PHVA

Baird's Tapir

Tapirus bairdii

Baird's Tapir (*Tapirus bairdii*) Conservation Workshop
Population and Habitat Viability Assessment (PHVA)

15 to 19 August 2005, Belize, Central America

Final Report

A contribution of the IUCN/SSC Tapir Specialist Group (TSG), IUCN/SSC Conservation Breeding Specialist Group (CBSG) in cooperation with the Belize Zoo and Tropical Education Center.
Baird's Tapir (*Tapirus bairdii*) Population and Habitat Viability Assessment (PHVA). Final Report.
CBSG Mexico and CBSG Headquarters.

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A participative workshop in cooperation with:

Workshop organized by: *IUCN/SSC Tapir Specialist Group (TSG).*

Financial support provided by: *Africam Safari, Association of Zoos and Aquariums (AZA) - Tapir Taxon Advisory Group (TAG), Brevard Zoo, XCARET Park, Connecticut's Beardsley Zoo, Bergen County Zoological Park, BREC´s Baton Rouge Zoo, Brookfield Zoo - Chicago Zoological Society, Critical Ecosystem Partnerrship Fund (CEPF) - Conservation International, European Association of Zoos and Aquaria (EAZA) - Tapir Taxon Advisory Group, Franklin Park Zoo, Jacksonville Zoo and Gardens, Lee Richardson Zoo, Los Angeles Zoo, Louisiana Parchase Gardens and Zoo, Milwaukee County Zoological Gardens, Nashville Zoo at Grassmere, Omaha´s Henry Doorly Zoo, San Diego Zoo and Wild Animal Park, Sedgwick County Zoo, Tapir Preservation Fund (TPF), U.S. Fish & Wildlife Service - Division of International Conservation, Houston Zoo Inc., Virginia Zoological Gardens, Wuppertal Zoo, World Association of Zoos and Aquariums (WAZA), Zoo Conservation Outreach Group (ZCOG) and Private Donors.*

Institutional support provided by: *IUCN/SSC Tapir Specialist Group (TSG), IUCN/SSC Conservation Breeding Specialist Group (CBSG), Association of Zoos and Aquariums (AZA) - Tapir Taxon Advisory Group (TAG), European Association of Zoos and Aquaria (EAZA) - Tapir Taxon Advisory Group, Houston Zoo Inc., and The Belize Zoo and Tropical Education Center (TEC).*

Workshop facilitated by: *IUCN/SSC Conservation Breeding Specialist Group (CBSG www.cbsg.org).*

Medici, E. P.; Carrillo, L.; Montenegro, O.L.; Miller, P.S.; Carbonell, F.; Chassot, O.; Cruz-Aldán, E.; García, M.; Estrada-Andino, N.; Shoemaker, A.H.; Mendoza, A. (Editors). 2006. Baird's Tapir Conservation Workshop: Final Report. IUCN/SSC Tapir Specialist Group (TSG) & IUCN/SSC Conservation Breeding Specialist Group (CBSG), Apple Valley, MN, United States.

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Executive Summary

Introduction

Until recently, tapirs had received relatively little international support and attention, in comparison with that received by their closest relatives, the rhinos and wild equidae. Tapirs are disappearing from their original distribution ranges, the Central and South American and Southeast Asian forests, mainly due to habitat destruction and hunting. The current distribution of the Baird's tapir (*Tapirus bairdii*) goes from Veracruz, in Mexico's southeastern region, through Central America and up to eastern slopes of Andes in South America, in the northernmost part of Colombia. The species occurs in all Central American countries, with the exception of El Salvador, where it is considered to be locally extinct. Its presence in South America was unknown until an individual was captured in Guayaquil, Ecuador, and soon transported by ship to the San Diego Zoo, United States, where it died in 1945 (Hershkovitz 1954). Nonetheless, there is no recent evidence of its occurrence in Ecuador, and in Colombia it is restricted to a small population at Parque Nacional Natural Los Katios. The distribution area is estimated to be 1,186,300 km^2 (Arita *et al.* 1990). Looking at Baird's tapir current distribution in more detail, one can conclude that the species survives mainly in areas where human access is difficult; thus where suitable habitat remains.

The species is listed as Endangered (A1abcde + 2abcde + 3bce) in the IUCN Red List of Threatened Species (2005), what means that it faces a high extinction risk in the wild. Besides, the species is included in CITES Appendix I, which in effect prohibits its international trade, and is also listed as Endangered by the U.S. Fish & Wildlife Service. The IUCN/SSC *Tapir Status Survey and Conservation Action Plan* (Brooks *et al.* 1997) and previous long-term research results have identified that Baird's tapir survival is threatened mostly by habitat destruction and hunting. Hunting is reducing Baird's tapir populations to dangerously low levels while deforestation is isolating these populations in small forest fragments. Consequently, while the sizes of tapir populations decrease, and the isolation interrupts the exchange of genetic material, the probability of extinction dramatically increases. Another factor to consider is that, in many parts of its range, Baird's tapir occurs outside Protected Areas.

The slow reproductive rate of tapirs (2-year inter-birth interval and usually only 1 offspring per litter) makes it difficult for the species to recover from low population levels, especially if we consider that the remaining habitats have been almost completely fragmented in recent years, leaving, in the majority of cases, small remnant populations isolated from one another. Tapirs have a critical role in creating and maintaining biological diversity, and they work as indicators of the health of various tropical ecosystems. The local extinction or population reduction can trigger adverse effects to the ecosystem, causing a breakdown of some key ecological processes (*e.g.* seed dispersal and predation, nutrient recycling), and eventually jeopardizing the ecosystem biodiversity and integrity in the long term. These factors justify the urgency in the development and implementation of conservation and management plans for the Baird's tapir populations in the eight countries where it occurs - Belize, Colombia, Costa Rica, Guatemala, Honduras, Mexico, Nicaragua and Panama.

IUCN/SSC Tapir Specialist Group (TSG)

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

The Tapir Specialist Group's mission is to preserve biological diversity by stimulating, developing, and executing practical programs to study, save, restore, and manage the four tapir species and their remaining habitats in Central and South America and Southeast Asia. The TSG attempts to fulfill this mission through the implementation of the following strategies: a.) Frequent revision, status determination, and promotion of tapirs and their needs; b.) Promoting and supporting research and distributing informative materials; c.) Promoting conservation and management programs by the appropriate organizations and governments; and, d.) Establishing effective and strong relationships among conservationists focused on tapirs in order to stimulate cooperation. Nowadays, the TSG has 107 members, including field researchers, environmental educators, veterinarians, governmental agencies, non governmental organizations (NGOs) representatives, zoo personnel, university professors and students, from 27 countries worldwide (Argentina, Australia, Belize, Bolivia, Brazil, Burma, Canada, Colombia, Costa Rica, Denmark, Ecuador, France, French Guyana, Germany, Guatemala, Honduras, Indonesia, Malaysia, Mexico, Panama, Paraguay, Peru, Thailand, The Netherlands, United Kingdom, United States, and Venezuela). All members are directly or indirectly involved in field research and/or captive breeding in their respective regions.

The TSG, alongside the Association of Zoos and Aquariums (AZA) Tapir Taxon Advisory Group (TAG), European Association of Zoos and Aquaria (EAZA) Tapir Taxon Advisory Group (TAG), Copenhagen Zoo, Denmark, and Houston Zoo Inc. are the key groups working in the development and implementation of tapir conservation, management and research projects . An important aspect of the mission of these five organizations is to contribute to the development of a coordinated international conservation strategy for these species.

TSG Action Planning Committee

Action plans are designed to promote conservation strategies of a given species, supported by scientific information, which is summarized and translated into prioritized conservation recommendations suggesting real solutions through specific actions. These documents are designed by any person or body of decision-makers in order to promote or catalyze conservation actions in financial, technical, or logistical ways, influencing key players in the conservation field at the local, national, regional, and global levels. They provide a common framework and are focused on a range of players from decision-makers at the governmental level to those who will implement the conservation actions in the field. Scientists, resource managers, government personnel, funding bodies, universities, zoos, and political leaders use them when deciding on how to allocate the available resources. Action plans provide all the available information to explain why the species conservation actions should be carried out, including the species conservation status and the problems associated with its long-term survival and viability; they also provide specific management recommendations aiming at conducting, maintaining or improving species population levels and mitigating threats. Action plans are also "snapshots in time", providing a baseline information and data set against which one can measure changes and monitor progresses, indicating where changes of emphasis or direction may be needed to conserve the species. Furthermore, they identify gaps in the research and policies on the species and give directions for future endeavors on what data and knowledge are most needed. Lastly, action plans are "*living documents*" that must be periodically updated and revised as our knowledge on the species and conservation problems improves.

During the past three years, TSG Action Planning Committee has worked tirelessly, making all the necessary effort to conclude the task of revising and updating the first version of the IUCN/SSC *Tapir Status Survey and Conservation Action Plan*, edited by Daniel Brooks, Richard E. Bodmer and Sharon Matola in 1997. During the First International Tapir Symposium held in San José, Costa Rica, in November 2001, participants agreed that the revision and updating of the first version of the Action Plan should be one of the priority goals for the Tapir Specialist Group in the medium term. An Action Planning Committee was created and it was discussed the most efficient and practical ways to revise the 1997 Action Plan. The final conclusion was that carrying out Population and Habitat Viability Assessment (PHVA) Workshops, within the framework of the IUCN/SSC Conservation Breeding Specialist Group (CBSG), would be the most efficient and appropriate methodology for developing updated versions of the Action Plans for each one of the four tapir species.

The first step towards achieving the goal of carrying out a PHVA workshop for each one of the four tapir species was the Malayan Tapir Population and Habitat Viability Assessment Workshop (PHVA), held in Krau Wildlife Reserve, Malaysia, in August 2003. The workshop organizers were the IUCN/SSC Tapir Specialist Group (TSG); European Association of Zoos and Aquaria (EAZA) Tapir Taxon Advisory Group (TAG); IUCN/SSC Conservation Breeding Specialist Group (CBSG) and the Malaysian Department of Wildlife and National Parks (DWNP). The largest financial support came from the Copenhagen Zoo in Denmark. Other contributors were the Wildlife Conservation Society of Thailand, the DWNP, and Idea Wild, United States. The workshop included a group of 35 participants, representing the Malayan tapir range countries in Southeast Asia, including Malaysia, Indonesia and Thailand, and also TSG representatives from other countries. The final result was an updated Malayan tapir Action Plan listing and prioritizing strategies and actions for the conservation of the species.

Some months later, during the Second International Tapir Symposium, held in Panama, participants agreed that the next PHVA would focus on mountain tapirs. Although there were already some previous local efforts for mountain tapir conservation, it was deemed important to identify larger scale strategies including all three countries in the distribution range — Colombia, Ecuador and Peru. Therefore, the Mountain Tapir Population and Habitat Viability Assessment (PHVA) Workshop was carried out at the Otún-Quimbaya Sanctuary, Pereira, Colombia, in October 2004. The institutional support for this workshop came from the IUCN/SSC CBSG; Association of Zoos and Aquariums (AZA) Tapir Taxon Advisory Group (TAG); European Association of Zoos and Aquaria (EAZA) Tapir Taxon Advisory Group (TAG); Colombian Tapir Network (Red Danta de Colombia); Houston Zoo Inc., United States; World Wildlife Fund (WWF), Colombia; and Conservation International (CI), Colombia. Financial support came from the AZA Tapir TAG; WWF — Colombia; Conservation International — Colombia; U.S. Fish & Wildlife Service, Division of International Conservation; Special Administrative Unit of Colombia's Natural National Parks System (Unidad Administrativa Especial del Sistema de Parques Nacionales Naturales de Colombia - UAESPNN); Houston Zoo Inc., United States; Los Angeles Zoo, United States;

Copenhagen Zoo, Denmark; and Cheyenne Mountain Zoo, United States. A total of 66 representatives from the mountain tapir range countries (Colombia, Ecuador, and Peru) attended the workshop, as well as TSG members from other countries, and it resulted in the revision and updating of the Mountain Tapir Action Plan, listing and prioritizing strategies and actions for the conservation of the species.

The third workshop of a series of four — the Baird's Tapir Conservation Workshop: Population and Habitat Viability Assessment (PHVA) — was held in Belmopan, Belize, Central America, from August 15 to 19, 2005. A total of 60 participants from the Baird's tapir range countries - Belize, Colombia, Costa Rica, Guatemala, Honduras, Mexico, and Panama – and several other TSG officers, as well as international participants, attended the meeting. The main workshop organizers were the TSG, Houston Zoo Inc. and The Belize Zoo and Tropical Education Center. Institutional support was provided by IUCN/SSC Conservation Breeding Specialist Group (CBSG); Association of Zoos and Aquariums (AZA) Tapir Taxon Advisory Group (TAG); European Association of Zoos and Aquaria (EAZA) Tapir Taxon Advisory Group (TAG). Financial support came from Conservation International's Critical Ecosystem Partnership Fund (CEPF), United States; TSG Conservation Fund (TSGCF); Houston Zoo Inc., United States; U.S. Fish & Wildlife Service, Division of International Conservation, United States; Chicago Board of Trade Endangered Species Fund, Brookfield Zoo, Chicago Zoological Society, United States; Milwaukee County Zoological Gardens, United States; Parque XCARET, Mexico; Africam Safari, Mexico; World Association of Zoos and Aquariums (WAZA), Switzerland; Nashville Zoo at Grassmere, United States; Sedgwick County Zoo, United States; Virginia Zoological Gardens, United States; Bergen County Zoological Park, United States; Los Angeles Zoo, United States; San Diego Zoo, United States; Franklin Park Zoo, United States; Omaha's Henry Doorly Zoo, United States; Jacksonville Zoo and Gardens, United States; Louisiana Purchase Zoo, United States; Wuppertal Zoo, Germany; BREC's Baton Rouge Zoo, United States; Connecticut's Beardsley Zoo Conservation Fund, United States; Brevard Zoo, United States; Lee Richardson Zoo, United States, and Private Donors.

Considering that there are four tapir species and that PHVA Workshops were held for three of them — Malayan Tapir PHVA Workshop held in Malaysia in 2003, Mountain Tapir PHVA Workshop held in Colombia in 2004, and Baird's Tapir PHVA Workshop held in Belize in 2005 — we can say that we have completed 75% of the second version of the IUCN/SSC Tapir Action Plan, listing and prioritizing strategies and actions for the conservation of the three species and their remaining habitats.

IUCN/SSC Conservation Breeding Specialist Group (CBSG)

The main objective of the Conservation Breeding Specialist Group, as a member of the Species Survival Commission (SSC) of the International Union for the Conservation of Nature and Natural Resources (IUCN), is to contribute for the development of holistic and viable conservation strategies, as well as the management of action plans. With that aim, CBSG is cooperating with agencies and other specialist groups in the world in the development of scientifically-based procedures both at the global and the regional level, having the facilitation of a comprehensive approach for species management and conservation as its goal. One of the tools to achieve that goal is the process of the Workshop of Population and Habitat Viability Assessment (PHVA).

CBSG-Mexico has organized several PHVA (Population and Habitat Viability Assessment) and CAMP (Conservation Assessment and Management Plan) workshops, such as: Mexican felids, primates, cactaceae and lagomorphs CAMPs, and howler monkey, scarlet macaw, horned guan, peninsular pronghorn, harpy eagle, whale shark, and mountain tapir PHVAs. Besides, CBSG-Mexico, aiming to train more and more professionals involved with wildlife management, care and research, also organizes training workshops to offer valuable tools to those specialists in whose hands lies the regulation of the wild fauna and flora in the country. Those were the cases of the workshops carried out in 2002: VORTEX handling (July 2002), that being a computational model through which one can make predictions about the future of a given species, according to the current management data; and the Disease Risk Assessment Workshop (October 2002), whose objective was to provide practical procedures to evaluate the risk of emergence or introduction of diseases in wild animal populations, especially those at extinction risk, to fauna management professionals, field biologists and veterinarians.

The PHVA Process (Population and Habitat Viability Assessment)

The IUCN/SSC Conservation Breeding Specialist Group (CBSG) has the philosophy that the effectiveness of the conservation actions for an endangered species is based, among other things, on critical knowledge revision and on the use of the best biological information available, but also on the attitudes of the people that share the habitat with the species in question. At the beginning of each PHVA workshop, participants agree on the objectives of the meeting, which are to prevent the extinction of the species and to maintain viable populations of it. The PHVA process goes through an in-depth look at the species ecology, populations, conservation status, threats and conservation measures.

The Population and Habitat Viability Assessment (PHVA) is a very efficient and systematic process for species action planning. Managing endangered species is an extremely complex conservation problem. It requires the involvement and collaboration of experts from different professions and areas, an interchange of knowledge and technology, a building up of a consensus about threats and solutions, and a mobilization of resources. The PHVA workshop process balances the need to integrate the necessary information for evaluating alternative species conservation strategies with the need to integrate, or at least connect, individuals from different disciplines and backgrounds that are centrally concerned with the species of interest. The process is done on the hope of obtaining some realignment of priorities among individual stakeholder groups, taking into account the needs, views and initiatives of other groups. Key to this process is the use of VORTEX, a computer software that models population dynamics, performs a risk assessment, and provides both a tangible focus for quantitative evaluation of conservation options for a species and a vehicle for integrating different biological species and human sociological data. Taken together, the risk assessment modeling and the discussion among stakeholder participants are designed to address the issues affecting the species in a straight way, so that alternative strategies can be rationally and systematically analyzed. When such analysis happens, they result in better conservation decisions and specific action steps with targeted responsibility. One of the main results of PHVA workshops is the unpublished information which is gathered and compiled. It is estimated that around 80% of the useful information about a given species is inside the heads of experts and this may never come to be published. This information will lay the basis upon which to build simulations of each population through the use of models that will allow the analysis of stochastic and deterministic effects as well as the interaction of genetic, demographic, environmental and catastrophic factors on the population dynamics and extinction risk. This process leads to the elaboration of a baseline species model based on consensus. The model simulates the biology of the species, as it is currently known, and allows for the continuation of the discussion about management alternatives and the species or population adaptive management as more information on the species is obtained. Lastly, it allows the establishment of management programs which, on the way of scientific exercises through the continuous evaluation of new information, allows a strategy in the management procedures and the benefit of the power to adjust them as needed.

In a PHVA, all participants are equivalent and the contribution of everyone for the success of the process is acknowledged. The information brought by researchers, government officials, members of local communities, park rangers, hunters etc. has one and the same importance. Another significance of the PHVA process lies on communication. Frequently, there are different people who have been working with the same species for years, yet never shared information face to face. During the PHVA workshop, participants work in small groups to discuss those issues previously identified as central for the species recovery. Those issues may include, for example, prevention of mortality causes, habitat conservation, management of prey species, human pressure, captive breeding etc.

The main goal of the Baird's Tapir PHVA Workshop was to compile, organize and discuss all available data and information on this species (population demographic parameters, for example, age structure, birth, dispersion, and mortality rates, and other biological data, the current species status and its distribution, threats to survival on its range, available habitat etc.). Ultimately, the workshop aimed at using all this information to develop a new, updated Baird's Tapir Action Plan. This involved establishing conservation, management and research priorities of the species in the wild, but also paying attention to the captive population, education, and funding and research priorities. The goals of the workshop were: **1.)** To define the limits of the Baird's tapir populations in the remaining habitats; **2.)** To determine the status of the Baird's tapir sub-populations; **3.)** To determine the threats against these sub-populations **4.)** To define geographical areas where the Baird's tapir would have long-term survival prospects; **5.)** To prioritize research, conservation and management actions needed to protect Baird's tapir throughout these areas; **6.)** To develop a communication strategy to approach politicians and decision-makers.

The workshop was officially opened by Dr. Lizandro Quiróz from the Belize's Forestry Division. Subsequently, Patrícia Medici, chair of the IUCN/SSC Tapir Specialist Group (TSG), as well as Dr. Eduardo Naranjo, TSG Baird's Tapir Coordinator, welcomed participants. Dr. Lewis Greene, Chair of the AZA Tapir TAG, welcomed participants on behalf of his network. Next, participants were asked to introduce themselves and to consider which were, on their point of view, the main threats faced by the species and the main factors and challenges for the conservation of Baird's tapir in the next 25 years. Lastly, there were introductory presentations about the CBSG, the PHVA workshop process and about VORTEX modeling. Once the introductory presentations were concluded, TSG Country Coordinators for Baird's tapir range countries made presentations and gave reports about Baird's tapir conservation status in their countries: Belize, Humberto Wohlers; Colombia, Olga Montenegro; Costa Rica, Fengmei Wu Chen; Guatemala, José Roberto Ruiz Fuamagalli; Honduras, Nereyda Estrada Andino; Mexico, Epigmenio Cruz Aldán; and Panama, Karla Aparício, Rafael Samudio, and Alberto Mendoza.

Based on the recognized challenges for the conservation of the species, the group and workshop facilitators identified five (5) working groups:

1.) Habitat Management
2.) Population Management
3.) Human Impact
4.) Population Biology and Simulation Modeling
5.) *Ex-Situ* Conservation

Each working group was given the following tasks:

- To discuss and refine the issues and problems faced by the species;

- To prioritize the issues;

- To develop and prioritize short- and long-term goals for each issue;

- To develop and prioritize detailed action steps for each high-priority goal;

- To identify the different types of resources required to implement each action step.

Each group presented the results of its deliberations in plenary sessions, in order to guarantee that everyone had the opportunity to contribute to the work of the other working groups and to ensure that every issue was revised and discussed by the whole group.

In order to assess the risk in possible future ecological scenarios, the Population Biology and Risk Assessment group developed simulation models (VORTEX) and identified the critical factors related to population extinction/survival. Even then, the group considered some alternative management strategies that could improve the Baird's tapir situation.

During the workshop, participants had several open and productive discussion sessions about the overall viability of Baird's tapir conservation. Every working group produced a report of its deliberations, all of which are included in this workshop report. The success level of a PHVA depends on its general functioning, in which everyone, many with quite different interests, feels they have "won" in the development of demographic simulation models and management strategies that best represent the reality of the species and that these be achieved by consensus.

Prioritization of Goals of all Working Groups

In an effort to develop a significant consensus level among all workshop participants about the most important goals for Baird's tapir conservation, the workshop facilitators led the group through a process where the goals of each one of the working groups were prioritized by all participants according to a single selection criterion.

Below are the prioritized goals produced by each working group:

Population Management

1. After one year, to have agreed on a standard methodology for population evaluation for specific research topics, which will start to be applied on each country.

2. In 2010, the region will have 16 research projects, all leading to scientific publications; these will fill the information gaps, and will focus on the research topics already prioritized in the 2005 Baird's Tapir PHVA Workshop.

3. To identify, after one year, the reference genetics laboratories in order to analyze the samples that can be preserved, mainly in the cases where there is no one who carries out the analyses.

4. To have, every two years, a periodic evaluation of the aims and progresses of the goals and actions.

5. To have, after one year, a standardization of protocols for biomedical research.

6. To identify, after of one year, the reference laboratories for evaluating the samples that can be preserved, mainly in the cases where there is no one who carries out the analysis.

7. In 2010, the region will have at least one research per range country leading to scientific publications; these will fill the information gaps, and will focus on the research topics already prioritized in the 2005 Baird's Tapir PHVA Workshop.

8. To have National Action Plans for Baird's Tapir Conservation in each range country by the end of 2007.

9. In 2007, the TSG will build and implement at least three partnerships/cooperation agreements in the region and at the country level.

10. In 2010, every range country will have the integration of new researchers and institutions, forming a working team which allows fulfilling its research needs.

11. Until 2006, each range country will have a committee to promote the liaison among the institutions working with Baird's tapir research and new institutions, represented by one person committed with information diffusion and the work with tapirs' conservation.

12. To compile and distribute, in six months, a list of organizations which provide funding, capacity-building programs at the national and international levels, institutions directly or indirectly involved with Baird's tapir conservation, their abilities, action focus, as well as their material resources and equipment which can be borrowed, donated or interchanged.

13. To have, in 2006, an implemented annual database listing the financial contributtions made for tapir conservation projects and programs.

14. From this Baird's Tapir PHVA Workshop on, that we manage to send all PDFs or scientific articles about research projects that have been carried out up to date to the TSG and the *Tapir Conservation* Newsletter and that this goes on along time.

15. To achieve, for 2006, TSG support for speeding up the required formalities and permits for research projects in favor of the Baird's tapir (in the case of those countries where the problem occurs: Guatemala, Costa Rica and probably others).

16. T o produce, until 2006, along with national security officials, a list and a map of areas in which there is insecurity due to social or political conflicts and bring this document to public opinion.

17. To manage raising awareness of governments about the need of a written commitment to the working stability and professional profile for key positions, as well as the importance of Baird's tapir conservation.

Habitat Management

1. To reduce the processes of Baird's tapir habitat degradation and loss in priority areas.

2. To promote the conservation of Baird's tapir habitat using scientific-based knowledge.

3. To strengthen and improve the system of protected wild areas using scientific-based criteria of habitat planning and management.

4. To include Baird's tapir habitats that are not covered yet by national systems of protected areas within some management category.

5. To strengthen the management capacity of the governmental institutions responsible for law enforcement.

Human Impact

1. To increase by 75% (along 4 years) the knowledge of rural communities, urban areas, decision-makers, schools and high schools, and personnel involved with natural resources management about the Baird's tapir.

2. To manage getting the Baird's tapir to be a charismatic species through clear and concise messages.

3. To have environmental plans from governments and private companies which include protection of the Baird's tapir and its habitat in four countries in a period of five years.

4. To develop and approve laws, over the next five years, to protect Baird's tapirs and their habitat.

5. To implement alternative systems of production as an income source for rural communities. With this, we aim at improving the conservation of Baird's tapir and its habitat, in 25% of the priority areas, in the next five years.

6. Within five years, the Baird's tapir will be recognized as a priority species for conservation in all range countries.

7. To reduce illegal hunting by 20% in the next five years in the areas where Baird's tapir lives in.

8. To establish, within four years, national legislations to punish actions against the integrity of Baird's tapir and its habitat in Honduras, Nicaragua and Guatemala.

9. To have the current legislation implemented by the responsible authorities within two years in all range countries involved.

10. To promote the establishment of a body of officials trained in law enforcement.

11. To raise awareness, where it is most needed, about the importance of Baird's tapir.

12. To count on the active participation of local communities in the conservation of Baird's tapirs and their habitat.

13. To define, within one year and based on the available information, the priority sites to channel conservation actions.

14. To have 50% of the institutions, researchers and communities technically trained in information production and management within two years and a half.

15. To have an accessible information and documentation center on the Baird's tapir and its habitat, within four years.

Population Biology and Simulation Modeling

1. To quantify and document habitat loss and change, hunting and introduction of diseases, which reduce the size of the populations, jeopardizing the Baird's tapir long-term viability, and to generate more information about distribution, abundance, population dynamics, genetics, health status evaluation and habitat availability.

2. To have a map of priority areas for Baird's tapir conservation within the distribution range.

3. To start up the international institutional cooperation in the areas shared between neighboring nations for the generation of conservation strategies, and production of information on abundance, population dynamics, genetics, health status evaluation and habitat use and availability.
4. To have a diagnosis (identification of needs) about the isolated Baird's tapir populations and to propose strategies for their long-term conservation.

5. To have an updated map of the actual distribution of Baird's tapir on each range country, guaranteeing the standardization of the methodology.
6. To define minimum viable population sizes.

7. To focus the generation of information on abundance, population dynamics, genetics, health status evaluation and habitat use and availability in the five biological regions where the largest Baird's tapir populations occur (Zoque Forest, Maya Forest, La Mosquitia, Lower San Juan river basin, Talamanca – Darién).

8. To define the necessary habitat to maintain a viable Baird's tapir population in the long term.

9. To define the minimum genetic variability to guarantee a viable Baird's tapir population.

10. To document the main problems related with the incoherence in public policies, deficiencies in education and communication, and the political instability, which hinder the design and implementation of management and conservation actions.

11. To have a synthesis of the information on natural history up to the moment.

12. To estimate the frequency and intensity of the natural hazards of variable intensity on each range country.

Ex-Situ Conservation

1. To achieve effective communication among the professionals involved with Baird's tapir conservation in captivity.

2. To develop and implement a Regional Collection Plan (RCP).

3. To identify potential *ex-situ* research projects.

4. To identify, in each range country, the current obstacles for Baird's tapir importing/exporting and transport and to get members from the region to know the procedures for carrying out such interchange/transport.

5. There will be adequate conditions for the tapirs in most of the collections in the region.

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15 to 19 August, 2005

Section 2

Population Management Working Group Report

Population Management

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José Roberto Ruiz Fuamagalli, Universidad de San Carlos (University of San Carlos) - TSG, Guatemala
José Soto, Wildlife Conservation Society, Guatemala
Juan de Dios Valdez Leal, TSG, Mexico
Marco Benítez, Africam Safari, Mexico
Nereyda Estrada Andino, USAID/MIRA & TSG, Honduras
Oscar Ulloa, Conservation Division of Belize, Belize
Rafael Samudio Jr., SOMASPA/PROBIOMA & TSG, Panama
Sergio Midence, Ministerio del Ambiente (Ministry of Environment), Honduras

PROBLEMS

1. The information on Baird's tapir ecological and biological monitoring is incomplete, particularly about:

- Current Baird's tapir distribution, abundance and density in its entire range in the region (all countries)
- Standardization of methods and criteria
- Movement patterns and habitat use
- Population genetics
- Reproductive aspects
- Diet and feeding ecology
- Seed dispersal and predation
- Natural predation on Baird's tapir

2. Poor knowledge of the biomedical parameters as reference or comparison of the wild populations, given the proximity with domestic animals

- Physical/chemical restraint methods
- Methods for collection and processing of biological samples
- Biomedical parameters (biometry and macrobiota)
- Disease prevalence and epidemiological risk factors
- Biosecurity

3. rganizations (governments, NGOs, universities etc.) in the region do not contribute in a more effective manner for Baird's tapir conservation due to:

- Inadequacy of the administrative resources for the field work
- Poor regional and inter-institutional cooperation

- Lack of specialized human resources
- Scarce availability and knowledge of economical resources and funding sources
- Deficient availability and difficulties on material acquisition, teams, and infrastructure
- Lack of capacity-building, training and updating
- Non-existence of National Action Plans for Baird's Tapir Conservation in each range country
- Work instability in administrative and research positions
- Lack of institutions to back up and carry out research projects (Honduras and Guatemala, biomedical aspects)
- Lack of resource optimization
- Bias in the study sites

4. Diffusion, interchange and access to scientific information is too scarce (lack of incentive, language, financial and cultural aspects)

5. Administrative norms and processes are not efficient at the regional level and hinder conservation actions

- Lack of enforcement and absence of laws, norms and regulations
- Obstacles for permits procedures (excess of laws and procedures in Costa Rica)
- Lack of safety for field work (guerilla, drug traffic, illegal workers) — it does not apply to Costa Rica
- Lack of appropriate profiles in decision-making positions
- Incompatibility between researchers' and government objectives

DATA ASSEMBLY

PROBLEM 1: THE INFORMATION ON BAIRD'S TAPIR ECOLOGICAL AND BIOLOGICAL MONITORING IS INCOMPLETE.				
Fact	**Assumption**	**Required information**	**Specific region of the problem**	**Bibliographic references**
DIET • Hábitos alimentarios e impacto de la actividad humana sobre *Tapirus bairdii* en la Reserva de la Biosfera la Sepultura. [Feeding habits and impact of human activity on *Tapirus bairdii* in La Sepultura Biosphere Reserve. (in Spanish)] • Dieta de la danta centroamericana *Tapirus bairdii* en la Reserva de la Biosfera La Sepultura. [Diet of Baird's tapir *Tapirus bairdii* in La Sepultura Biosphere Reserve. (in Spanish)] • Natural history of Baird's tapir on Barro Colorado Island, Panama Canal Zone • Digestive seed predation by a Costa Rican Baird's tapir. • Wild plant acceptability to a captive Costa Rican Baird's tapir. • Hábito de alimentación del tapir (*Tapirus bairdii*) en un bosque tropical húmedo de Costa Rica. [Feeding habits of Baird's tapir (*Tapirus bairdii*) in a Costa Rican tropical rain forest. (in Spanish)] • Habitat use and diet of Baird's tapir (*Tapirus bairdii*) in a montane cloud forest of the Cordillera de Talamanca, Costa Rica.		Feeding habits	Belize Colombia Guatemala Honduras Nicaragua	• Cruz-Aldán, E. 2001 • Héctor Castillejos García, 1996 • Terwilliger. 1978. Biotropica • Janzen, D. H. 1981. Biotropica 13 (suppl.):59-69. • Janzen, D. H. 1982. Brenesia 19/20:99-128 • Naranjo, E. J. 1995. Vida Silvestre Neotropical 4:32-37 • Tobler, M. 2002. Biotropica 34(3):468-474

• Ecología de la danta Centroamericana *Tapirus bairdii* en un bosque húmedo tropical de Costa Rica [Ecology of Baird's tapir (*Tapirus bairdii*) in a Costa Rican tropical rain forest. (in Spanish)] • Aspectos ecológicos de la danta centroamericana (*Tapirus bairdii*) en un bosque húmedo tropical, Costa Rica. [Ecological aspects of Baird's tapir (*Tapirus bairdii*) in a tropical rain forest, Costa Rica. (in Spanish)]				• Foerster, C. R. 1998. Master's thesis, Universidad Nacional, Costa Rica. • Valdéz, J. 2004. Master's thesis.
GENETICS • Genetic variability and population structure among wild Baird's tapirs. • Genetic variability and population differentiation in captive Baird's tapirs (*Tapirus bairdii*).		Genetic information on wild populations	Belize Costa Rica Colombia Guatemala Mexico Nicaragua Panama	• Norton, J. E. & M. V. Ashley. 2004. Animal Conservation 7:211-220 • Norton, J. E. & M. V. Ashley. 2004. Zoo Biology
REPRODUCTION • Baird's tapir Project – Corcovado National Park, Costa Rica • Comportamiento de copulación del tapir en la estación Sirena, Parque Nacional Corcovado, Costa Rica. [Copulation behavior of Baird's tapir (*Tapirus bairdii*) at the Sirena station, Corcovado National Park, Costa Rica. (in Spanish)] • Natural history of Baird's tapir on Barro Colorado Island, Panama, Canal Zone • Baird's tapir chapter of the IUCN/SSC *Tapir Status Survey and Conservation Action Plan* (1997)		Birth rate, mortality rates during the first, second and third years of life, sex ratio, age at sexual maturity in the wild, percentage of offspring that reach adulthood, reproductive age, percentage of adult animals in verifiable reproductive status (according to fertility, dominance conditions)	Belize Costa Rica Colombia Guatemala Mexico Nicaragua Panama	• Foerster, C. 2002. Tapir Conservation: The Newsletter of the Tapir Specialist Group. 11(1) • Valdez J. & Foerster C. 2005. Nota Científica. Vida Silvestre Neotropical. In Press. • Terwilliger V. Biotropica 10 (3):211-220 • Sharon Matola, Belize, & Alfredo Cuarón, Mexico

• Central American tapir activity in upper Macal and Raspaculo river valley. • Behavior of Baird's Tapir (*Tapirus bairdii*) in Captivity.				• Sharon Matola. Tapir Conservation: The Newsletter of the Tapir Specialist Group. 11(2) • Lira-Torres, I.; Cruz-Aldán, E.; Guerrero, S. 2004. Tapir Conservation: The Newsletter of the Tapir Specialist Group. 13/2(16)
DISTRIBUTION • Current distribution and conservation status of the Colombian lowland tapir (*Tapirus terrestris colombianus*) and the Baird's or Central American tapir (*Tapirus bairdii*) in Colombia. • Programa Nacional para la Conservación del Género *Tapirus* en Colombia. [National Plan for Conservation of the Genus *Tapirus* in Colombia. (in Spanish)] • Mammals of northern Colombia, Preliminary report no. 7: Tapirs (Genus Tapirus), with a systematic review of American Species. • El danto o tapir en Honduras: *Tapirus bairdii*. [The tapir in Honduras: *Tapirus bairdii* - Baird's tapir. (in Spanish)] • Notes on Baird's tapir (*Tapirus bairdii*) from the southern region of Biosfera Tawahka–Asangni, Honduras.	Guatemala and Belize have unpublished distribution information	There are no distribution data in these countries. For some countries the information is limited or does not exist in certain regions of the distribution range on each country.	Belize Costa Rica Colombia Guatemala Mexico Nicaragua Panama	• Constantino, E. 2005. IUCN/SSC Tapir Specialist Group (TSG). Colombia. • Ministry of Environment, Housing and Land development, Colombia • Hershkovitz, P. 1954. Proceedings of the United States National Museum. Smithsonian Institution, 103 (3329):465-496 • Marineros L. & Martínez-Gallegos. 1998. • Townsend, J. 2002. Tapir Conservation: The Newsletter of the Tapir Specialist Group. 11(2)

• Field notes from eastern Honduras: Tapirs (*Tapirus bairdii*) in the Rio Patuca region. • Preliminary notes on the conservation status of Baird's tapir *Tapirus bairdii* in northeastern Honduras. • Notes on the relative abundance and hunting of Baird's tapir in the Rus-Rus Region of la Moskitia, Honduras: a proposed biological reserve. • Guía de Campo de los Mamíferos de Honduras. [Honduras mammals field guide. (in Spanish)] • Una aproximación a los dantos de Nicaragua. [An approach to the Nicaraguan tapirs. (in Spanish)] • Ampliación del área de distribución de *Tapirus bairdii*, Gill 1865 (Perissodactyla: Tapiridae) en Oaxaca, México. [Extension of distribution range of *Tapirus bairdii*, Perissodactyla, Tapiridae in Oaxaca, Mexico. (in Spanish)] • Hábitat actual y potencial del tapir en el ACA. [Current and potential tapir habitat in the ACA. (in Spanish)] • Ampliación del ámbito altitudinal del tapir centroamericano (*Tapirus bairdii*). [Extension of the altitudinal range of the Baird's tapir (*Tapirus bairdii*). (in Spanish)]				• Townsend, J. 2002. Tapir Conservation: The Newsletter of the Tapir Specialist Group. 11(1) • Flesher, K. 1999. Oryx 33 (4): 294 • Estrada, N. 2004. Tapir Conservation: The Newsletter of the Tapir Specialist Group. 13(1) • Marineros, L. & Martínez, F. 1998. INADES-PAGS. Tegucigalpa. 374 pp. • Medina, A. Book. • Lira-Torres, I.; Naranjo, E. J. & Reyes, C. H. 2005. Acta Zoológica Mexicana • Carbonell, F. & Gonzalez, J. 2000. ACA-SIG-INBIO. • Naranjo, E. J. & Vaughan, C. 2000. Revista de Biología Tropical

• Current situation of tapirs and its four species (Bibliographic compilation) • Evaluación de La Estructura de un Paisaje y su relación con La Distribución de Áreas Importantes Para La Conservación, en la Reserva de da Biosfera "La Sepultura", Chiapas, México. [Evaluation of a landscape structure and its relation with the distribution of important areas for conservation in the Biosphere Reserve "La Sepultura", Chiapas, Mexico. (in Spanish)] • Conservación del tapir en la Sierra Madre de Chiapas. Mexico. [Tapir conservation at Sierra Madre de Chiapas, Mexico. (in Spanish)] • Checklist of the mammals of Panama.				• 1998, Claudia A. García Bonilla • Gordillo R. M. 2002. Master's Thesis. • Naranjo, E. J. & Cruz-Aldán, E. 1999. • Handley, C. O. Jr. 1966. Ectoparasites of Panama. Pp. 753-795.
HABITAT USE • Hábitat actual y potencial del tapir en el ACA. [Current and potential tapir habitat in the ACA. (in Spanish)] • Hábitat potencial para la danta centroamericana (*Tapirus bairdii*) en el Corredor Biológico San Juan la Selva, Costa Rica. [Potential Baird's tapir habitat in the San Juan la Selva Biological corridor, Costa Rica. (in Spanish)] • Ecología de la danta Centroamericana *Tapirus bairdii* en un bosque húmedo tropical de Costa Rica [Ecology of Baird's tapir (*Tapirus bairdii*) in a Costa Rican tropical rain forest. (in Spanish)]		There are no habitat data in these countries. For some countries the information is limited or does not exist in certain regions of the distribution range on each country.	Belize Costa Rica Colombia Guatemala Mexico Nicaragua Panama	• Carbonell, F. & Gonzalez, J. 2000. ACA-SIG-INBIO. • Chassot, O. ; Monge, G. & Jimenez, V. 2005. Tropical Science Center, Executive Committee of the San Juan-la Selva Biological Corridor. • Foerster, C. 1998. Master's Thesis, Universidad Nacional, Costa Rica.

• Home range, habitat use and activity of Baird's tapir in Costa Rica. • Abundancia y uso de habitat del tapir (*Tapirus bairdii*) en un bosque tropical humedo de Costa Rica. [Abundance and habitat use of Baird's tapir in a tropical rain forest of Costa Rica. (in Spanish)] • Relación entre impacto de la cacería, y abundancia, densidad y uso de hábitat de la danta centroamericana *Tapirus bairdii* en la Reserva de la Biosfera La Sepultura, Chiapas, México. [Relationship between hunting impact and abundance, density and habitat use of Baird's tapir (*Tapirus bairdii*) in the Biosphere Reserve La Sepultura, Chiapas, Mexico. (in Spanish)]				• Foerster, C. & Vaughan, C. 2002. Biotropica 34(3): 423-437 • Naranjo, E. J. 1995. Vida Silvestre Neotropical 4:20-31 • Gálvez, R. 2000. Bachelor's Thesis.
DENSITY AND ABUNDANCE • IUCN/SSC *Tapir Status Survey and Conservation Action Plan* (1997) • Aspectos ecológicos de la danta centroamericana (*Tapirus bairdii*) en un bosque húmedo tropical, Costa Rica. [Ecological aspects of Baird's tapir (*Tapirus bairdii*) in a tropical rain forest, