, Field Coordinator, Wildlife Conservation Society - Ecuador
San Francisco 441 y Mariano Echeverría, Quito, Ecuador
E-mail: vutreras@wcs.org

### LUIS FERNANDO SANDOVAL CAÑAS
Biological Sciences Graduate, Biology School, Central University of Ecuador
Member, IUCN/SSC Tapir Specialist Group (TSG)
Javier Loyola y Nueva Avenida Oriental, Conjunto Carolina 2, Casa # 38, Quito, Pichincha, Ecuador
Tel.: +593-22-320-548 / E-mail: lfsandoval_c@hotmail.com

### JOSÈ DIONICIO MACHOA SANTI
Manager of Natural Resources of Sarayaku Tayjasaruta, Organization of Indigenous Villages of Pastaza
Project for the Conservation of Tapirs in the Sarayaku Territory
Management of Biodiversity in the Territory of Sarayaku, Ecuador
E-mail: josemachoa@yahoo.es

### LEONARDO ORDOÑEZ DELGADO
Coordinator, Project of Conservation Corridors, ArcoIris Ecological Foundation
Country Coordinator, Ecuador, IUCN/SSC Tapir Specialist Group (TSG)
Segundo Cueva Celi 03-15 y Clodoveo Carrión, Casilla Postal 11-01-860, Loja, Ecuador
Tel.: +593-7-257-7449 Ext. 116 / Fax: +593-7-257-2926 / E-mail: paramos@arcoiris.org.ec; tsg.ecuador@gmail.com


# GUYANAS (4)


### BENOIT DE THOISY
D.V.M. Kwata Association
Country Coordinator, Guyanas, IUCN/SSC Tapir Specialist Group (TSG)
BP 672, F-97335 Cayenne cedex, French Guyana - France
Tel. & Fax: +594-25-43-31 / E-mail: thoisy@nplus.gf; bdethoisy@pasteur-cayenne.fr

### LAURE DEBEIR
Scientific Research Engineer Assistant, Technical Support (VCAT)
National Office of the Game and of the Wild Fauna - ONCFS
6 Avenue de France, 97379 Kourou, Guyane Française - France
Tel.: +594-06 94 00 69 87 / E-mail: laure.debeir@oncfs.gouv.fr; lordebeir@yahoo.fr

### CLAUDINE SAKIMIN
Nature Conservation Division, Suriname Forest Service, Suriname
Tel.: +597-479431 / Fax: +597-422555 / E-mail: lbbnb@yahoo.com; claudinesakimin@yahoo.com

### KRISNA GAJAPERSAD
Biodiversity Analyst, Conservation International Suriname
Kromme Elleboogstraat 20, Paramaribo, Suriname
Tel.: +597-421305 / Celular: +597-8590346 / E-mail: kgajapersad@conservation.org; kgajapersad@yahoo.com

## PARAGUAY (4)


**MIGUEL A. MORALES**
Protected Areas Management Advisor, People, Protected Areas and Conservation Corridors, Conservation International
Country Coordinator, Paraguay, IUCN/SSC Tapir Specialist Group (TSG)
2011 Crystal Drive, Suite 500, Arlington, VA 22202, United States
Tel.: +1-703-341-2637 / E-mail: mamorales@conservation.org

**FREDY RAMIREZ PINTO**
Technician of the Research Department, Moisés Bertoni Foundation
Prócer Argüello No 208 and/ Avda. Mcal. López y Boggiani, Casilla de correo 714, Asunción, Paraguay
Tel.: +595-21-608-740; +595-21-608-742 / E-mail: framirez@mbertoni.org.py

**MAGDALENA CUBAS**
Yacyretá Binational Entity, Yacyretá Private natural Reserve
Sede Ayolas - Centro Administrativo, Gral. Diaz entre Ayolas y Montevideo Nº 831, Asunción, Paraguay
E-mail: magdalena.pirelli@eby.gov.py

**EVELIO NARVEZ**
Yacyretá Binational Entity, Atinguy Faunal Refuge, Paraguay
E-mail: narvaez@itacom.com.py


## PERU (2)


**MATHIAS TOBLER**
Ph.D. Student, Botanical Research Institute of Texas (BRIT)
Member, IUCN/SSC Tapir Specialist Group (TSG)
509 Pecan Street, Fort Worth, Texas 76102, United States
Tel.: +1-817-332-4441 Ext. 34 / E-mail: matobler@gmx.net

**LIZETTE BERMUDEZ LARRAZABAL**
General Curator, Huachipa Recreational Zoological Park
Member, IUCN/SSC Tapir Specialist Group (TSG)
Av. Las Torres s/n, Ate Vitarte, Lima, Peru
Tel.: +51-1-356-3141 Ext.120 / Fax: +51-1-356-3141 Ext.115 / E-mail: lizettelarrazabal@yahoo.com


## VENEZUELA (2)


**LUIS GUILLERMO AÑEZ GALBAN**
D.V.M. Director, Zoo of South Park of the Maracaibo City
Coordinator, Venezuela Captive Tapirs Working Group (GTTV)
Vía a la Cañada, Km 10 1/2, Municipio San Francisco, Ciudad de Maracaibo, Estado Zulia, Venezuela
Tel.: 00-58-0261-731-3565; 00-58-0261-611-0772 / E-mail: galbanluis97@yahoo.com; galbanluis70@hotmail.com

**PILAR ALEXANDER BLANCO MÁRQUEZ**
D.V.M. Technical Director, National Foundation of Zoological Parks and Aquaria (FUNPZA) – Ministry of Environment (MARN)
Member, IUCN/SSC Tapir Specialist Group (TSG)
Torre Sur, Ministerio del Ambiente, Centro Simón Bolívar, Piso 6, El Silencio, Codigo Postal 1010, Caracas, Venezuela
Tel.: +58-212-408-2161; +58-212-4082114 / Fax: +58-212-408-2163 / Celular: +58-414-458-8374
E-mail: pblanco@minamb.gob.ve; albla69@yahoo.com.mx; albla69@hotmail.com

# INTERNATIONAL PARTICIPANTS (7)


## ALBERTO MENDOZA

President, Association of Zoos and Aquariums (AZA) Tapir Taxon Advisory Group (TAG)
Member, IUCN/SSC Tapir Specialist Group (TSG)
Houston, Texas 77030, United States
E-mail: alumen@aol.com

## LEONARDO SALAS

Animal Population Biologist, Editor, *Tapir Conservation* Newsletter, IUCN/SSC Tapir Specialist Group (TSG)
2215 NW Canterbury Dr., Roseburg, OR 97470, United States
Tel.: +1-541-673-4664 / E-mail: LeoASalas@netscape.net

## GILIA ANGELL

User Interface Designer, Amazon.com
Coordinator, Marketing Committee & Webmaster, IUCN/SSC Tapir Specialist Group (TSG)
270 Dorffel Drive East, Seattle, Washington 98112, United States
Tel.: +1-206-266-2613; +1-206-568-1655 / Fax: +1-206-266-1822 / E-mail: gilia_angell@earthlink.net

## JEFFREY FLOCKEN

Director, Washington DC Office, International Fund for Animal Welfare (IFAW)
Member, IUCN/SSC Tapir Specialist Group (TSG)
1350 Connecticut Avenue, NW, Suite 1220, Washington DC  20036, United States
Tel.: +1-202-536-1904; +1-202-296-3860 / Fax: +1-202-296-3802 / E-mail: JFlocken@ifaw.org

## AUDE DESMOULINS

Assistant of Direction, Beauval ZooPark
Lowland Tapir Studbook Keeper, European Association of Zoos and Aquaria (EAZA) Tapir Taxon Advisory Group (TAG)
Member, IUCN/SSC Tapir Specialist Group (TSG)
41110 St. Aignan, France
Tel.: +00-33-0-2-54-75-74-22 / Fax: +00-33-0-2-54-75-50-01 / E-mail: aude.desmoulins@zoobeauval.com

