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Volume 12 / Number 1 June 2003

# Tapir Conservation

**The Newsletter of the IUCN/SSC Tapir Specialist Group**

*Edited by Siân S. Waters and Stefan Seitz*

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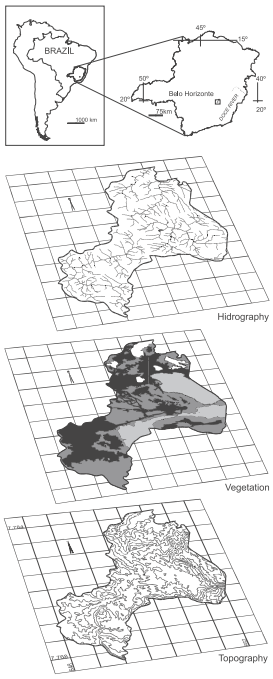
*See back cover and page 2 for details.*




Lowland tapir
(*Tapirus terrestris*)
Photo by Carolina Villegas
Medellin Zoo, Colombia

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## Contents



### Note of Correction

The conversion of the print files for the December issue of *Tapir Conservation* unfortunately lead to the loss of some letters with special characters. Most notable were omissions of special characters from some Spanish and Portuguese names. We apologise for the mistake and everyone concerned. For everyone who wishes to see a correct version of his or her contribution or mention in the previous issue, the download file on our web site shows the correct spelling.


## Volume 12, Number 1, June 2003
## Abbreviation: Tapir Cons.

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# LETTER FROM THE CHAIR

This year has already been an extremely busy one for the Tapir Specialist Group. We continue to work hard to improve our effectiveness in terms of the conservation of tapirs and their remaining habitats in Latin America and Southeast Asia. Most of our time and energy has been spent on structuring the recently established Tapir Specialist Group Conservation Fund (TSGCF), a vehicle to raise funds for tapir conservation projects. We have been conducting a number of fundraising campaigns in partnership with the Tapir Preservation Fund (TPF), the American Zoo and Aquarium Association (AZA) Tapir Taxon Advisory Group (TAG), and the European Association of Zoos and Aquaria (EAZA) Tapir Taxon Advisory Group (TAG). This is the first time that all four major tapir conservation groups have joined forces to raise funds for tapir conservation. The following organisations etc have been targeted to raise funds for the TSGCF and these are conservation NGOs, corporations, trusts and foundations, tapir-holding institutions and zoos worldwide and tapir researchers and enthusiasts. The funds are being collected and managed by the Tapir Preservation Fund. The TSGCF will support in-situ and ex-situ research, promote education work with local communities within the tapirs' range and implement conservation recommendations. We should be ready to announce our first call for proposals in the second semester of 2003.

One of our TSGCF fundraising campaigns is the "Friends of TSG" programme. The main approach of this programme is to contact potential private donors and invite them to make an annual contribution to the TSGCF. We have several different ranges of contribution and each individual can decide how much she/he would like to donate. With the invaluable help and totally voluntary work of Kate Wilson, TPF board member, and Gilia Angell, web designer with Amazon.com, both big tapir fans and supporters, we designed a flyer explaining the programme and a donation form which we then mailed to our entire mailing list … over 550 people worldwide. I am quite confident that all of you reading this article received our flyer a few weeks ago! It is with much satisfaction that I can tell you that donations are coming in on a regular basis and Sheryl Todd, as always, has been working hard to collect the funds and make sure they will soon be ready for distribution. For further information about the "Friends of TSG" project and the TSG Conservation Fund, please visit the web page: http://www.tapirback.com/tapirgal/TSGCF/. I would like to thank Sheryl, Gilia and Kate for all their help with making this project a reality! Also, thank you VERY MUCH to all of you who have made donations!

Also with regard to fundraising, the TSG has been trying to help tapir researchers and conservationists approach specific funding agencies in order to raise funds for their projects. We have been reviewing and endorsing a growing number of very good proposals that has helped tapir researchers to obtain the funds they need to conduct their activities. Additionally, we have contacted a number of zoological institutions worldwide over the past year, especially those holding tapirs, and compiled a list of potential funding sources for tapir-related projects. This compilation has been made available for TSG members and other tapir researchers and we hope it will help everyone who is seeking funds.

**TAPIR SYMPOSIUM**

**2004 PANAMA**

Another major priority for the TSG right now is the organisation of the Second International Tapir Symposium, to be held in Panama City, Republic of Panama, from January 10 to 16, 2004. The main organisers of the Second Symposium are the IUCN/SSC Tapir Specialist Group (TSG), and the American Zoo and Aquarium Association (AZA) Tapir Taxon Advisory Group (TAG). The Tapir Preservation Fund (TPF) will also be involved. Phil Schaeffer with Caligo Ventures, United States, will be our symposium manager once again, and ANCON Expeditions will be the ground operator in Panama. The first symposium, held in Costa Rica in November 2001, attracted 85 participants from 22 countries, and proved to be a major boost for tapir conservation. The Second Symposium will once again bring together a multi-faceted group of tapir experts, including field biologists, educators, captivity specialists, academicians, researchers, veterinarians, government authorities, politicians and other interested parties. The symposium's planning committee visited Panama in January 2003 and met the Mayor of Panama City, Juan Carlos Navarro. Mayor Navarro was the founding Executive Director of ANCON, Panama's National Association for the Conservation of Nature, one of the leading environmental organisations of the region since 1985 and he also served as Regional Councilor for IUCN. The mayor has not only agreed to give the opening address at the symposium but has committed the resources of his entire staff to assist us in promoting this conference. As a result of our visit to Panama, the AZA Tapir TAG and the Houston Zoo are already working on improving the tapir facilities at the Summit Zoo, just outside of Panama City. This addresses our holistic approach to the Second International Tapir Symposium.

An important event planned for the Symposium is an auction to raise seed funds for the TSG Conservation Fund. Attendees will be asked to bring typical items from their countries

Meeting with the Mayor of Panama City, Juan Carlos Navarro. From left to right: Luis Eduardo Arias (Mayor's secretary), Phil Schaeffer (Caligo Ventures), Marco Gandasegui (ANCON Expeditions), Rick Barongi (Houston Zoo, AZA Tapir TAG), Mayor Juan Carlos Navarro, Patrícia Medici (Chair, TSG), Charles Foerster (Deputy-Chair, TSG), and Alberto Mendoza (Houston Zoo). Credit: Rick Barongi

to sell at the auction. The auction conducted during the First International Tapir Symposium in Costa Rica raised $10,000 to expand tapir habitat in Costa Rica. Mid-conference trips will provide the opportunity for participants to either visit a tapir breeding facility (Summit Zoo), or to spend the day at Barro Colorado Island (BCI), one of the most studied patches of tropical forest and one that is managed by the Smithsonian Institution. Post-conference tours will also be available for those who wish to stay and enjoy Panama's wonderful natural resources. For more detailed information about the Second International Tapir Symposium please visit the web site: http://www.caligo.com/tapir/. The web site includes a request form that you can complete and submit if you are interested on being included in our mailing list and receiving information on the Symposium programme schedule, registration and other information as it develops.

The major goal of the Second Symposium is to review the current conservation status of and threats to tapirs worldwide, addressing and prioritising the most serious issues facing tapir conservation and generating recommendations and strategies necessary for their conservation, their remaining habitats, and biological diversity as a whole. Any results and recommendations coming from the Second Symposium will be incorporated into the upcoming revision of the 1997 *IUCN/SSC Tapir Status Survey and Conservation Action Plan*. Other documents to be incorporated as chapters in the next edition of the Tapir Action Plan are the National Programme for Tapir Conservation and Recovery in Colombia, produced in 2002 by the Colombian Ministry of Environment and the Natural Science Institute of the National University of Colombia; the National Action Plan for Tapir Conservation and Recovery in Mexico under development by the Mexican Committee for Tapir Conservation and Recovery (MCT) sponsored by the Mexican Ministry of Environment and Natural Resources; and the Malay Tapir Action Plan, which will be developed during the upcoming Malay Tapir Conservation Workshop that will be held in Malaysia, from August 12 to 16, 2003. We were also recently informed that the Panamanian Mammal Society (SOMASPA), in partnership with the Autoridad Nacional del Ambiente (ANAM) and the Smithsonian Tropical Research Institute, has been conducting an evaluation of the conservation status of tapirs in Panama, aiming to produce a regional action plan for tapirs. This document may also be incorporated into the new version of the Tapir Action Plan.

Due to a combination of unforeseen circumstances the Tapir Specialist Group, the European Association of Zoos and Aquaria (EAZA) Tapir Taxon Advisory Group (TAG), and the IUCN/SSC Conservation Breeding Specialist Group (CBSG), in consultation with the Department of Wildlife and National Parks (DWNP), Malaysia, decided to postpone the Malay Tapir Conservation Workshop until 12-16 August 2003. The workshop was originally scheduled for 12-16 April 2003. A considerable number of participants indicated the necessity of acquiring financial support and this requires more time in order to raise the funds needed to make the workshop an event that can be attended by all. Moreover the current world economic situation is making fundraising more difficult than anticipated. The location and the programme will remain the same. We are confident that this decision has been made in the best interest of everyone concerned, and that it will ultimately lead to a better and more productive workshop. Nico van Strien continues to work on the Malay Tapir central database that

Second International Tapir Symposium Planning Committee during visit to Republic of Panama in January 2003. From left to right: Alberto Mendoza (Houston Zoo), Phil Schaeffer (Caligo Ventures), Patrícia Medici (Chair, TSG), and Rick Barongi (Houston Zoo, AZA Tapir TAG). Credit: Patrícia Medici

will be produced to support the workshop in Malaysia.

I am very thankful to our new Zoo Coordinator, Siân Waters, who has been putting in a lot of time and energy in improving the structure and effectiveness of our TSG Zoo Committee. Her first report will appear in the next newsletter.

The Houston Zoo graphic department continues to work hard on the development of educational and organisational brochures for the TSG. I had the chance to see the first drafts during a meeting with Alberto Mendoza, Houston Zoo's Community Programmes Coordinator, during our visit to Panama in January and I must tell you that the brochures look great! I would like to thank the Houston Zoo, especially Alberto and Kelly Russo, for all the hard work they have been putting into this project!

Finally, I would like to stress once again how grateful I am for the invaluable assistance of a number of volunteers who help us to conduct our activities and projects. I receive about 100 e-mail messages a day and there are always many messages coming from people offering to help in some way. It is incredible how many tapir fans there are out there! And, it is with the help of these people that we have been turning several projects we envisioned into reality! I will not mention any more names here, but you know who YOU are!

THANK YOU!

My very best wishes,

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# GENERAL NEWS

## New Ramsar Site in the Pantanal
### (An Area Where Lowland Tapirs Occur)

*Contributed by Mike Chong, Malaysia*

The Bureau of the Convention on Wetlands is delighted to announce that Brazil has designated a significant portion of the Pantanal in Mato Grosso State as a Wetland of International Importance, to complement the related 135,000-hectare Pantanal Matogrossense Ramsar site. An extraordinarily interesting feature of Brazil's eighth site is the fact that it is an extensive privately owned protected area, with government authorization, and includes such management aids as 5 fire control towers, an airplane, 6 boats, 6 all-terrain vehicles, and 26 professional staff and 16 trained rangers, and 1 airplane pilot. The separately-managed hotel employs 100 people, a 500-square-meter visitors' centre is in construction, and a nearby social ecotourism lodge on the other side of the Cuiabá River has 120 beds -- currently, around 10,000 visitors come to enjoy the reserve per year. The Serviço Nacional do Comercio (SESC) is a non-profit organization created by law and funded through an annual contribution from private enterprises, with branches in every state in the country. As a Reserva Particular do Partimônio Natural (RPPN), its legal status is said to differ from a national park only in terms of ownership; the owner could legally sell the area but, under the RPPN law, only if the objective of nature protection would not be altered. Here is a brief description of the site drawn from the Ramsar Information Sheet by Ramsar's Julio Montes de Oca (Spanish below):

Reserva Particular do Patrimonio Natural SESC Pantanal. 06/12/02; Mato Grosso State; 87,871 ha; 16º39'S 056º15'W. Privately owned nature reserve. A significant and representative sample of the large Pantanal wetlands, known as Poconé's Pantanal, a private estate fully owned by the Serviço Nacional do Comercio (SESC) and established in 1998 as a reserve. The site, a mix of permanent rivers, seasonal streams, permanent and seasonal floodplain fresh water lakes, shrub-dominated wetlands, and seasonally flooded forests, satisfies all eight Ramsar criteria for designation as a Wetland of International Importance and is an excellent ecological complement to the Pantanal Matogrossense, already on the Ramsar List. The site contains several endangered species including hyacinth macaws (*Anodorhynchus hyacinthinus*), giant otters (*Pteronura brasiliensis*), and marsh deer (*Blastocerus dichotomus*), as well as numerous nesting sites for the rare *Jabiru* (*Jabiru mycteria*). Populations of over 20,000 cormorants (*Phalacrocorax brasiliensis*) and some of the Pantanal's healthiest nesting sites for wood stork (*Mycteria americana*) are also found within. Many of the 260 fish species in the Pantanal are also believed to be found in the Reserva, a good number having a high commercial value. Since sport and commercial fishing is prohibited inside, the reserve provides essential ecological refuge for fish in the Cuiabá and Sâo Lourenço rivers. The SESC administers this private reserve, under the supervision of the Brazilian Intitute for the Environment and Natural Renewable Resources (IBAMA), and is responsible for implementing its management plan and carrying out environmental education

activities and non-intensive ecotourism at the site. Ramsar site nº 1270.

Reserva Particular do Patrimonio Natural SESC Pantanal. 06/12/02; Estado de Mato Grosso; 87.871 ha; 16º39'S 056º15'O. Reserva natural privada. Propiedad privada del Serviço Nacional do Comercio (SESC), esta reserva establecida en 1998 es conocida tambien como Pantanal de Poconé, y representa una muestra significativa del Pantanal brasileño. El sitio contiene ríos y lagos permanentes y estacionales, pantanos con vegetación arbustiva y humedales boscosos inundados estacionalmente, y satisface los ocho criterios de Ramsar para designación como Humedal de Importancia Internacional, siendo un excelente complemento ecológico al Pantanal Matogrossense, ya incluido en la Lista Ramsar. El sitio contiene varias especies en peligro, incluyendo guacamayos jacintos (*Anodorhynchus hyacinthinus*), lobos de río (*Pteronura brasiliensis*) y ciervos de los pantanos (*Blastocerus dichotomus*), así como numerosos sitios de nidaje para la poco común ave Jabirú (*Jabiru mycteria*). En el sitio se han observado también poblaciones de más de 20.000 cormoranes (*Phalacrocorax brasiliensis*), así como algunos de los más saludables nidos de cigueña o tántalo americano (*Mycteria americana*). Se cree que muchas de las 260 especies de peces presentes en el Pantanal también se encuentran en la Reserva, muchas de ellas con alto valor comercial. Al estar prohibida la pesca comercial o deportiva dentro del sitio, este proporciona un refugio ecológico esencial a estas especies en los ríos Cuiabá y Sâo Lourenço. El SESC administra esta reserva privada, bajo la supervisión del Intstituto Brasileño del Ambiente y Recursos Naturales Renovables (IBAMA), y es responsable por la implementación de su plan de manejo, así como de llevar a cabo actividades de educación ambiental y ecoturismo de baja intensidad dentro del sitio. Ramsar site nº 1270.

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# CURRENT PROJECT UPDATES

## Argentina

### Cattle Impact on Tapirs (*Tapirus terrestris*) in El Rey National Park, Salta, Argentina

**By Silvia Chalukian**

Competing herbivores: tapir and cow. Credit: Silvia Chalukian

Very little is known about tapirs in Argentina, the southernmost limit of *Tapirus terrestris* distribution. This species is considered locally vulnerable due to habitat reduction and disturbance and hunting. In the montane forests (Yungas) tapirs seem to be competing with and are, in some places, displaced by a domestic herbivore, the cow. This also happens inside protected areas and with unknown consequences for the environment.

Tapirs are impacted by ranching mainly because of human activity, but cattle alone may also have direct effects such as: 1) competition or interference; 2) alteration of the forest structure 3) water contamination and 4) parasites and disease transmission. Although there has been a lot of discussion about the effects of cattle impact on natural communities, very few data can be found for Neotropical forests, particularly regarding the impact on native animal species. Since October 2002 we have been working in El Rey National Park, an area that presents a unique situation in which to study the impact of cattle on the ecosystem without human influence, as feral animals have remained inside the forest since it was declared a protected area 54 years ago. Although there is an ongoing project to control cattle, many animals still remain.

Our main objectives are to understand tapir habitat use, and the impact of cattle on their habitat and habitat use, to provide useful parameters for ecological corridors, buffer zones and protected area design and management and to contribute to knowledge about conserving the species.

El Rey National Park is located at 64º40´W and 24º15´S,

Silvia Chalukian collecting samples in the study area.

in Salta Province, Northwestern Argentina. It covers an area of 44,162 hectares and has a subtropical climate with seasonal summer rains. The Yungas forest is the dominant type of vegetation. The Park is almost completely surrounded by mountains, whose heights range from 750 to 2,300 m asl.

We selected sites with and without cattle where we marked, measured and positioned 8 km of transects per site (16 km total) along stream beaches, where we counted tapir tracks to assess frequency of habitat use. We also collected foraged plants and faeces (both tapirs and cattle) for analysis of food items and parasites. We performed "rainy season" sampling and habitat structure analysis along the transects. We recorded abundance and frequency of trees, shrubs, saplings and herbaceous species, canopy, soil and vertical cover using circular plots. Preliminary analysis shows a significant difference on transect use by tapirs between areas with cattle (less used) and without. Vegetation cover is obviously low and sapling predation high in the first areas.

The project is supported by the Wildlife Conservation Society and Wildlife Trust and we have received equipment from Idea Wild. It was declared of Institutional interest by the National Parks Administration and has logistical support from the Park´s authorities and employees. We plan to continue our research next year with the addition of another site outside the Park, in order to assess the impact of ranching activities. We are also looking for funding to survey the current distribution and status of tapirs in other areas of northern Argentina.

The current work team consists of the following members: Silvia C. Chalukian (M.Sc., wildlife management, team leader), Soledad de Bustos (biologist, assistant), Maria Saravia (biologist), and Roberto L. Lizárraga (natural resources management student, maps). The cattle control project coordinator, Sergio Giménez, gives us logistical support in the field, and students of natural resources are invited to assist in field trips.

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# Brazil

## Camera Trapping Reveals the Status of Lowland Tapir *Tapirus terrestris* (Linnaeus, 1758) in a Private Natural Reserve in Southeastern Brazil

**By Edsel A. Moraes Jr., Joaquim A. Silva & Rafael L. A. Freitas**

A study to ascertain the status of lowland tapir in southeastern Brazil is being undertaken by IBIAUARA – Biodiversity Research Group of Minas Gerais State in Brazil. The project is based in the Serra do Caraça Natural Reserve (10,188 ha). This area is located in the southern part of the Espinhaço Range (20º05' S; 43º29' W) in Minas Gerais. This orographic system is represented by a mountainous complex that represents a contact zone between the "Cerrado" (savannas) and the Atlantic Forest, in its southern portion, and transition zones of "Cerrado", Atlantic Forest, and "Caatinga" (tropical deciduous forest), on its central and northern borders (Giulietti & Pirani 1988; Harley 1955; Giulietti *et al.* 1997). The reserve is comprised of three main vegetation formations which are represented by seasonal semideciduous forests, "campos de altitude" (high altitude grasslands), and "campos rupestres" (rocky grasslands), these occur at elevations of between 850 and 2,072 m. The climate in this region has a rainy summer (October-March) and a dry winter (April-September). "Campos rupestres" consist of grasslands surrounded by rocky outcrops, as well as shrubs and small trees (Fig. 1). Vegetation patches in different stages of ecological succession are present in the region as a consequence of timber extraction and "slash-and-burn" agricultural practices used in the past. The reserve represents a rich artistic, cultural and historical heritage resulting from over two centuries of human occupation (Andrade, 2000).

The aim of this study was to evaluate the distribution of lowland tapir along the elevational gradient of Serra do Caraça, and to investigate habitat use by this species in different vegetation and its relationships with water courses.

The camera trap was located in a trail near the forest edge. During 20 trap/night the first results confirmed the presence of lowland tapir in 1,380 m with three photos (Figs. 2, 3 and 4). In addition, tapir presence was determined at high altitudes (2,000 m) by tracks and faeces. A rugged relief marked by abrupt elevations formed by quartzite rocks characterised the area occupied by lowland tapir. In this region, large expanses of flat areas are scarce or absent.

This is the first camera trapping project conducted in the reserve and these results will be of the utmost importance in the development of conservation strategies for the lowland tapir, a species on the endangered list of Minas Gerais State.

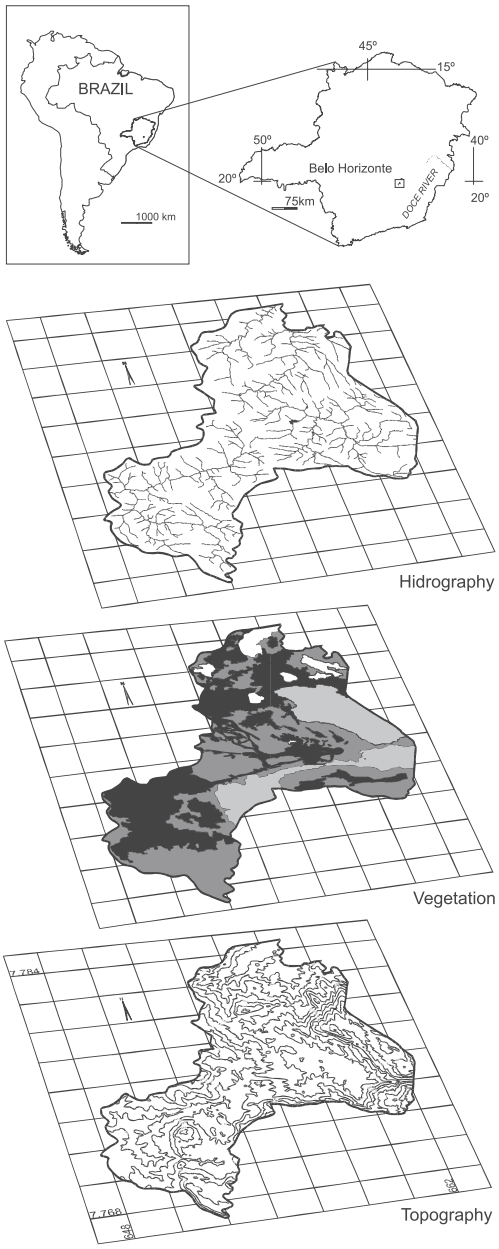


**Figure I.** Map of the Private Natural Heritage Reserve Serra do Caraça, MG, Brazil. Graphic by Joaquim A. Silva.


## Acknowledgements

We would like to thank Wally Van Sickle (Idea Wild, USA), Pe Célio Del'Amore, Marcelo F. Vasconcelos, Consuelo Paganini and the Caraça Reserve Rangers.


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**Figures 2, 3 and 4.** Picture of a lowland tapir captured on film by an infrared camera-trapping system in Caraça Reserve, MG, Brazil.
Photo Credit: IBIAUARA – Biodiversity Research Group.

# Lowland tapirs as Landscape Detectives of the Atlantic Forest: An Innovative Conservation Approach

**By Patrícia Medici**

This long-term research project investigates the conservation status of lowland tapirs (*Tapirus terrestris*) in the Pontal do Paranapanema Region, located in the extreme west of São Paulo State, Brazil. The Pontal region includes Morro do Diabo State Park (35,000 ha), one of the last remnants of Atlantic Forest of significant size, and surrounding forest fragments (12,000 ha). Specifically, population size, conservation genetics, health status and dispersal pattern information are continuously evaluated and monitored. The major goal of this project is to use this database to facilitate the implementation of two management plans critical to the long-term conservation of tapirs and the Atlantic Forest ecosystem itself: 1.) Metapopulation management of tapirs (*e.g.* the promotion of genetic exchange between reduced or fragmented populations), and 2.) Restoration of main wildlife corridors to re-establish landscape connectivity, increase habitat availability and improve biological diversity in fragmented rural landscapes. Metapopulation management and habitat conservation planning, which involves identification and restoration of main animal routes and corridors, are seen as effective conservation strategies. Consequently, future metapopulation management may include the shifting (*e.g.* reintroductions, translocations, managed long distance dispersal) of individuals between fragments. Additionally, research on tapirs within the concept of *landscape detectives* is an innovative conservation approach and will provide essential information for the future management of highly fragmented landscapes. Building upon the tapirs' ability to travel long distances, we will develop a network of core reserves linked by biological corridors to allow for the natural dispersal of tapirs and other wide-ranging species and for genetic exchange between different populations.

This project is currently expanding in several different ways. In December 2002, another experienced wildlife veterinarian, Dr. George Velastin, was added to our team. Dr. Velastin has been spending all his time in the field with us and, together with Dr. Paulo Rogerio Mangini, who has been working with us for the past five years, will help me to increase our capture rate and improve the veterinary aspects of the project. We have developed a specific proposal for the veterinary aspects of the project which consists of a long-term health assessment to investigate the prevalence and monitor the incidence of etiological agents in free-ranging lowland tapir populations in the Atlantic Forest fragments of the Pontal region. Despite the considerable amount of data available about tapir diseases in captivity, there is a notable lack of information coming from the wild. Our initial objectives are to evaluate the prevalence of infectious diseases and the presence of ectoparasites, hemoparasites and endoparasites and determine the hematological and biochemical parameters in the lowland tapir populations at Morro do Diabo State Park and surrounding forest fragments. Once gathered and analysed, the information on the prevalence of etiological agents will be correlated with data on the prevalence of etiological agents in the domestic livestock raised in the private farms and agrarian-reform settlements surrounding the forest fragments in the region, and with data on the level of landscape fragmentation. The main goals of this health study are to investigate the morbidity, mortality, transmission sources, as well as vectors involved in the epidemiological chains occurring in tapir populations, and potential outbreaks; to provide the necessary tools to study the relationship between forest fragmentation, tapir population ecology, and etiological agents and apply all this information to the establishment of effective tapir and livestock management programmes in the Pontal region.

The high level of fragmentation in the Atlantic Forest of the Pontal do Paranapanema region, and the fact that tapirs move

Construction of corral to be tested as an alternative capture method for lowland tapirs in Morro do Diabo State Park. Credit: Patrícia Medici

Patrícia Medici getting ready for tapir manipulation. Credit: Jefferson Ferreira de Lima

Veterinarian, Dr. George Velastin, working on the analyses of tapir feces' samples searching for tapir endoparasites. Credit: Patrícia Medici

throughout the landscape, obviously expose these animals to infectious diseases and other etiological agents. Tapirs and domestic livestock are living in close proximity, which facilitates the transmission of infectious agents. Forest fragmentation may cause diseases to emerge that threaten the persistence of wildlife populations. Anthropogenic alteration of landscape structure, and contact with domestic livestock, may introduce diseases that can cause rarity or even the local extinction of populations. Bacterial, viral and even parasitic outbreaks, resulting from emerging infectious diseases or anthropogenic zoonoses, are seen as potential risks for the survival of wildlife populations and domestic livestock. Many diseases found in wild animals can be derived from domestic animals. Likewise, wild animals are frequently indicated as reservoirs or natural vectors for some diseases that affect human populations or domestic animals. The real interactions between these epidemiological aspects must be carefully investigated. Therefore, health assessments are crucial to understanding the consequences of habitat fragmentation on population dynamics, to establishing adequate population management strategies in fragmented landscapes and should be used as an additional tool in the analysis of population viability.

In the second semester of 2003 we will establish another project called "The Influence of Large Herbivores on the Atlantic Forest." This project is a new conservation initiative and will investigate the role large herbivores (tapirs, deer and peccaries) play in maintaining and shaping the plant communities of the Atlantic Forest. Specifically, we will examine how the removal of large herbivores affects the physical structure and floristic diversity of the understory vegetation of Morro do Diabo State Park. Many ecologists have documented the important roles played by large animals in seed dispersal, seed predation, herbivory, pollination, and predation, but until recently few have considered what would happen if large animals were removed from the system. Tropical rainforests are the most complex and important ecosystems on the face of the earth. How would these forests change if the large herbivores were removed? How do large herbivores contribute to the success and functioning of tropical ecosystems? Studies on plant-animal interactions in the Neotropics show that the disappearance of large herbivores may alter the structure and species composition of the forest.

In order to simulate the removal of these herbivores from the forest, we will construct exclosures that will prevent them from foraging in selected areas. The results obtained will provide additional insights into the ecological functions of these herbivores, which will in turn, enhance existing and future management plans. Most people agree that rainforests are an important resource that should be conserved, if only for the benefit to mankind as water sources, pharmaceutical development, climate control, and sources of food, etc. In this day and age, conservation merely for the preservation of a species or ecosystem does not seem to be enough of an incentive. Unfortunately, until an ecosystem or animal's "value" to the human race can be proven it is hard to convince the world that it must be protected and saved. Our major goal for this study is to provide evidence that tapirs, peccaries and deer are vital to the health of tropical rainforests and that more efforts should be made to protect them. We want to provide wildlife managers and decision-makers with our results to enable them to justify the implementation of programmes designed to prevent the disappearance of large herbivores from the forest.

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# Bolivia

## Tapir Diet (*Tapirus terrestris*) and Seed Dispersal in the Bolivian Chaco

**By Grimaldo Soto Quiroga**

The lowland tapir (*Tapirus terrestris*) is the largest mammal in the Bolivian Chaco and an important source of protein for the indigenous Izoceño-Guaraní communities of the Isoso, who neighbour the Kaa-Iya del Gran Chaco National Park. This ungulate also plays an essential role in forest regeneration through the dispersal of intact seeds.

I conducted research at "Cerro Cortado" field camp (19° 32' 16" S & 62° 18' 35" W), on the border between the Kaa-Iya del Gran Chaco National Park and the Isoso Indigenous Territory, from October 1999 to June 2000. To determine tapir diets I analysed faecal samples collected along trails and

in the forest around the field camp. I also opportunistically compiled data of fruit and leaf consumption from behavioural observations and interviews with local residents of the Isoso.

I analysed a total of 153 faecal samples. After collecting each faecal sample in the field, I placed it in a bag, numbered it with a field tag and dried it in the open. In the laboratory, I analysed the components of the tapirs' diet by separating four principal components (fibre, leaves, fruit-seeds and others). I collected faecal samples over four seasons: late dry season (63 samples), early wet season (38), late wet season (27) and early dry season (25). I separated seeds and identified them by comparing them with samples from a pre-existing voucher collection.

To verify whether the tapir is a legitimate seed disperser, I obtained seeds from the five most common species found in tapir faeces and evaluated germination under field conditions. I planted a set of seeds from each species collected directly from fruiting trees, and a second set of the same seeds collected from faecal samples, and compared their germination rates.

I identified a total of 44 plant species in the faecal samples. With respect to families, Cactaceae is the most important with 16 species represented. The most frequent component in the diet was fibre, principally from Cactaceae stems or stalks. The fruits and seeds of "coropeta" (*Agonandra brasiliensis*, Opiliaceae) were most frequently found in tapir faeces. This plant could potentially be a key source of nutrients for the tapir in the Chaco.

Diet composition varied according to the availability of fruit during and across seasons, with a positive tendency between the frequency of fruit consumed by the tapir and the phenology studies of Chacoan plant species.

According to our data, the tapir is a "legitimate" and "escape" seed disperser for seeds of "sorimi" (*Castela coccinea*, Simaroubaceae), "alcaparro" (*Capparis speciosa*, Capparaceae), "coropeta" (*Agonandra brasiliensis*, Opiliaceae), and "mistol" (*Ziziphus mistol*, Rhamnaceae). The seeds of these plants showed similar germination ability after passing through the tapir digestive tract, and tapir faeces provide a favourable microhabitat for seed germination.

Tapirs are probably the main disperser of algarrobillo (*Caesalpinia paraguariensis*, Leguminosae, Caesalpinioideae), because I found entire fruits in their faeces that had not been masticated. In relation to other ungulates found in the Chaco, the tapir could be the principal if not the exclusive disperser of *C. paraguariensis.* In conclusion, these results provide another reason to conserve the tapirs of the Chaco forest.

This study received financial support from WCS-Bolivia and the KAA-IYA PROJECT (USAID, CABI Capitanía del Alto y Bajo Isoso, WCS, Wildlife Conservation Society).

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# NEWS FROM CAPTIVITY

## AZA Tapir TAG Report

**By Rick Barongi**

The American Association of Zoos and Aquaria (AZA) Tapir Taxon Advisory Group (TTAG) was created in 1992. It includes Institutional Representatives (IR's) from all AZA accredited zoos holding tapirs. A core group of these IR's are selected to participate on the Steering Committee. The Steering Committee is under the direction of a Chair and Vice Chair. Included on the Steering Committee are Studbook Keepers and Species Coordinators for individual tapir species. The TAG also has a number of advisors (veterinary, nutrition, reproductive, education, marketing/PR and field biologists).

The mission of the Tapir TAG is to enhance conservation initiatives for all four species of tapirs in captivity and in the wild. The critical components of the TAG are:

- Regional Collection Plan
- Three-Year Action Plan
- Husbandry Standards

Before I define each of the above topics let me give you a brief summary of the present status of tapirs in the AZA accredited zoos and non-AZA zoos in North America. Presently, there are 143 tapirs (all four species) held in 76 institutions in North America. The breakdown according to species is:

- Malay tapir (*T. indicus*):
  58 (29.29) in 26 institutions
- Baird's tapir (*T. bairdii*):
  35 (25.10) in 20 institutions
- Lowland tapir (*T. terrestris*):
  44 (26.18) in 19 institutions
- Mountain tapir (*T. pinchaque*):
  6 (4.2) in 3 institutions

It is significant to note that none of these numbers constitute a viable long-term self-sustaining population without exchange with other zoos outside North America. All four species are currently listed as Endangered by the U.S. Fish and Wildlife Service and three of the four (Malay, Baird's and mountain) are listed on Appendix I of CITES. The mountain

From left to right: Rick Barongi, Joe Roman, Jennifer McLain, Michael Dee, Charles Foerster, Kirk Nemecheck, Patrícia Medici, Lewis Greene, Patty Peters, Don Goff, Brandie Smith, Phil Schaeffer, Alan Shoemaker, Liz Harmon, and Connie Phillip.

tapir is the most critically endangered in the wild and may number only a few thousand individuals throughout its entire fragmented range.

The AZA Tapir TAG meets at least once a year, usually during the annual AZA Conference. These meetings are more informational than decision-making. The working meetings occur less frequently and consist of members of the steering committee and various advisors. We have just conducted a Tapir TAG workshop at the Houston Zoo from 9-11th of May, 2003. The participants are pictured in the accompanying photograph.

While the findings and recommendations of this meeting are still in draft form, and need to be approved by the AZA management authorities, we would like to share some of the key action plan items.

### Regional Collection Plan (RCP)

The RCP is the key element of any AZA TAG and must be continually updated. Essentially, it is a demographic and space analysis of the captive population. The major discussion centred on which of the four species of tapirs presently held in North American zoos should be managed according to SSP and PMP (population management plan) guidelines. After much discussion it was decided that the AZA Tapir TAG should concentrate its efforts on two species, Malay and Baird's tapirs. The criteria that led to this decision were based on both captive restraints and status in the wild. Like all captive animals, there is limited space for tapirs. They are large, long lived animals and require significant space to exhibit and breed. A target population of 75 Malay tapirs and 75 Baird's tapirs was recommended. In order to accomplish this goal more space will need to be allocated for these two species.

### Why did we decide not to include the lowland and mountain tapirs in the RCP?

The reasoning was different for each species. The lowland tapir is still fairly common throughout its range and has large captive populations in other regions (European and South American zoos). Phasing this captive population out will mean no future breeding by AZA institutions and moving animals to non AZA facilities.

The mountain tapir decision was more difficult, in that this is the most critically endangered tapir species and one of the most endangered large mammals in South America. The six animals currently held in captivity are all descendants of one pair imported to the Los Angeles Zoo in 1967. At the present time, there is very little hope of acquiring more founders (unrelated animals) for the captive population. Therefore, it was decided that we direct our efforts to *in situ* conservation rather than captive breeding programs. If the situation changes, then the RCP will be modified to accommodate a different captive strategy.

In order to carry out these recommendations, we are recommending the formation of two SSP's, one for Malay and one for Baird's tapirs. Both species already have international studbook keepers. A Species Coordinator and Assistant Coordinator will be recommended for each SSP. The Chair of the TAG and the steering committee will still deal with all issues pertaining to the other two non SSP species.

The RCP draft document was prepared by Brandie Smith (AZA Assistant Director of Conservation and Science) with input from all workshop participants. It will be distributed to all Tapir TAG steering committee members for review and final approval.

### Three Year Action Plan

Every TAG and RCP must have a list of realistically achievable goals and objectives. These action items were divided into two categories, *ex situ* and *in situ* objectives.

**_Ex Situ_ Action Items:**

- Publish a tapir husbandry manual and standards for care and exhibition.
- Support basic zoo research, especially in the areas of nutrition and reproduction.
- Select advisors to the Tapir TAG in areas of: veterinary medicine, education, reproductive physiology, nutrition, marketing/PR and field biologists.
- Maintain accurate studbook data.
- Eliminate commercial gain from the sale of tapirs, unless the money raised is used for conservation initiatives in tapir range countries.
- Work with the EAZA Tapir TAG to conduct a joint tapir workshop in 2005/2006.
- Encourage more Tapir TAG Steering Committee

members to become members of the IUCN/SSC Tapir Specialist Group (TSG).
- Work closely with other conservation groups, such as the AZA Meso American Captive Action Plan (CAP), the Zoo Conservation Outreach Group (ZCOG) and other TAG's with species in the same native ranges.
- Increase the number of holding spaces in North American zoos.
- Acquire additional founders from captive born animals in other regions/zoos.

***In Situ* Action Items**:
- Identify and support tapir habitat preservation projects.
- Support field researchers and their conservation programs.
- Work closely with the IUCN/SSC Tapir Specialist Group (TSG).
- Enhance knowledge of population substructure and metapopulation dynamics.
- Build local capacity through training and increasing availability of local veterinarians in range countries.
- Evaluate and monitor effects of human influences, including the impact of hunting and ecotourism.
- Support in-country meetings, symposia and workshops that encourage exchange of information among and between captive and field biologists.

### Tapir Husbandry Standards

A subcommittee of tapir specialists was selected to develop a comprehensive husbandry manual for tapir care, management and exhibition. The final draft of this manual will be completed by September 2003. Alan Shoemaker will lead this effort.

### Tapir TAG Personnel Changes

Effective immediately, Lewis Greene will assume the duties of Acting Chair of the Tapir TAG, replacing Rick Barongi. Rick will remain very much involved with tapir conservation, but concentrate his efforts on tapir fund raising and the Malay tapir international studbook. A new steering committee will be formed based on responses from member institutions. A Vice Chair will be named after the steering committee is approved by the AZA.

*** Contact Information as of May 2003**
- AZA Tapir TAG Acting Chair: Lewis Greene, Virginia Zoo, Norfolk, VA.
- Baird's Tapir International Studbook Keeper: Joe Roman, Virginia Zoo, Norfolk, VA.
- Malay Tapir International Studbook Keeper: Rick Barongi, Houston Zoo, Houston, TX.
- Lowland Tapir Regional Studbook Keeper: Don Goff, Beardsley Park, Bridgeport, CT.
- Tapir Husbandry Standards: Alan Shoemaker, Columbia, S. Carolina.
- RCP and Genetic and Demographic Advisor: Brandie Smith, AZA Executive Offices.

All recommendations by workshop participants are pending approval by AZA.

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# Nutritional Considerations for Feeding Baird's tapir (*Tapirus bairdii*) in Captivity

**By Andrea Brenes Soto**

Simón Bolívar National Zoo in Costa Rica has a Baird's tapir male that arrived when he was approximately one month old. He arrived at the Zoo in 1999, from Rincón de la Vieja Volcano in Guanacaste, in the north area of Costa Rica, where he had been confiscated. "Totó" is now four years old and we are evaluating some nutritional aspects of his diet.

Tapirs have digestive adaptations in their gastrointestinal tract that allow the efficient use of high fibre foods, like other perissodactyls such as horses or rhinos. They have a hindgut digestive process that involves the development of their colon, used as a fermentation chamber for the digestion of fibre which contains a microbial colony (similar to ruminants). The animals obtain volatile fatty acids (VFA) that supply their energy needs, as well as nutrients such as vitamin K and B complex (Rojas, 1995).

Some studies on feeding preferences by tapirs have been conducted in the field (Janzen 1983; Naranjo, 1995). Tapirs are browsers and frugivores (Eisenberg, 1989), their diet consists of leaves, stems and bushes and they also eat aquatic plants and fruits (Ojasti, 1993).

Based on these characteristics and taking the wild diet into consideration plus diet palatability and environmental enrichment factors (much of the diet is presented as enrichment), the zoo's nutrition department formulated a diet for "Totó" (Table 2). This diet was formulated based on the NRC (Nutrient Requirements for Horses) for protein, energy and Calcium and Phosphorus values (Table 1).

The protein value is higher than the requirement, but is at an acceptable value because of the tapir's age. Due to this, it is recommended that the Calcium-Phosphorus ratio for tapirs

**Table 1.** Nutritional Composition of the Tapir's Diet.

| Nutrient | NRC Requirement* | Zoo's Diet Value |
|---|---|---|
| Crude Protein (%) | 8-12 | 13.4 |
| Energy (kcal/kg ME**) | 3000 | 3240 |
| Calcium (%) | 0.30-0.50 | 0.31 |
| Phosphorus (%) | 0.20-0.30 | 0.29 |

* Probable requirements adapted from National Research Council (NRC 1989) Nutrient Requirements for horses

** Metabolizable Energy

**Table 2.** Diet for Baird's Tapir at Simón Bolívar Zoo, Costa Rica.

| Food* | Formula (%) |
|---|---|
| Yuca (*Manihot esculenta*) | 9.9 |
| Carrot (*Daucus carota*) | 9.9 |
| Sweet potato (*Ipomoea batatas*) | 5.9 |
| Beet (*Beta vulgaris*) | 5.9 |
| Papaya (*Carica papaya*) | 3.0 |
| Watermelon (*Citrullus lanatus*) | 4.9 |
| Lettuce (*Lactuca sativa*) | 11.8 |
| Berros (*Nasturtium officinale*) | 7.4 |
| Potato (*Solanum tuberosum*) | 4.9 |
| Banana (*Musa sp.*) | 6.9 |
| Banana peel | 4.9 |
| Horse cube concentrate** | 24.6 |
| TOTAL | 100 |

* Nutritional values adapted from Animal Nutrition and Diet Manual For Wild Animals in Captivity

** Pellet concentrate for maintaining horses

be reviewed along with the effect of high energy diet on body weight.

Totó's food intake is 10 kg of fresh matter per day, and he weighs approximately 150 kg. It means that he eats 1.5% of his body weight in fresh matter. This is a normal value for domestic animals. His feeding regime consists of two feeds per day – one in the morning and the other in the afternoon. His body condition is good and he demonstrates normal activity patterns and normal behaviour.

It is necessary to conduct more studies involving the study of the effects of diet at each physiological stage, the fibre content of the diet, the dynamics of vitamins and minerals and further laboratory analysis for more reliable data.

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## One of the oldest tapirs in captivity dies at Wilhelma Zoo, Stuttgart, Germany

A report on one of the oldest Malay tapirs in captivity in the last edition of the newsletter was in print when we heard that she had died (cf. *Tapir Cons*. Vol. 11, No. 2). A report on her death follows:

Lilith (studbook no 78) was born on the 1st June 1966 at Nuremberg Zoo and arrived at Wilhelma Zoo on 17th April 1968 where she died on 16th December 2002 following an attack of colic. She had suffered from constipation for some days, and, although treatment was administered, it was to no avail. The post mortem study showed that a "ball" of fibres (probably mango fibres) had blocked her intestines. In old animals (and humans, too), the passage can become a problem. Lilith had shown various signs of old age for a long time, but was still in relatively good shape, enjoying her food and her keepers´ attention. She gave birth to two female and four male offspring whilst at Wilhelma between 1970 and 1979.


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# CONTRIBUTED PAPERS

## Re-introductions: A Comprehensive Approach

**By Pritpal S. Soorae**

### Introduction

Due to an increasing number of species translocations worldwide the IUCN in 1987 developed the *IUCN Position Statement on the Translocation of Living organisms* (IUCN, 1987). This position statement acknowledged that translocation is a powerful tool in the management of the natural environment and, when properly used, offers great benefits to natural biological systems and to man but if misused has the potential to cause enormous damage.

While the position statement helped to raise awareness of the pros and cons of translocation it was subsequently felt that there was a need for more detailed guidelines to provide comprehensive coverage of the much wider issues of re-introduction for conservation purposes. An international task force was therefore established to draft more detailed guidelines and this led to the development of the *IUCN Guidelines for Re-introductions*, a general policy document covering both animals and plants, which was finalised in 1995 and became official IUCN policy after an exhaustive international review process. These guidelines have subsequently been translated into French, Spanish, Russian, Chinese and Arabic (IUCN, 1998) and printed into booklets that have been extensively distributed worldwide.

While the development of the general *IUCN Guidelines for Re-introduction* provided valuable guidance on many of the key issues concerning re-introduction, the increasing numbers of re-introduction projects worldwide involving a growing number of taxa, have further highlighted the need for more detailed species- or taxon-specific guidelines. As a first step in this direction, the IUCN/SSC Re-introduction Specialist Group (RSG) finalized in 2002, its first taxon-specific guidelines the *Guidelines for Nonhuman Primate Re-introductions* to assist primate re-introduction practitioners worldwide with "best-practice" lessons for re-introducing primates and is currently working on developing African Elephant Re-introduction and Translocation Guidelines.

### Aims, Objectives and Definition of Terms

#### Aim

According to the *IUCN Guidelines for Re-introductions* (IUCN, 1998), the principal aim of a re-introduction should be to establish a free-ranging viable population in the wild of a species, subspecies or race, which has become globally or locally extinct, or extirpated in the wild in that particular area.

#### Objectives

The main objectives of a re-introduction project are as follows:

- To enhance the long-term survival of a species
- To establish a keystone species (in the ecological or cultural sense)
- To maintain and/or restore natural biodiversity
- To provide long-term economic benefits to the local and/or national economy
- To promote conservation awareness

#### Definition of terms

- **Re-introduction:**
  an attempt to establish a species in an area which was once part of its historical range, but from which it has been extirpated or become extinct ("Re-establishment" is a synonym, but implies that the re-introduction has been successful).
- **Re-inforcement/Supplementation:**
  addition of individuals to an existing population of conspecifics.
- **Conservation/Benign Introductions:**
  an attempt to establish a species, for the purpose of conservation, outside its recorded distribution but within an appropriate habitat and eco-geographical area. This is a feasible conservation tool only when there is no remaining area left within a species' historic range.
- **Translocation:**
  deliberate and mediated movement of wild individuals or populations from one part of their range to another.

## Phases of a re-introduction project

There are four main stages of a re-introduction project, these are:

1. Feasibility,
2. Implementation,
3. Post-release Monitoring, and,
4. Lessons Learned stage.

### 1) FEASIBILITY

This stage involves the gathering of data on habitat suitability, biological issues involving the species and on socio-political/economic concerns. If the project proves feasible it should proceed further. If there are concerns these should be addressed before proceeding to the implementation stage.

When considering a re-introduction project it is important that the following three factors *i.e.* Habitat, Species and Socio-political/economic are considered equally. The success of a project will depend on the proper evaluation of all three of these factors.

#### a) Habitat

The choice of re-introduction site is very important and when conducting a re-introduction (see above for definition) there should be no remnant population to prevent the possibility of disease spread, social disruption, and, introduction of alien genes. If it is considered necessary to conduct a re-enforcement, then there should only be a few remnant wild individuals.

The re-introduction should only take place where the habitat and landscape requirements of the species are satisfied and changes since extirpation have been considered. The area should have sufficient carrying capacity to support a viable, self-sustaining population and the original cause of decline must be identified and eliminated or reduced to a sufficient level.

If the release site has undergone substantial degradation then a habitat restoration must be carried out before a re-introduction can proceed.

#### b) Species

When considering the species factor it is important to conduct a background research into the species and also evaluate the taxonomic and genetic status. Detailed studies on the status and biology of wild populations must be undertaken and the effect of species to be re-introduced, or one that has filled the void must be evaluated. In some cases it may also be useful to consider modeling and to conduct a population and habitat viability analysis (PHVA) to guide long-term population management.

It is important to have the availability of suitable release stock for any re-introduction project. Normally wild stock is preferred but if the animals are from a captive source they must have been managed both demographically and genetically. Also, if using captive-bred stocks their probability of survival must approximate those of a wild counterpart. It should be remembered that re-introductions should not be carried out because of the availability of surplus stock and that any stock destined for a re-introduction must meet all necessary health requirements.

#### c) Socio-economic and political

It is important to conduct a comprehensive socio-economic assessment of human populations in the proposed re-introduction area and ensure that the project has long-term financial and political support. It must be appreciated that re-introductions are long-term, expensive projects that require long-term financial and political support. The impacts and costs and benefits to local communities must be evaluated prior to a re-introduction. If both, risks to and from human activities are envisaged then adequate measures should be undertaken, if these are inadequate, then alternative release areas should be sought and the attempt abandoned.

A thorough review of both national and international policies should be undertaken. In the case of national or country policies special attention should be made to existing provincial, national and international policies. Full permission and involvement of all relevant government agencies should be taken well in advance and where re-introductions can occur in border areas, or where species expand into states, provinces or other territories.

### 2) IMPLEMENTATION

During the implementation stage it is important for re-introduction practitioners to:

- Establish a multidisciplinary team.
- Obtain the approval of relevant government agencies, landowners, NGO's (both local and international).
- Identify both short- and long-term success indicators.
- Secure funding for all phases of the project.
- Project should be done as a carefully designed scientific experiment.
- Ensure all veterinary protocols are in place.
- Welfare of animals should be of the highest concern during all stages of the project.

### 3) POST-RELEASE MONITORING

This is the most important stage because without monitoring the success indicators cannot be evaluated.

- This can be done by monitoring all or a sample by using direct (*e.g.* tags, telemetry) or indirect (*e.g.* spoor, informants) methods.
- Long-term studies on adaptation, ecology and behav-

iour should be undertaken.
- Mortalities should be thoroughly investigated.

#### 4) LESSONS LEARNT

- Results of projects, whether successful or not, should be published in scientific and popular literature.
- Future projects should learn from past successes and failures to help design their projects more successfully.
- A cost-benefit analysis should be carried out to gauge the cost of the project.
- Public relation activities and dissemination of information through the mass media should be conducted to ensure project information is available to a wide audience.

## Conclusion

We hope the information above provides some information on issues to consider when planning re-introduction projects. The IUCN/SSC Re-introduction Specialist Group would be keen to work closely with the IUCN/SSC Tapir Specialist Group in developing specific protocols to assist tapir re-introduction projects. There have not been many attempts at re-introducing tapirs but what little information exists out there can be collated and merged with the existing *IUCN Guidelines for Re-introduction* to provide specific guidelines that can be useful to tapir re-introduction projects. This can be constantly updated as new information becomes available. This initiative would be similar to the specific guidelines the RSG has developed for primates and is currently developing for African elephants.

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# Identification of Ecto and Endoparasites in Baird's Tapir (*Tapirus bairdii*), in Chiapas, Mexico

**By E. C. Aldán[1], I. L. Torres[1], D. M. G. Andrade[2], D. O. Sarabia[3] & M. T. Quintero M.[4]**

## Abstract

**The purpose of this study was to assess levels of parasitism in Baird´s tapir (*Tapirus bairdii*) in Chiapas, Mexico. We analyzed 19 samples of Baird´s tapir faeces from La Sepultura Biosphere Reserve collected between March and July 1999. We also took samples directly from a male tapir captured at Montes Azules Biosphere Reserve. We used the techniques of flotation, MacMaster, micrometric, sedimentation of Ritchie (formol ether) for preserved samples, and Ferreira´s quantitative. In addition, we collected ectoparasites from animals captured at both La Sepultura and Montes Azules reserves as well as from a pair maintained in captivity at the Miguel Alvarez del Toro Regional Zoo (ZooMAT) in Tuxtla Gutierrez, Chiapas. The following new genera of gastrointestinal nematodes and protozoa were found: *Agriostomum* sp, *Lacandoria* sp, *Neomurshidia* sp, *Trichostrongylus* sp, *Strongylus* sp, *Brachylumus* sp, and a species of Ancylostomatidae. We also detected the presence of *Eimeria* sp, and *Balantidium coli*, as well as the mites: *Dermacentor halli, Dermacentor latus, Amblyomma cajannense, Amblyomma coelebs, Amblyomma ovale, Anocentor nitens* and *Ixodes bicornis*.**

## Introduccion

Entre la numerosa diversidad de animales del sureste mexicano el Tapir Centroamericano *Tapirus bairdii* (Gill, 1865) destaca por constituir un recurso alimenticio y peletero para los pobladores rurales, sin embargo, las poblaciones de este ungulado son vulnerables a la extinción local ocasionada por la perdida y fragmentación del hábitat, cacería y a la traslocación de especies domésticas (Emmons, 1990; Vos, 1995; Brooks *et al*., 1997; Anónimo, 2000).

Con respecto a este ultimo punto, la traslocación de especies domestica es un tema poco evaluado e investigado en nuestro estado, además esta actividad representa indirectamente un potencial de enfermedades infectocontagiosas y parasitarias para la especie dentro de las áreas naturales protegidas del sureste de México (Overall, 1980; Cunningham, 1995).

En base a que no existen estudios sobre parasitósis en tapires de vida silvestre en el estado de Chiapas y las condiciones ambientales del Estado son favorables (temperatura, precipitación, humedad relativa, etc), además de retomar lo propuesto por el Plan de Acción elaborado por Matola, Cuarón y Rubio-Torgler para la especie (1997), y citando el punto numero diez (Investigación Científica) apartado quinto, donde se recomienda: *La búsqueda del desarrollo de técnicas no obstructivas (quizás utilizando heces) que permitan la recolección de información sobre el sexo, estado reproductivo, y otra información fisiológica de tapires en campo;* el objetivo del presente trabajo, es dar a conocer los géneros, especies y grado de infestación parasitaria que puedan tener las poblaciones de *Tapirus bairdii* en dos áreas naturales protegidas del estado de Chiapas.

## Material y metodios

La Reserva de la Biosfera La Sepultura (REBISE), es decretada el 5 de junio de 1995, con una extensión de 192.734 ha. Se ubica en el Estado de Chiapas entre los 16º 00' y 16º 29' latitud Norte y 93º 24' y 94º 07' longitud Oeste, dentro de la región fisiográfica de la Sierra Madre de Chiapas, región accidentada que se eleva desde los 25 msnm hasta los 2.550 msnm. Para esta región, se distinguen dos zonas: una húmeda, caracterizada por una alta precipitación pluvial, abarcando la comarca El Soconusco; con selvas medianas y bosque mesófilo de montaña, y una zona menos húmeda, la cual comprende una porción del Istmo de Tehuantepec, que según Goodwin (1969) es una de las regiones más secas del Pacífico, por lo que las asociaciones vegetales características son las selvas bajas caducifolias y matorrales xerófitos (Miranda, 1975; Breedlove, 1981). En su conjunto la reserva es considerada como una zona de alta diversidad biológica y elevado endemismo (Hernández 1994; Naranjo y Cruz 1998).

Por otro lado, la Reserva de la Biosfera de Montes Azules (REBIMA) se ubica al noreste del Estado de Chiapas, entre los 16° y 17° latitud norte y los 90° 30´ y 91° 30´ de latitud oeste. Cuenta con una superficie total de 331.200 ha, y está comprendida principalmente dentro de los Municipios de Ocosingo, Margaritas, Benemérito de las Américas, Marqués de Comillas y Palenque (Campos y Flores, 1992).

La REBIMA se encuentra en condiciones climáticas húmedas, cálidas y semicálidas, predominando el clima cálido húmedo Am(w)igw, con una temperatura media anual superior a los 22° C, con baja oscilación térmica anual. Las lluvias alcanzan valores anuales superiores a los 1.500 mm y llega hasta los 3.000 mm en la zona norte (Orellana, 1972; García-Gill, 1992).

El criterio que se utilizó para la recolecta de las excretas provenientes de los tapires se basó en que estas no debían tener más de tres días de evacuadas, tomando en cuenta las características físicas de las mismas, como: textura, olor penetrante, color, edad (dependiendo del tamaño de la excreta), conformación y humedad, siempre evitando el desarrollo de semillas u hongos. Las muestras se obtuvieron directamente del suelo, arroyos, letrinas, pozas, etc, el método de muestreo utilizado fue el de trayecto en línea de amplitud variada.

Los recorridos para la recolecta de excretas fueron de ocho días al mes durante cinco muestreos consecutivos en diversos trayectos con diferentes tipos de vegetación. Una vez obtenidas las muestras se colocaron en pequeños frascos de vidrio limpios agregándoles formol al 5% como conservador. Estas fueron debidamente etiquetadas con los siguientes datos: fecha, número de registro, número de trayecto, vegetación, altitud, edad aproximada, medio de conservación lote, y colector.

La única forma de llegar a un diagnóstico preciso de las parasitosis es mediante el examen postmortem de las vísceras que alojan temporal o definitivamente a los parásitos, sin embargo, esto no es posible, mencionando además que el animal examinado es sólo una parte, pero no una muestra representativa de la población, por lo tanto la alternativa fue: el examen coproparasitoscópico mediante las técnicas de flotación, MacMaster, micrometría, sedimentación de Ritchie (formol-eter) para muestras preservadas y la cuantitativa de Ferreira (Thienpont, 1979).

En lo que respecta a los ectoparásitos, estos fueron recolectados de animales capturados en vida silvestre en las dos reservas anteriormente descritas y en una pareja mantenida en el Zoológico Regional "Miguel Álvarez del Toro" (ZooMAT) en el estado de Chiapas, los ectoparásitos colectados (pulgas, piojos y garrapatas) fueron colocados en frascos con alcohol al 70% para su identificación en el laboratorio (Acevedo, 1990; Lamothe, 1997).

Todas las muestras fueron remitidas y procesadas manualmente en la Policlínica y Diagnóstico Veterinario, Tuxtla Gutiérrez, Chiapas, en el Laboratorio de Helmintología del Instituto de Biología y el Departamento de Parasitología de la Facultad de Medicina Veterinaria, ambos pertenecientes a la Universidad Nacional Autónoma de México (UNAM).

## Resultados

En relación a los resultados obtenidos en la presente investigación sobre parasitosis gastroentéricas en tapires de la reserva de la Biosfera de La Sepultura, se encontró que de un total de 19 excretas procesadas, 13 fueron positivas a nematodiasis gastroentérica y 3 a protozoarios lo que representa una distribución proporcional del 68.4 y 23.0% respectivamente. Se identificaron por primera vez en los tapires del Estado de Chiapas, México los siguientes géneros de nematodos en una proporción de: *Lacandoria* sp (53.8%), *Neomurshidia* sp (53.8%), *Trichostrongylus* sp (30.7%), *Agriostomum* sp (15.3%) y *Strongylus* sp (23.0%). Mientras que en protozoarios la distribución proporcional fue del 7.6% para *Balantidium coli*, y del 15.3% para *Eimeria* sp.

Las muestras uno y dos evidenciaron la presencia de huevos de nemátodos ovales de zonas periféricas hialinas, y masa de segmentación central con dimensiones de 96 x 51 micrones típicamente estrongiloide pertenecientes al género *Agriostomum* sp. En la muestra número uno el cuantitativo resultó con 15 huevos por gramo de muestra. En la muestra dos la densidad resultó de siete huevos por gramo de muestra.

En las muestras uno, dos, tres, cinco, ocho, 12 y 17 se pudieron observar larvas de nemátodos protostrongílidos, su morfometría y dimensiones los hacen compatibles con los géneros *Lacandoria* sp y *Neomurshidia* sp con caudas poco aguzadas. En las seis primeras muestras fueron abundantes con más de 19 huevos por gramo, en la muestra 12 sólo se pudieron localizar dos huevos y en la 17 fueron escasos, en estas dos últimas no se aplicó la técnica cuantitativa.

En las muestras dos, cuatro, 11 y 14 se detectó la presencia de huevos ovalados más pequeños (15 x 12 micrones) y diferentes a los ya señalados, compatibles con huevos del género *Trichostrongilus* sp, muy abundantes (462 huevos por gramo) y con las blastomeras conspícuas.

En las muestras nueve, 15 y 19, se detectaron larvas de nemátodos pertenecientes al género *Strongylus* sp caracterizados por sus caudas largas, siendo sus abundancias elevadas con 8.066 huevos por gramo. En las muestras tres, nueve y doce se detectó la presencia de quistes esféricos cuyas características morfológicas y morfométricas (15 a 18 micrones de diámetro) los hacen compatibles con protozoarios de los géneros *Eimeria* sp y *Balantidium coli*.

Por otra parte, se hace referencia a especimenes de nematodos adultos obtenidos a partir de un muestreo directo efectuado a un tapir macho proveniente de la Reserva de la Biosfera Montes Azules, Selva Lacandona, del cual se identificaron a los géneros: *Neomurshidia* sp, *Brachylumus* sp, *Lacandoria* sp y otro ancilostomaideo que se está buscando bibliografía para situarlo taxonómicamente.

En cuanto a la identificación de las especies de ectoparásitos recolectados en tapires, los resultados son los siguientes: Para la pareja de tapires mantenida en el ZooMAT, todos los ácaros (garrapatas) identificados pertenecen a la familia Ixodidae y del género *Amblyomma* se determinó a *Amblyomma cajennense* y *A. ovale*, y del género *Anocentor* se determinó a *Anocentor nitens*. En un tapir macho capturado en el Ejido Nueva Palestina en la Reserva de la Biosfera Montes Azules, Selva Lacandona, las especies de ácaros colectados también pertenecen a la familia Ixodidae y del género *Amblyomma* se determinó a *Amblyomma cajennense*.

En el caso de una cría de tapir encontrada en la Reserva de la Biosfera La Sepultura los ácaros identificados pertenecen a la misma familia Ixodidae como sigue: del género *Dermacentor*: *Dermacentor halli*, y *D. latus*; del género *Amblyomma*: *Amblyomma cajannense* y *A. coelebs* y del género *Ixodes*; *Ixodes bicornis*.

## Discusion

En cuanto a los géneros identificados en la presente investigación se encontró que el nematodo *Neomurshidia* sp. es igualmente reportado por Padilla (1994) en el Tapir de tierras bajas (*Tapirus terrestris*). En tanto que Terwilliger (1978) en un análisis de excretas provenientes de un macho juvenil de *Tapirus bairdii* encontró *Strongylus sp*, al igual que Parás *et al*. (1996) en un muestreo de cinco tapires capturados en la reserva de Corcovado en Costa Rica, hallazgos similares a lo reportado en este trabajo, pero con abundancias distintas, cuya explicación se infiere que sea similar al genero *Trichostrongylus* sp.

Con respecto a los géneros *Lacandoria* sp, *Brachylumus* sp y *Agriostomum* sp, no han sido reportados por otros autores, lo que podría inferir condiciones especiales del hábitat para la sobrevivencia, preservación y reproducción de estos tres géneros en el estado de Chiapas o a la falta de estudios concernientes a esta temática y especie animal. En tanto que para el género *Trichostrongylus* sp, también no es reportado en el Tapir Centroamericano por otros autores, únicamente en animales domésticos como equinos y bovinos del estado de Chiapas con prevalencias elevadas (Zenteno, 1993; Güiris, 1995), la infestación a esta especie silvestre posiblemente se deba al hecho de que los tapires de la Reserva de la Biosfera La Sepultura bajan a los pastizales y conviven en forma mixta con equinos y bovinos los cuales se alimentan en este lugar, o a la contaminación de forraje por huevos de nematodos provenientes de estos rumiantes y equinos, cabe aclarar que este género de parásito no es muy prolífico, pero la longevidad de sus huevos es relativamente larga al ser depositados sobre los pastos, soportando la exposición al medio ambiente externo adverso, lo cual contribuye a la infestación y presencia de este parásito en la especie en estudio (Quiroz, 1984; Güiris 1995).

Con respecto a *Eimeria* sp y *Balantidium coli*, ambos protozoarios anteriormente habían sido reportados por Padilla (1994) en la recopilación hecha del Tapir de tierras bajas, así como por Parás *et al.* (1996) en el *Tapirus bairdii*; en este caso,

estos protozoarios tienen la capacidad de enquistarse cuando las condiciones ambientales no les son favorables para su sobrevivencia, y esto podría inferirse como una de las causas por las cuales se observaron durante el estudio (Soulsby 1988). Por último, en el caso de los ácaros, Hoffmann (1962) reporta la presencia de *Amblyomma cajannense* en el tapir centroamericano de México, sin embargo, no específica en que estado o región se llevó acabo este hallazgo y Overall (1980) menciona que los ácaros encontrados en dos ejemplares de *Tapirus bairdii* de la Isla de Barro Colorado, Panamá son vectores de protozoarios de importancia sanitaria como *Babesia* y *Theileria;* especies endémicas del neotropico y que afectan a los equinos domésticos como a los tapires respectivamente. Sin embargo, para nuestro estado la presencia de estos protozoarios no ha sido confirmada aun, debido a la carencia de estudios clínicos y epidemiológicos sobre el tapir centroamericano en las respectivas áreas naturales protegidas donde aun sobreviven.

Para finalizar, retomando la relevancia de los párrafos anteriores, queremos comentar que la importancia de los hallazgos realizados en la presente investigación tienen como finalidad profundizar en el conocimiento de la biología y ecología del tapir centroamericano en el Estado de Chiapas. En la actualidad la frontera agropecuaria y ganadera se extiende cada día más, esto ha ocasionado una perdida y fragmentación de los bosques prístinos y de los diferentes ecosistemas que conforman la región. La expansión de la frontera agrícola trae entre otras consecuencias la introducción de nuevas enfermedades y vectores, debido a la presencia de especies simpátricas que estarán en estrecho contacto con la especie. Además es importante mencionar los movimientos de fauna tanto silvestre como doméstica que desarrollan las comunidades locales en casi todas las áreas naturales protegidas del estado. Para efectos de este estudio estos movimientos se describen como cualquier asistencia humana en la movilización animal (Overall, 1980; Cunningham, 1995).

En los movimientos de fauna silvestre llámense introducción, reintroducción , reforzamiento, y traslocación se recomienda seguir los lineamientos de la IUCN en la medida que sean posibles con el fin de evitar la importación de nuevos riesgos para las especies locales, este riesgo puede incrementarse si la introducción de animales es por crianza o mantenimiento en cautiverio. La introducción de nuevos hospederos por acciones antropocéntricas influencia la relación existente entre hospedero-parásito con otras especies en el área (Cunningham, 1995).

Por tal motivo es importante implementar algunos lineamientos básicos sobre los procedimientos en educación, higiene y cuarentena en animales criados o mantenidos en cautiverio. Además profundizar en el conocimiento biológico y ecológico de la especie en estudio y efectuar una evaluación del estado de salud de las poblaciones silvestres y domésticas con la finalidad de prevenir epidemias.

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# Notes on the Distribution, and Conservation Status of Mountain Tapir (*Tapirus pinchaque*) in North Peru

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## Abstract

**Currently mountain tapirs (*Tapirus pinchaque*) are found in the Andes of Colombia, Ecuador and northern Peru but their actual distribution in Peru is unknown. We analysed mountain tapir distribution in Peru by measuring the amount of habitat available to the species. We identified tapir habitats by using criteria such as areas of conflict with local communities and the main threats to mountain tapirs in the Tabaconas-Namballe National Sanctuary (TNNS). The total available area for tapirs in the Northern Andes of Peru is approximately 206,000 ha. This area could hold between 350-375 mountain tapirs. The main threat to the tapir in the region is habitat loss due to cattle ranching and forest clearance by subsistence farmers. One area of conflict was identified in eastern TNNS. In addition, we discuss the main challenges involved in conserving the mountain tapir in Peru.**

## Introduction

Despite the high rate of deforestation in South America (Henderson *et al*., 1991) some countries, like Peru, still have 75% of forest cover remaining in the Peruvian Northern Andes. However, only 12% of this is under government protection (WWF, 2001). By the year 2000, deforestation had affected a total area of 7.5 million hectares in the Peruvian Andes (Rios, 2001). The accelerated process of deforestation coupled with over hunting in the region of the Andes seriously threatens unique mammal species such as the mountain tapir through diminishing populations and habitat reduction, which contributes to the population fragmentation of these species.

Today all four tapir species are threatened by hunting and habitat loss (IUCN, 1996). Probably the most threatened species is the mountain tapir, the smallest of the four species (Hershkovitz, 1954). Its main habitats are tropical montane forests and Paramos at altitudes of between 2,000 and 4,000 m (Downer, 1996, 1997). Currently mountain tapirs are found in the Andes of Colombia, Ecuador and northern Peru. Little information is known about their distribution in Ecuador (Downer, 1996, 1997) and Colombia but it appears to be found in low densities in those regions and its populations are restricted to a few forest patches in the Andes region (Acosta, 1996; Lizcano & Cavelier, 2000a; Lizcano *et al.,* 2002). No information regarding its population and distribution status is known from Peru. Currently mountain tapir populations are in decline because they are hunted for use both as food and for traditional medicine (Brooks *et al*., 1997). This species is considered endangered (IUCN, 1996) and is included in Appendix I of CITES.

For this study we analysed the distribution of mountain tapir in Peru by measuring the habitat availability for the species and verifying its presence in the field. We identified tapir habitats, areas of conflict with local communities and main threats to mountain tapirs in the Tabaconas-Namballe National Sanctuary. The main challenges to tapir conservation in Peru are discussed.

## Study Area

This study was carried out in the Tabaconas-Namballe National Sanctuary (TNNS) and in the small villages located in that area (Fig. 1). The TNNS was created in 1988 by "decreto supremo" 051-88-AG, with an extension of 29,500 ha. Its objectives are to protect and conserve a representative Paramo region, and with it, the mountain tapir, the Andean bear *Tremarctos ornatus*, and the *Podocarpus* forests and their upper catchment areas. It is part of the occidental mountain range. Its altitude ranges from 1,700 m, where the vegetation is dominated by plants of the family Lauraceae and Podocarpaceae, to 3,800 m where the vegetation is lower and very dense with a predominance of ferns and grasses (Castillo *et al.,* 1999).

## Methods

To measure habitat availability we used a digital map of forest cover for the Northern Andes Ecoregion Peru (WWF, 2001). The forested areas located between 2,000-4,000 m were selected as potential tapir habitats using ArcView 3.2 (Environmental Systems Research Institute, Redlands, California). In these habitats we conducted a field survey to verify the presence of mountain tapir both inside and around the TNNS. Two biologists and two INRENA (National Institute of Natural Resources) park guards formed the expedition team. The field survey was carried out during the first two weeks of August 2001. In the field, we searched for tapir signs such as faeces, tracks and hairs. Searching for sign was done randomly, transects were not undertaken because of the limited time available and difficult topographic conditions in the area. Former hunters were informally interviewed in the villages of Tabaconas (n=8), Tamborapa Pueblo (n=7), San Miguel (n=9) and San Ignacio (n=12) to confirm the presence of mountain tapir and to identify possible areas of conflict and possible threats to tapirs. These interviews were carried out in Spanish using illustrations from Eisenberg (1989) for support to aid identification of mountain tapir. The three main questions asked were as follows:

- Do you recognise the mountain tapir?
- Please identify it in the drawings,
- Where have you seen this animal?

As an exercise to obtain estimates of present population size of the mountain tapir in Peru, we multiplied estimates of mean density by the area where the species occurs. Estimates of mean density ranged from 1 ind./ 551 ha (Lizcano & Cavelier, 2000b) in Colombia to 1 ind./587 ha in Ecuador (Downer, 1996).

## Results and Discussion

The presence of mountain tapir was verified in TNNS. Tapir faeces, tracks and a skull were found. The total available habitat for tapirs in the Northern Andes of Peru is approximately 206,000 ha (Fig. 1). This area could hold between 350-375 mountain tapirs. The total habitat available for tapirs and protected under TNNS is 16,909 ha. that could hold between 28 and 30 tapirs. Only seven former hunters in Tabaconas and six in San Miguel were familiar with the species and only five former hunters in Tabaconas correctly identified it. The main threat to the tapir in the region is habitat loss due to cattle ranching and clearance by subsistence farmers for coffee and maize cultivation. The high number of villages in the eastern and western TNNS region increases demand for natural resources which causes the gradual elimination of

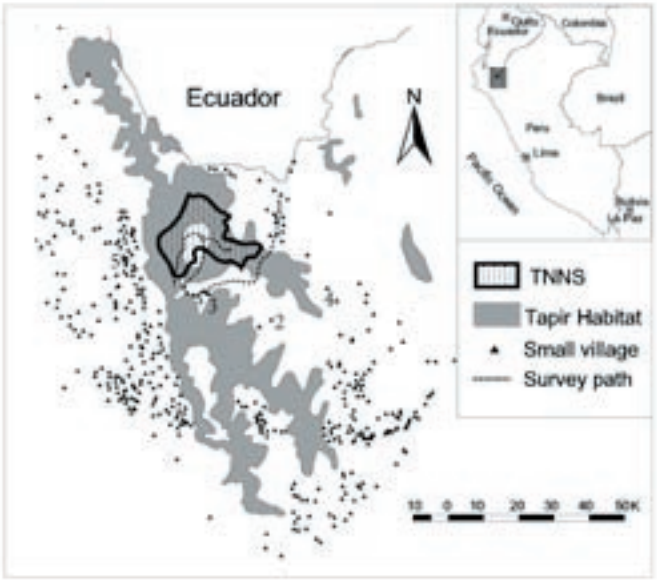


**Figure 1.** Map of Tabaconas-Namballe National Sanctuary (TNNS) and available habitat for tapirs in northern Peru. Notice the high number of small villages around TNNS, especially on the western side. The numbers are villages: 1 San Ignacio, 2 Tamborapa pueblo, 3 Tabaconas, 4 San Miguel, 5 Huancabamba.

tapir habitat. Evidence of hunting was found in the southern TNNS region, but this may have possibly decreased in the last few years mainly due to the constant presence of INRENA guard parks. A new road planned between Puerto Tamborapa to Huancabamba is threatening the southern border of the sanctuary and would split tapir habitat that currently runs continuously from Ecudador.

An important area of conflict between humans and tapirs was identified in eastern TNNS where some farms overlap the sanctuary due to territorial occupation not having been planned well or restricted in any way in protected areas of northern Peru. For example, since the 1980's all available land around the TNNS has been occupied and in the 1990's, some people began to invade the eastern region of TNNS particularly in the "Chaupe Protection Forest" a forest rich in Podocarpus and containing abundant wildlife such as mountain tapirs and Andean bears (INRENA, 2000). As population and agricultural border areas surrounding forest fragments increase, they will be exhausted, and very few primary forests will exist within these holdings. In the future, the conservation of mountain tapirs in Peru will be dependent on whether conservation and development agencies, the research community and the Peruvian government can focus on truly effective protection of protected areas and their surrounding habitats.

The TNNS is the southern location for the mountain tapir. No tapirs have been reported in the region to the south of Huancabamba valley (Downer, 1997). The presence of tapirs is suspected in the Cordillera del Condor region and in the Santiago Comainas reserved zone but to date mountain tapirs have not been reported from this area (Conservation International, 1997). In addition the areas within altitudes over 2,000 meters, the lowest latitudinal limit for tapirs, are few in this region. For this reason TNNS constitutes the only protected area with tapirs in Peru and is the most important conservation location for mountain tapirs in their southern distribution. The mountain tapir has large habitat requirements (Downer, 1996; Lizcano & Cavelier, 2000b). Viable populations of this species require broad areas of habitat, but in addition to maintaining habitat blocks large enough to support populations of this species, smaller intact habitat blocks could be created to serve as stepping stones to maintain connectivity with corridors among habitat blocks supporting sub-populations (WWF, 2001). These smaller habitat blocks can support a wide range of medium-sized seed dispersers, pollinators and predators. In this context, the TNNS plays the role of a core and source area for the conservation of mountain tapirs at the southern limit of their distribution.

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# A Camera Trapping and Radio Telemetry Study of Lowland Tapir (*Tapirus terrestris*) in Bolivian Dry Forests

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## Abstract

**This article is the first reported use of camera trapping to estimate population densities of lowland tapirs *Tapirus terrestris* according to capture-recapture statistics, applying a systematic survey methodology developed for tigers in Asia and recently applied to jaguars in Latin America. We survey three sites in the Kaa-Iya del Gran Chaco National Park, representing Chaco thorn scrub vegetation and Chaco-Chiquitano transitional dry forest, and one site in the San Miguelito private reserve, representing Chiquitano dry forest. We acquired too few photographs at Ravelo to estimate population densities, but density estimates from camera trapping at the other sites range from 0.22-0.80/km$^2$, surprisingly high estimates for these dry forest habitats. This indicates that the vast Kaa-Iya National Park protects a major tapir population. The article is also the first reported comparison for any species of density estimates derived from camera trapping and radio telemetry at the same site. At the Cerro Cortado site, prior to the camera trap surveys, we tracked five tapirs for 22-29 months each. The two methodologies provide similar information on ranging and activity patterns, but the density estimate from radio telemetry would appear to be considerably higher. We discuss reasons for these differences, the costs and benefits of the two methodologies, and the potential of camera trapping for tapir research.**

## Introduction

The lowland or Brazilian tapir (*Tapirus terrestris*) is vulnerable to local extinction throughout its range as a result of continued habitat conversion and hunting (Bodmer & Brooks, 1997). Given its large size, it is an important food source for indigenous peoples in the Bolivian Chaco as elsewhere across its geographic distribution (Brooks & Eisenberg, 1999). While researchers have studied the species in humid lowland forests, its status in dry forests has remained unknown. The titling and zonification of extensive lands to indigenous groups in Bolivia (including the 19,000 km$^2$ Izoceño-Guaraní Tierra Comunitaria de Orígen), where subsistence hunting activities are permitted, the zonification of immense national parks (the 34,400 km$^2$ Kaa-Iya del Gran Chaco National Park) to include certain resource exploitation in certain areas (Taber *et al.,* 1997) and the creation of nature reserves on private lands (Rumiz *et al.* 2002), have all together motivated increasing attention to management plans that assure the sustainable use of wildlife and other natural resources.

In support of community wildlife management and long-term biodiversity conservation in Bolivia's dry forests, we have focused attention on the tapir as one of the species most vulnerable to hunting pressure (Noss, 2000). This article describes research using camera traps and radio telemetry to study *Tapirus terrestris* in the Chaco and Chiquitano dry forests of Bolivia. In addition to activity patterns and ranging behavior, both methods provide estimates of population density, upon which sustainable harvest models and conservation recommendations depend. Recently, researchers have begun to employ camera trapping methodologies to study several species of tapirs, for example to determine the status of the species (Lynam, 1999; Holden *et al.,* 2003; Kawanishi *et al.,* 2002), or to study habitat use (Lizcano & Cavelier, 2000a; Montenegro, 1999). This is the first reported use of camera trapping to estimate population densities of tapirs according to capture-recapture statistics, and the first reported comparison for any species of density estimates derived from camera trapping and radio telemetry at the same site.

## Study Area

1. Kaa-Iya del Gran Chaco National Park: This 34,400 km$^2$ protected area covers the northern end of the Gran Chaco, and includes four principal landscape systems (Figure 1: Navarro & Fuentes, 1999). The two purely Chacoan forest landscape systems are the Chaco alluvial plain forest (13,800 km$^2$) and the Chaco riverine forest (500 km$^2$). The two other landscape systems are transitional forests: the Chaco transitional landscape system (9,100 km$^2$) and the Chiquitano transitional landscape system (11,500 km$^2$).


**Figure 1.** Study Sites in Bolivian Chaco and Chiquitano Dry Forests: 1=Cerro Cortado, 2=Tucavaca, 3=Ravelo, 4=San Miguelito.

1.a. During 1997, we established a field camp at Cerro Cortado (19° 31.60' S, 61° 18.60' W) in the Chaco alluvial plain landscape system, on the border between the Kaa-Iya National Park and the adjacent Izoceño indigenous territory. Annual precipitation at the site averages 500 mm. During the 6-8 month dry season, surface water disappears for extended periods. A single road runs through the study site, which was unused for over a decade until we reopened it to establish our research camp. We opened a grid of 2-4 km study trails off the road. The area is not subject to hunting or livestock pressure.

1.b. During 2001, we established a field camp at Tucavaca (18° 30.97' S, 60° 48.62' W) in the Chiquitano transitional landscape system, on the Bolivia-Brazil gas pipeline and 85 km south of the town of San José de Chiquitos. Annual precipitation at the site averages 800 mm. During the six month dry season, surface water disappears for extended periods. Existing roads include the gas pipeline itself (30 m-wide right-of-way, with a 3-6 m-wide road to one side or in the centre), a gravel road north to San José, and an overgrown road south to Paraguay. We opened a square grid of 5 km study trails, enclosing a 100 km$^2$ study area centred on the field camp and the gas pipeline. Scrub patches remain where the forest was burned roughly 30 years ago, but the area is not subject to hunting or livestock pressure.

1.c. During 2001 we established a third field camp towards the southern end of the same landscape system at Ravelo (19° 17.72' S, 60° 37.23' W), near the Paraguayan border. Annual precipitation at the site averages an estimated 650 mm, with a 6-month dry season, but, unlike the previous site, water

points (springs, lagoons) persist year-round in all but the driest years. A single road crosses the area, from the city of Roboré to the northeast, passing through Ravelo military outpost, and on to Paraguay. Several overgrown roads also exist, unused for over 10 years: one leads west to the large salt pans within the Kaa-Iya National Park and from there north to Tucavaca and San José, others were opened in a grid of oil exploration lines. We re-opened several of these roads as footpaths/study trails, as well as cutting additional new study trails 3-5 km long to cover the study area. The dozen soldiers at the Ravelo military outpost maintain a small number of cattle (30) and several donkeys, while the nearest cattle ranch 15 km to the southeast at Palmar de las Islas maintains roughly 300 cattle. Livestock is not fenced in and therefore strays between Ravelo and Palmar along the main road.

2. The San Miguelito Private Reserve comprises approximately 25 $km^2$ within a 400 $km^2$ cattle ranching property 200 km to the east of Santa Cruz, and north of the Kaa-Iya National Park (17° 05.52' S, 61° 47.32' W). The landscape system is Chiquitano dry forest, with an average annual rainfall from 1000 to 1500 mm (Rumiz *et al.,* 2002). Cattle ranching is the principal economic activity outside the private reserve itself, with patches of forest cleared for pasture. The ranch maintains a system of roads through the reserve, in addition to which we opened a number of study trails 1-3 km in length. A small river runs through the private reserve, and several permanent springs and artificial ponds also provide surface water for wildlife during the 6-month dry season.

## Methods

### Radio Telemetry

The radio telemetry study at Cerro Cortado of five individual tapirs followed standard procedures and has been described previously by Ayala (2002; 2003). However, we continued to track the tapirs for 15 months after Ayala completed his fieldwork (Barrientos & Maffei, in press), until the radio-collar batteries failed. We tracked animals for 4-6 hour periods both day and night, registering location information every hour, and activity every 15 minutes. Radio collars marked activity by varying the number of pulses per 30 seconds from 26 (no movement of the collar) to 52 (maximum movement). We determined locations by triangulation from three separate marked points along study trails or the road, estimating position using the Locate II software (Version 1.5, Pacer-Canada). We then analysed positions in Arcview 3.2, estimating home range from minimum convex polygons described by 95% of the positions for each animal (eliminating outliers). We estimated density in turn based on the observed home ranges for individual animals and overlap among home ranges.

### Camera Trapping

The camera trapping methodology consisted of a systematic camera trap survey, whose primary objective was to survey jaguar *Panthera onca* populations and estimate population densities of this species (Maffei *et al*., 2002, under review; Silver *et al*., under review). Cameras were active continuously (24 hours a day). We set them in pairs facing each other across a trail/road in order to simultaneously photograph both sides of any animal passing between them along the trail/road, with a distance of 1-2 km between camera sets. In addition, the cameras function continuously and record the date and time of photographs, allowing us to describe activity patterns by counting records per time period.

At Tucavaca, during eight months (May-December, 2001), we rotated 12 camera traps among sites on the study trails and the gas pipeline, for a total of 2520 trap-nights. During an intensive 60-day survey period (19 January-20 March 2002), we installed 32 pairs of camera traps on the same study trails and pipeline road, for a total of 1920 trap-nights. Following the intensive survey a set of seven cameras continue to be rotated around the study trails.

At Cerro Cortado, we have conducted two intensive 60-day surveys. During the first survey (1 April-30 May 2002), we installed 34 pairs of camera traps along the road and study trails, in addition to two single cameras at water holes and two single cameras at salt licks. During the second survey (28 November 2002-28 January 2003), we installed 26 pairs of camera traps along the road and on the study trails. We installed one single camera at a salt lick and another single camera at a pond. Trapping effort totaled 2280 and 1680 trap nights respectively.

At Ravelo, we conducted pilot camera trapping efforts (May-December, 2001) on study trails and at seasonal ponds for a total of 1248 trap-nights. During a single intensive 58-day survey (February 10-April 10, 2003), we installed 37 pairs of camera traps: 10 on roads, 17 on study trails, 8 around a saltpan, and 2 at ponds. Trapping effort totaled 2170 trap nights.

At San Miguelito we conducted an intensive 60-day survey (20 September-20 November, 2002), installing 22 pairs of camera traps on existing roads and study trails. We also installed four pairs of cameras along the edge of the river, one pair at a salt lick and one pair at a spring. Trapping effort totaled 1695 trap nights (Rumiz *et al.,* 2003).

We used the time information recorded on all camera trap photographs of tapirs to describe activity patterns at each site, according to the proportion of photographs of the species during each time period. We also compared capture frequencies at different types of locations within each site: roads, trails, salt licks, and ponds.

A number of unique features serve to distinguish individuals: scars, white spots and stripes on the stomach or legs, black spots on the face or sides, white markings at the base and fringe of the ears, torn or missing ears, toenail markings or colour, tail length and white markings on the tail (Emmons,

pers. comm.; Holden *et al.,* 2003; Montenegro, 1999). Coat colour and body structure also varies among individuals, and gender can often be determined from the photographs. We took care not to use temporary markings as identifiers, for example marks from mud or shallow scratches that could disappear during the two-month survey period. We also took care to account for the differences in the observed features resulting from differences in camera angle, tapir body position, and lighting conditions. In cases where definitive identifications were not possible, no more than 20% of photographs for each survey, we tentatively attributed the photographs to one of the previously identified individuals from the same area. In other words, we did not assume that a photograph represented a new individual unless we could definitively distinguish it, according to one or more of the features described above, from all other previously identified individuals.

Based on the number of "captures" and "recaptures" during each intensive survey, it is possible to estimate population abundance using the closed population models of the programme CAPTURE (Rexstad & Burnham, 1991; White *et al.,* 1978). To estimate densities for each study site, we divided the abundance calculated above by the effective sample area. The effective sample area included a circular buffer around each camera trap site, whose radius was half the mean maximum distance among multiple captures of individual tapirs during the survey period (Wilson & Anderson, 1985). At the two sites where we repeated surveys, we treated the two surveys as independent, and did not attempt to cross-identify the two sets of individuals obtained for the site.

## Results

Table 1 presents complete telemetry results by individual tapir at Cerro Cortado (individual, sex, months, locations, area, maximum distance). During 22-29 months of radio-tracking for each animal, we recorded between 645-955 locations per animal, and estimate home ranges of five individuals, according to 95% of observations (eliminating outliers), to cover 1.9-3.0 km$^2$ (Figure 2). Based on these ranges, and on the observed overlap of 32-55% (average 43.5%) in home ranges of the four neighbouring animals, we estimate an average "exclusive" home range of 1.4 km$^2$. Assuming that tapirs occupy the landscape evenly and completely in this fashion, population density at this site is 0.71/km$^2$ (SE=0.23, 95% confidence limits 0.26-1.16). It is important to note that we recorded all three possible types of overlap: male-male, female-female, and male-female. Figure 3a presents activity patterns, based on the proportion of observations per time period when the animals were active.

Table 2 presents relative abundance based on capture frequencies during camera trapping among the three survey sites and by type of location. Activity patterns are decidedly nocturnal (Figure 3b) in all forest types, even where hunting does not occur. Relative use of trails versus roads varies among sites and over time at particular sites. Tapirs have shown certain preference for salt licks, according to capture frequencies across camera trap locations. However, tapir visits to salt licks are brief, generally less than five minutes, in comparison to gray brocket deer (10-20 mn), white-lipped peccary (10 mn) and collared peccary (20-60 mn).

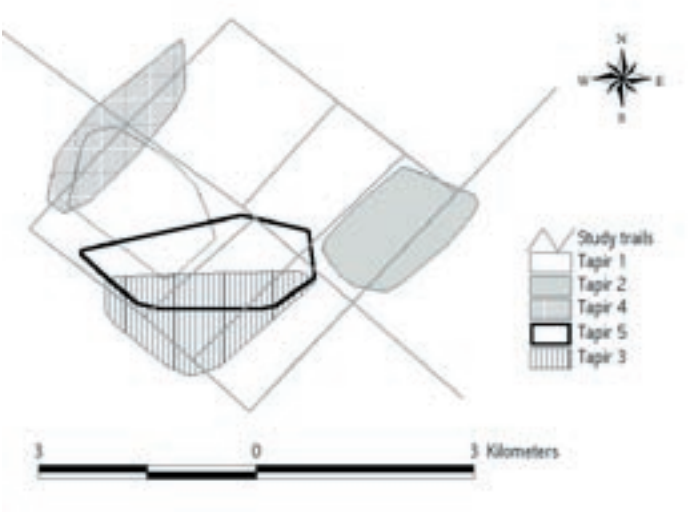


**Figure 2.** Home Ranges of Radio-collared Tapirs at Cerro Cortado.

Table 3 provides the details for each intensive camera trap survey of the population density estimation. Figure 4 provides maps of each study site indicating camera trap positions and the effective survey area defined by the buffer around each camera position. At Ravelo with no recaptures we were unable to calculate a buffer and estimate the survey area, and have used 1 km as a hypothetical buffer. With few observations and no recaptures, the analysis by Capture is also tentative and the standard error correspondingly high. For several animals at each site, we also estimate a minimum home range based on the minimum convex polygon uniting the points where each animal has been recorded by camera traps (Figure 4): from 0.97-3.74 km$^2$ for four individuals in the first survey and 1.03-4.83 km$^2$ for four animals in the second survey at Cerro Cortado, and 0.50-5.78 km$^2$ for six individuals at San Miguelito.

## Discussion

In general, the *Tapirus terrestris* density estimates based on camera trapping from Chaco and transitional Chaco-Chiquitano dry forests are below figures of approximately 0.5/km$^2$ cited for lowland rainforest sites across the Amazon basin (Peres, 2000), as well as density estimates for Baird's tapir

**Table 1.** Radio Telemetry of *Tapirus terrestris* at Cerro Cortado.

| Individual | Sex | Months | Locations | Area ($km^2$, minimum convex polygon) | Maximum distance (km) |
|---|---|---|---|---|---|
| 1 | M | 29 | 955 | 2.57 | 2.3 |
| 2 | M | 28 | 918 | 2.19 | 2.2 |
| 3 | F | 24 | 645 | 2.70 | 2.9 |
| 4 | M | 22 | 670 | 1.90 | 2.9 |
| 5 | F | 24 | 646 | 3.02 | 3.2 |
| Average | | 25.4 | 767 | 2.48 | 2.7 |

**Table 2.** Camera Trap Capture Frequencies (Observations per 1000 Trap Nights) for *Tapirus terrestris*.

| | Total | Road | Trail | River | Salt lick | Salt pan | Pond/spring |
|---|---|---|---|---|---|---|---|
| San Miguelito | 60 | 57 | 63 | 50 | 94 | -- | 81 |
| Tucavaca | 11 | 15 | 10 | -- | -- | -- | -- |
| Ravelo | 2 | 5 | 0 | -- | -- | 2 | 8 |
| Cerro I | 26 | 23 | 29 | -- | 50 | -- | 0 |
| Cerro II | 51 | 68 | 32 | -- | 175 | -- | 50 |

**Table 3.** Estimated Densities for *Tapirus terrestris* Based on Camera Trapping Records.

| | Individuals | Abundance* | Buffer km | Area $km^2$ | Density per $km^2$ ± SE | 95% confidence limits |
|---|---|---|---|---|---|---|
| San Miguelito | 34 | 41 ± 5.01 | 1.24 | 49 | 0.80 ± 0.09 | 0.64-0.96 |
| Tucavaca | 11 | 25 ± 7.85 | 0.93 | 84 | 0.29 ± 0.04 | 0.22-0.36 |
| Ravelo** | 5 | 7 ± 12.25 | (1.00) | (81) | (0.09 ± 0.15) | (0.00-0.38) |
| Cerro I | 16 | 17 ± 5.14 | 1.24 | 76 | 0.22 ± 0.03 | 0.16-0.28 |
| Cerro II | 19 | 22 ± 3.72 | 1.30 | 78 | 0.28 ± 0.03 | 0.22-0.35 |

* Abundance is estimated by Capture, using heterogeneity model M(h) and jackknife estimator.

** Hypothetical buffer estimated for analytical purposes, as we recorded no multiple captureswith which to calculate the buffer. Corresponding standard error in density estimate is derived from abundance estimate only. Negative lower confidence limit converted to 0.

(*T. bairdii)* from Costa Rica (Naranjo, 1995), and for mountain tapir (*T. pinchaque)* in montane forests of Colombia and Ecuador (Lizcano & Cavelier, 2000b). However, the camera trap estimate from Chiquitano dry forest at San Miguelito and the radio telemetry estimate from Cerro Cortado exceed all but Foerster's (2002) estimate for *T. bairdii* in Costa Rica of 1.6/$km^2$. These density estimates derived from a variety of methodologies are not directly comparable. However, it is clear from our data that dry forests can sustain relatively high population densities of tapirs, when these animals are protected from hunting. Tapirs have successfully adapted to conditions of seasonal drought, and to diets that include a large proportion of cactus fibre in the Chaco (Soto, 2002). Tapirs may be limited in some habitat types by dietary minerals: Herrera *et al.* (1999) report on a tapir periodically travelling over 5 km to visit a salt lick, whereas the radio-collared tapirs at Cerro Cortado never made long-distance forays out of their ranges which measured 3.2 km across or less, and we located several salt licks in the study area.

Of the three sites described above, the highest camera trap density estimate comes from the Chiquitano forest site (San Miguelito) with the highest annual rainfall, as we would expect, despite any effects that forest fragmentation, domestic livestock, and sporadic hunting may have on tapir populations here. The other density estimates are similar for both Chaco (Cerro Cortado) and transitional Chaco-Chiquitano dry forests (Tucavaca and Ravelo). The higher rainfall at the latter sites (800 mm versus 500 mm), and year-round surface water points in Ravelo, evidently do not improve resource availability to support significantly higher tapir populations. Variation in density estimates for the same site between the two Cerro Cortado camera trap surveys (eight months apart) is not statistically significant (confidence limits overlap – see Table 3), even though "capture" rates were twice as high during the second survey (wet season) as compared to the first survey (beginning of dry season). Capture rates during the wet season survey at Ravelo were the lowest of any site.

No tapirs with collars were photographed in the first

survey at Cerro Cortado, but two were photographed in the second survey. The capture-recapture analysis attempts to correct for animals present in the study area that are not "captured" by the camera traps, by estimating a population abundance greater than the number of observed animals. However, we may have under-estimated the tapir population by attributing incomplete photographs to previously identified individuals when they may have been new individuals. On the other hand, using radio telemetry information from only four or five animals, we may over-estimate tapir densities if other portions of the study area are less suitable for or unoccupied by tapirs. Camera traps cover a larger survey area and population estimates incorporate information on a larger number of individuals. The buffer we estimated from mean maximum distance covered by individual tapirs during the camera trap surveys, 1.24-1.30 km, is very close to the average of half the distance across home ranges of the five radio-tracked individuals (1.35 km). This would confirm that we have measured the effective survey area appropriately. We recorded between two and four different individuals at several of the camera trap sites, confirming the overlap among home ranges observed in the telemetry study.

The methodology for estimating population densities was developed and applied to survey jaguar populations. A key element of the design is the spacing of the camera traps, attempting to cover the greatest survey area without leaving any gaps that might encompass an entire home range for an individual of the target species, meaning that this individual would have zero capture probability. Jaguars occupy larger home ranges than do tapirs, therefore the camera spacing for a jaguar survey may not be appropriate to survey tapirs. The survey area is defined by the buffer around the camera traps, and the buffer calculated from observations of the particular species. At our sites, the respective buffers demarcate continuous survey areas at San Miguelito and Cerro Cortado, but not at Tucavaca. Any individuals whose home ranges overlap with the survey area have a capture probability greater than zero, whether the survey area is continuous or discontinuous. However, capture probabilities decrease from the centre towards the edge, and a discontinuous area maximizes the edge effect. Therefore, we would expect the density estimate from Tucavaca to be valid, though less precise than the estimates derived from continuous survey areas.

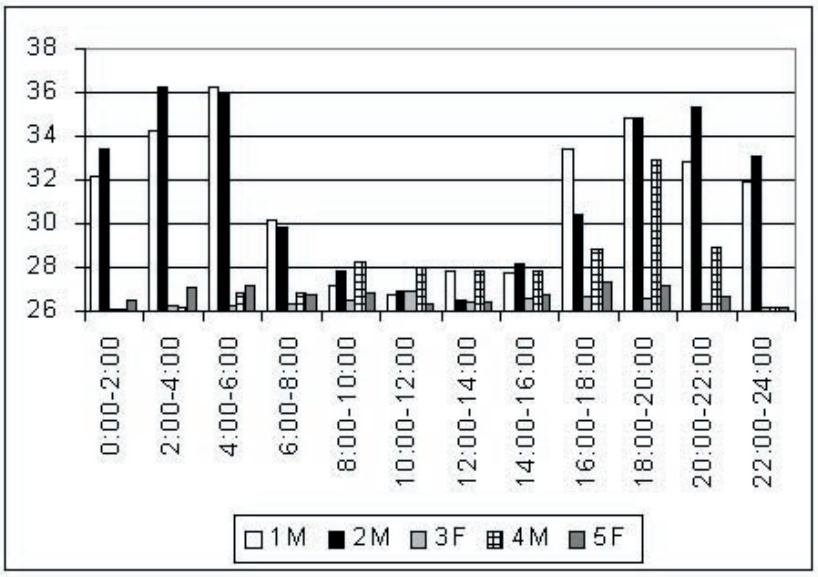


**Figure 3a.** Activity Patterns for Tapirus terrestris According to Radio Telemetry.

**Note:** Radio-collars emit pulses at a rate of 26-52/30 seconds, with 26 representing inactivity and 52 maximum activity. The y-axis indicates the average pulse rate during the activity period.

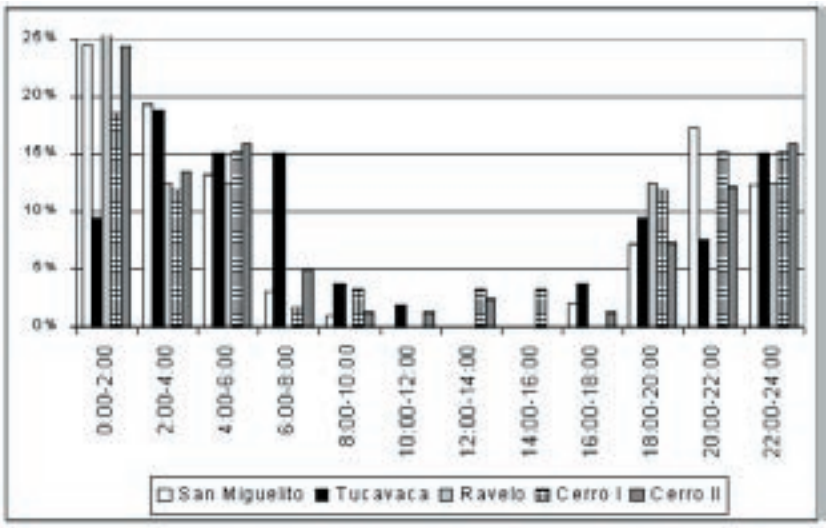


**Figure 3b.** Activity Patterns for Tapirus terrestris According to Camera Traps - Proportion of Observations per Time Period.

**Note:** With the small number of total observations from Ravelo (N=8), 50% of observations are in 0:00-2:00 time period.

Camera trapping provides an important alternative method for monitoring *Tapirus terrestris*, permitting the identification of individuals and description of their ranging behaviour, and in turn the estimation of population densities. As we demonstrate in this paper, the information provided by camera trapping on activity patterns and ranging patterns coincides with radio telemetry data at the Cerro Cortado site where we have applied both methodologies. While the density estimate

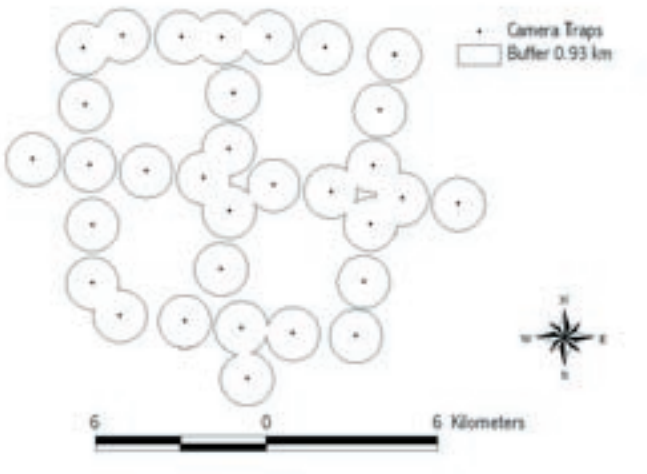


**Figure 4a.** Tucavaca I Camera Trap Location and Survey Area.

from radio-telemetry would appear to be much higher than those from camera trapping, the first is so imprecise that the 95% confidence limits of the three estimates overlap and the differences therefore are not statistically significant. Camera trapping provides considerably more precise density estimates, whereas radio telemetry provides considerably more precise and complete information on ranging patterns.

Both camera trapping and radio telemetry imply important costs, particularly to open and maintain study trails, to purchase equipment, and to support field staff. But camera trapping offers several important benefits over radio telemetry. First, telemetry requires animal capture and immobilization, which can be risky and stressful for both tapirs and biologists. Second, a systematic camera trapping survey lasts two months, with results of analysis available within three months of beginning fieldwork, whereas telemetry studies normally extend for a year or more. Third, camera trapping can simultaneously provide similar information for other species in the area: density estimates for jaguar, puma and ocelot; and activity patterns for these and other relatively abundant species (Maffei *et al*., 2002; Rumiz *et al*., 2003).

Camera traps have previously been used to monitor activity of *T. pinchaque* in Colombia (Lizcano & Cavelier, 2000a). However, only preliminary results regarding relative abundance of tapirs are available from other systematic camera trap surveys. The capture frequencies reported here for Bolivian dry forests (11-60/1000 trap nights) surprisingly exceed those reported from Bolivian lowland moist tropical forest in Madidi (7/1000 trap nights, Wallace *et al.,* 2002). Capture frequencies for *T. bairdii* in the rainforest of Belize (12/1000 trap nights - Kelly, under review), and for Malay tapir (*Tapirus indicus)* in lowland rainforest and hill dipterocarp forest of Sumatra, Indonesia (4-19/1000 trap nights, Holden *et al.,* 2003) are also at the low end of the Bolivia dry forest range.

The minimum time tapirs remain during visits to salt licks in these dry forests coincides with data from lowland tropical rainforest in Bolivia's Noel Kempff Mercado National Park (Herrera *et al.,* 1999). We have not recorded any extended stays as reported for *T. pinchaque* in Colombia (Lizcano & Cavelier, 2000a). These differences presumably derive from differences in quality and composition of food resources for tapirs in lowland and montane forests. Alternatively, the quality for tapir of the salt licks under surveillance may have varied among sites.

Our surveys at three sites within the vast Kaa-Iya del Gran Chaco National Park (33,400 km$^2$), with tapir densities from

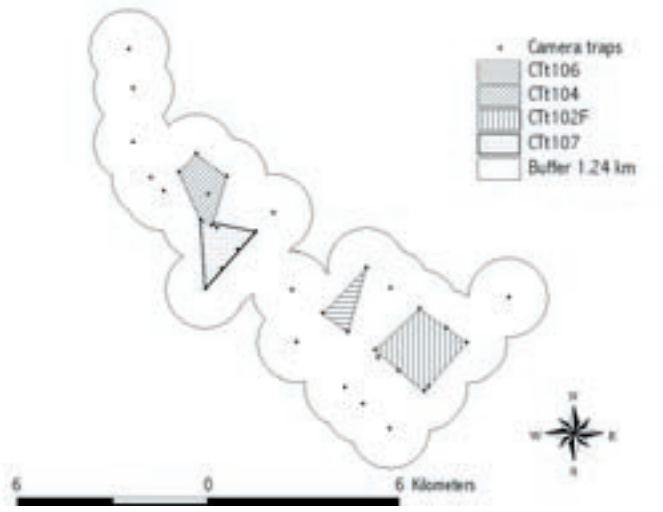


**Figure 4b.** Cerro Cortado I Camera Trap Location, Survey Area and Tapir Ranges.

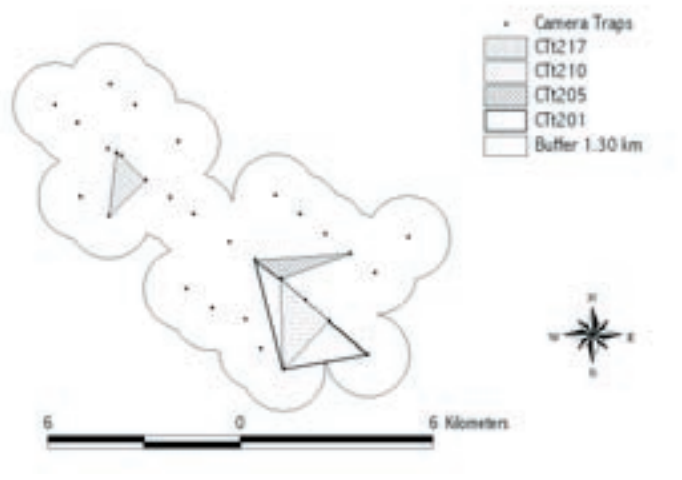


**Figure 4c.** Cerro Cortado II Camera Trap Location, Survey Area and Tapir Ranges.

0.20-0.29/km$^2$ according to camera traps, and potentially much higher according to radio telemetry, confirm the conservation value of this incredible wilderness as a stronghold where *Tapirus terrestris* can maintain a viable population, probably exceeding 6000 individuals, over the long-term. The protected area also appears to be an important "source" area that can provide benefits over the long-term for hunters in nearby indigenous community "sinks" such as the 19,000 km$^2$ Izoceño-Guaraní indigenous territory. Finally, our survey at San Miguelito suggests that even small, protected areas within fragmented agricultural landscapes can maintain tapirs at high densities and, therefore, private reserves can provide important conservation benefits, particularly when such reserves maintain connections to other protected areas to ensure long-term population viability (Rumiz *et al.,* 2002). We will continue to test and refine camera trapping methods by repeating the intensive surveys at our long-term research sites in order to monitor populations and individuals over time. We will also survey additional sites within Kaa-Iya's unsurveyed landscape systems to determine more precisely the species' status within the protected area.

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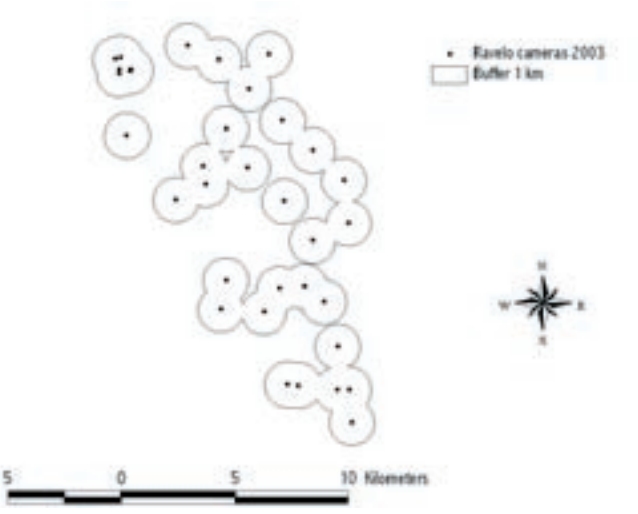


**Figure 4d.** Ravelo Camera Trap Location and Hypothetical Survey Area.

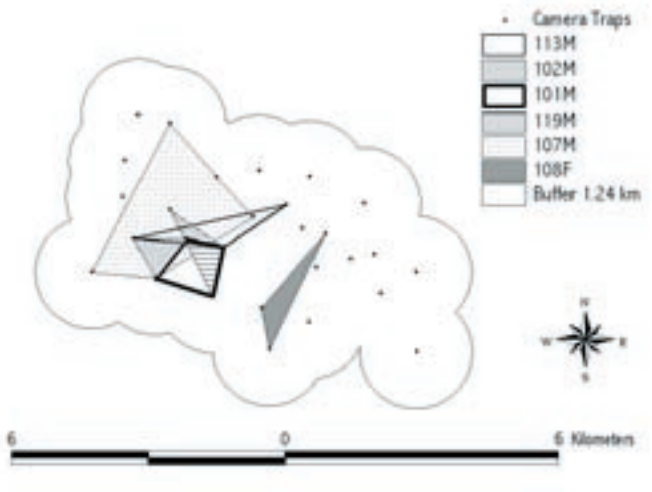


**Figure 4e.** San Miguelito Camera Trap Location, Survey Area and Tapir Ranges.

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# ASKING THE EXPERTS: OPINIONS ON TAPIR SCIENCE AND RESEARCH QUESTIONS

## Unequal Tapirs: A Question of Sex, Age and the Environment

**By Leonardo Salas**

Dimorphism in mammals, or lack thereof, is predominantly the outcome of one process that overrides other affecting factors. In principle, sexual dimorphism where males are the larger gender should be expected in mammals because, other things being equal, females provide a much larger investment in the offspring during gestation and lactation. This allows males to seek additional partners, thereby increasing their chances of passing on genes to the next generation. As a consequence, fecund females become scarce (many are not in oestrus or are gestating already) and males, social and environmental conditions allowing, would be forced to compete to gain control of access to as many females as possible. This competition would act as a selective force favoring larger males and thus engendering a dimorphism.

But other factors often enough bear an important role in dimorphism. In an extensive review published in the 70's, as many as 30% of mammal families had taxa with dimorphisms where females were the larger sex. The circumstances selecting for larger females were related to being able to better nurture the offspring under difficult physiological conditions, which would reflect upon the offspring's survival to adulthood. Consider a whale that migrates 5,000 miles one-way while at the same time gestating, lactating and protecting a calf that must also swim great distances soon after birth in order to survive. Under these strenuous circumstances there is an advantage in being a larger female.

In tapirs, where females may be slightly bigger, it is conceivable that holding home ranges large enough to fully encompass (and thus control access to) those of several females may be energetically too costly for males. Under such circumstances, males may increase their chances of siring by overlapping (but not encompassing) the home ranges of several females, meeting them in communal grounds (such as salt licks or under fruiting trees) and tuning to cues to gauge their female neighbors' reproductive status. Direct competition between males would be rare. Monogamy is another case where males would not compete with each other (monogamy in mammals is very rare and usually associated with significant male parental investment after birth to ensure offspring survival). In both these scenarios, males would not be expected to be the larger sex. Moreover, offspring survival may be dependant on the amount of nurturing they receive while in the womb and while lactating. Larger females would likely be better able to provide for the calves, explaining the sexual dimorphism in tapirs, if any exists.

A substantial pattern between the sexes in tapirs has not been clearly discerned yet. Body size is an extremely plastic character, varying significantly between individuals in a population and between populations due to many extraneous factors. But if tapirs are sexually dimorphic, differences may be set very early on in the calves' growth as a reflection of differential, sex-dependent parental care after birth.

Under the above mentioned hypothetical scenario, it is to the advantage of the female to nurture better her female offspring, given that there must be an advantage for females to become larger. Further, the amount of investment on calves of either sex may be related to the mother's age, as either youth or experience may make her more able to cope with the energetic demands of reproduction.

We asked the TSG members about their views on the question of differential parental investment, age of tapirs, and sexual dimorphism.

Keith Williams proposed a scenario where differential parental investment should not be expected. He explained that "given that the quality of the habitat will be paramount to the potential growth rate, as with other species, any assumed difference in mothering inputs will be negated by the offspring's capacity to establish and forage. Social and environmental factors coupled with the composition and dynamics of forest production will swamp any subtleties which may occur in mothering." The health and parasite load of the calf would add to the complications. Under such a scenario, Keith maintains, it would be unlikely that a dimorphism would ensue because differential parental investment would ultimately not make much of a difference in the size or survival of the calves.

At least two experts (Alan Shoemaker and Viviana Quse) were quick to point out that the possibility exist to evaluate differential parental investment in zoos, where the most important affecting factors (age of the animals, health, genetic variability and food availability) can be controlled. Keith Williams suggested that an ideal test would "involve male-female twins and be replicated, an extremely unlikely event," more so if the age of the mother bears some influence.

Two other experts tackled the problem from different angles. Matt Colbert noted that, when age is unknown, "a major difficulty in establishing sexual size dimorphism is determining the individual's age. Age, or maturity stage, has to be established with enough precision to allow patterns of static allometry (i.e., size variation occurring within an age cohort)

to be differentiated from ontogenetic allometry (i.e., size variation occurring as a consequence of growth within a population)." In Matt's view, in other words, field evidence would require being able to differentiate individuals of different ages in order to ascertain that the size differences are attributable to dimorphism. How to age tapirs in the field will be the subject of another installment in the next newsletter.

Mitch Finnegan offered insight from similar studies in other mammals: "I know this issue has been studied in red deer in Britain (though in this species the males are larger and require greater investment). Some things that seem to be relevant include birth order of calves. Younger […] and smaller females may tend to have male offspring and older, […] larger females may tend to have females." If in tapirs female body weight varies significantly with age, he added, researchers could "… just look at the sex of offspring and correlate that with [female] body weight – if female offspring require greater investment you might find that larger [females] tend to have female offspring and smaller […] have males." If indeed the environment may greatly influence parental investment that reflects on calf survival, Mitch pointed out, then "…it may be found that in good years or better habitat the calf sex ratio is skewed toward females and in poor years or habitat the sex ratio is skewed toward males. If this was found it would lend support to the idea that female calves get more maternal investment". Mitch cautiously noted that in the latter case "…good objective means of evaluating […] environmental quality" are needed.

Genetics may play a role too, as closely related females may show similar parental investment strategies. Thus, data must be provided for genetically unrelated animals. As it stands, only indirect evidence from zoos will shed light on this question. Zoos and other captive breeding facilities can provide age of research subjects (mother and calf) with certainty, and the logistic setting to measure post-natal parental investment and accurate body size.

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## Notes for Contributors

Scope – This newsletter aims to provide information regarding all aspects of tapir natural history. Items of news, recent events, recent publications, thesis abstracts, workshop proceedings etc concerning tapirs are welcome.

Please include the full name and address of the authors underneath the title of the article.

**Full-length articles** on any aspect of tapir natural history should not be more than 15 pages in length (including references). An abstract is required and British English spelling is requested.

**Figures and Maps.** Articles etc can include black and white photographs, high quality figures and high quality maps and tables.

**References.** Please refer to these examples when listing references:

***Journal Article***
Herrera, J.C., Taber, A., Wallace, R.B. & Painter, L. 1999. Lowland tapir (*Tapirus terrestris*) behavioural ecology in a southern Amazonian tropical forest. *Vida Silv. Tropicale* 8:31-37.

***Chapter in Book***
Janssen, D.L., Rideout, B.A. & Edwards, M.S. 1999. Tapir Medicine. In: M.E. Fowler & R.E. Miller (eds.) *Zoo and Wild Animal Medicine*, pp. 562-568. W.B. Saunders Co., Philadelphia, USA.

***Book***
Brooks, D.M., Bodmer, R.E. & Matola, S. 1997. *Tapirs: Status, Survey and Conservation Action Plan*. IUCN, Gland, Switzerland.

***Thesis/Dissertation***
Foerster. C.R. 1998. *Ambito de Hogar, Patron de Movimentso y Dieta de la Danta Centroamericana (Tapirus bairdii) en el Parque Nacional Corcovado, Costa Rica*. M.S. thesis. Universidad Nacional, Heredia, Costa Rica.

***Report***
Santiapilli, C. & Ramono, W.S. 1989. *The Status and Conservation of the Malayan tapir (Tapirus indicus) in Sumatra, Indonesia*. Unpublished Report, Worldwide Fund for Nature, Bogor, Indonesia.

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# TAPIR CONSERVATION

## The Newsletter of the IUCN/SSC Tapir Specialist Group

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