## OLIVIER CHASSOT

Great Green Macaw Research and Conservation Project, San Juan - La Selva Biological Corridor
Research Coordinator, Tropical Science Center
PO Box 8-3870-1000 San José, Costa Rica
Tel.: +506-253-3267 / Fax: +506-253-5449 / E-mail: investigacion@cct.or.cr

## SHERYL TODD

President, Tapir Preservation Fund (TPF)
Member, IUCN/SSC Tapir Specialist Group (TSG)
P.O. Box 118, Astoria, Oregon 97103, United States
Tel.: +1-503-325-3179; +1-503-338-8646 / E-mail: tapir@tapirback.com; oregontapir@yahoo.com

## LEE SPANGLER

Tapir Preservation Fund (TPF), United States

# Lowland Tapir (*Tapirus terrestris*) Conservation Workshop

## Population and Habitat Viability Assessment (PHVA)

### Sorocaba, São Paulo, Brazil
### 15 to 19 April, 2007

# GLOSSARY OF ACRONYMS

**ALPZA** – Asociación Latinoamericana de Parques Zoológicos y Acuários [Latin American Association of Zoological Parks and Aquariums]

**AZA** – Association of Zoos & Aquariums, United States

**AAZK** – American Association of Zoo Keepers, United States

**CBSG** – Conservation Breeding Specialist Group

**CBSS** – Corredor Biológico San Juan - La Selva, Costa Rica [San Juan-La Selva Biological Corridor]

**CI** – Conservation International

**CITES** – Convention on International Trade in Endangered Species of Wild Flora and Fauna

**CU** – Conservation Unit

**DB** – Data Bank

**EAZA** – European Association of Zoos & Aquaria

**EV** – Environmental Variability (VORTEX Parameter)

**GIS** –Geographical Information System

**GO** – Governmental Organization

**IAZE** – International Association of Zoo Educators, United States

**IBAMA** – Instituto Brasileiro do Meio Ambiente and dos Recursos Naturais Renováveis [Brazilian Institute for the Environment and Renewable Natural Resources].

**IF** – Instituto Florestal do Estado de São Paulo (Brasil) [Forest Institute of São Paulo State (Brazil)]

**IFAW -** International Fund for Animal Welfare, United States

**INRENA** – Instituto Nacional de Recursos Naturais (Peru) [National Institute of Natural Resources (Peru)]

**IPÊ** – Instituto de Pesquisas Ecológicas (Brazil) [Institute for Ecological Research (Brazil)]

**IUCN** – International Union for the Conservation of Nature

**K** – Carrying Capacity (VORTEX Parameter)

**LE –** Lethal Equivalent (VORTEX Parameter)

**MAVDT** – Ministerio del Ambiente, Vivienda y Desarrollo Territorial (Colombia) [Ministry of Environment, Housing and Land Development (Colombia)]

**NGO** – Non-Governmental Organization

**NP** – National Park

**PA** – Protected Area

**PHVA** – Population and Habitat Viability Assessment

**PVA** – Population Viability Analysis

**RPPN** – Reserva Particular do Patrimônio Natural (Brasil) [Private Reserve of Natural Heritage (Brazil)]

**SMA** – Secretaria do Meio Ambiente (Brasil) [Secretary of Environment (Brazil)]

**SPZ** – Sociedade Paulista de Zoológicos (Brasil) [São Paulo Association of Zoos (Brazil)]

**SSC** – Species Survival Commission

**SZB** – Sociedade de Zoológicos do Brasil (Brasil) [Brazilian Association of Zoos (Brazil)]

**TAG** – Taxon Advisory Group (American and European)

**TNC** – The Nature Conservancy, United States and other countries

**TPF** – Tapir Preservation Fund, United States

**TSG** – Tapir Specialist Group

**TSGCF** – Tapir Specialist Group Conservation Fund

**UAESPNN** – Unidad Administrativa Especial del Sistema de Parques Nacionales Naturales de Colombia [Special Administrative Unit of the System of Natural National Parks of Colombia]

**UNAL** – Universidad Nacional de Colombia (Colombia) [National University of Colombia]

**USFWS** – United States Fish & Wildlife Service, United States

**USP** – Universidade de São Paulo (Brasil) [São Paulo University (Brazil)]

**WAZA** – World Association of Zoos & Aquaria, Switzerland

**WCS** – Wildlife Conservation Society

**WWF** – World Wildlife Fund

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# APPENDIX

# Simulation Modeling and Population Viability Analysis

**Jon Ballou – Smithsonian Institution / National Zoological Park**
**Bob Lacy – Chicago Zoological Society**
**Phil Miller – Conservation Breeding Specialist Group (IUCN / SSC)**

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 1993/4). 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 (see Lacy and Miller (2002), Nyhus *et al.* (2002) and Westley and Miller (2003) for more details).

## The *VORTEX* Population Viability Analysis Model

For the analyses presented here, the *VORTEX* computer software (Lacy 1993a) 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.

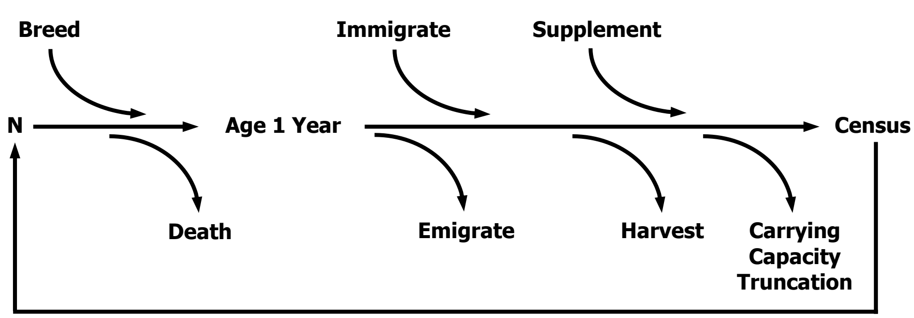
*Vortex* models loss of genetic variation in populations, by simulating the transmission of alleles from parents to offspring at a hypothetical genetic locus. Each animal at the start of the simulation is assigned two unique alleles at the locus. During the simulation, Vortex monitors how many of the original alleles remain within the population, and the average heterozygosity and gene diversity (or "expected heterozygosity") relative to the starting levels. Vortex also monitors the inbreeding coefficients of 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. (See figure above.) 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.

*VORTEX* requires a lot of population-specific data. 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 must be specified. 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 specific environment.

Further information on *VORTEX* is available in Lacy (2000) and Miller and Lacy (2003).

## VORTEX Simulation Model Timeline




Events listed above the timeline increase N, while events listed below the timeline decrease N.

## 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 that 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.

## Results

Results reported for each scenario include:

Deterministic r -- The deterministic population growth rate, a projection of the mean rate of growth of the population expected from the average birth and death rates. Impacts of harvest, inbreeding, and density dependence are not considered in the calculation. When r = 0, a population with no growth is expected; r < 0 indicates population decline; r > 0 indicates long-term population growth. The value of r is approximately the rate of growth or decline per year.

The deterministic growth rate is the average population growth expected if the population is so large as to be unaffected by stochastic, random processes. The deterministic growth rate will correctly predict future population growth if: the population is presently at a stable age distribution; birth and death rates remain constant over time and space (i.e., not only do the probabilities remain constant, but the actual number of births and deaths each year match the expected values); there is no inbreeding depression; there is never a limitation of mates preventing some females from breeding; and there is no density dependence in birth or death rates, such as a Allee effects or a habitat "carrying capacity" limiting population growth. Because some or all of these assumptions are usually violated, the average population growth of real populations (and stochastically simulated ones) will usually be less than the deterministic growth rate.

Stochastic r -- The mean rate of stochastic population growth or decline demonstrated by the simulated populations, averaged across years and iterations, for all those simulated populations that are not extinct. This population growth rate is calculated each year of the simulation, prior to any truncation of the population size due to the population exceeding the carrying capacity. Usually, this stochastic r will be less than the deterministic r predicted from birth and death rates. The stochastic r from the simulations will be close to the deterministic r if the population growth is steady and robust. The stochastic r will be notably less than the deterministic r if the population is subjected to large fluctuations due to environmental variation, catastrophes, or the genetic and demographic instabilities inherent in small populations.

P(E) -- the probability of population extinction, determined by the proportion of, for example, 500 iterations within that given scenario that have gone extinct in the simulations. "Extinction" is defined in the VORTEX model as the lack of either sex.

N -- mean population size, averaged across those simulated populations which are not extinct.

SD(N) -- variation across simulated populations (expressed as the standard deviation) in the size of the population at each time interval. SDs greater than about half the size of mean N often indicate highly unstable population sizes, with some simulated populations very near extinction. When SD(N) is large relative to N, and especially when SD(N) increases over the years of the simulation, then the population is vulnerable to large random fluctuations and may go extinct even if the mean population growth rate is positive. SD(N) will be small and often declining relative to N when the population is either growing steadily toward the carrying capacity or declining rapidly (and deterministically) toward extinction. SD(N) will also decline considerably when the population size approaches and is limited by the carrying capacity.

H -- the gene diversity or expected heterozygosity of the extant populations, expressed as a percent of the initial gene diversity of the population. Fitness of individuals usually declines proportionately with gene diversity (Lacy 1993b), with a 10% decline in gene diversity typically causing about 15% decline in survival of captive mammals (Ralls *et al.* 1988). Impacts of inbreeding on wild populations are less well known, but may be more severe than those observed in captive populations (Jiménez *et al.* 1994). Adaptive response to natural selection is also expected to be proportional to gene diversity. Long-term conservation programs often set a goal of retaining 90% of initial gene diversity (Soulé *et al.* 1986). Reduction to 75% of gene diversity would be equivalent to one generation of full-sibling or parent-offspring inbreeding.

## Literature Cited


Gilpin, M.E., and M.E. Soulé. 1986. Minimum viable populations: processes of species extinction. Pages 19 – 34 in: Soulé, M.E. (ed.). *Conservation Biology: The Science of Scarcity and Diversity*. Sunderland, MA: Sinauer Associates.

Jiménez, J.A., K.A. Hughes, G. Alaks, L. Graham, and R.C. Lacy. 1994. An experimental study of inbreeding depression in a natural habitat. *Science* 266:271-273.

Lacy, R.C. 2000. Structure of the *VORTEX* simulation model for population viability analysis. *Ecological Bulletins* 48:191-203.

Lacy, R.C. 1993b. Impacts of inbreeding in natural and captive populations of vertebrates: implications for conservation. *Perspectives in Biology and Medicine* 36:480-496.

Lacy, R.C. 1993/1994. What is Population (and Habitat) Viability Analysis? *Primate Conservation* 14/15:27-33.

Lacy, R.C., and P.S. Miller. 2002. Incorporating human activities and economics into PVA. Pages 490 – 510 in: Beissinger, S. and D. McCullough (eds.), Population Viability Analysis. University of Chicago Press, Chicago.

Miller, P.S., and R.C. Lacy. 2003. *VORTEX: A Stochastic Simulation of the Extinction Process. Version 8 User's Manual*. Apple Valley, MN: Conservation Breeding Specialist Group (SSC/IUCN).

Nyhus, P.J., F.R. Westley, R.C. Lacy, and P.S. Miller. 2002. A role for natural resource social science in biodiversity risk assessment. Society and Natural Resources 15:923-932.

Ralls, K., J.D. Ballou, and A. Templeton. 1988. Estimates of lethal equivalents and the cost of inbreeding in mammals. *Conservation Biology* 2:185-193.

Shaffer, M.L. 1981. Minimum population sizes for species conservation. *BioScience* 1:131-134.

Soulé, M., M. Gilpin, W. Conway, and T. Foose. 1986. The millennium ark: How long a voyage, how many staterooms, how many passengers? *Zoo Biology* 5:101-113.

Westley, F.W., and P.S. Miller (eds.). 2003. Experiments in Consilience: Integrating Social and Scientific Responses to Save Endangered Species. Washington, DC: Island Press.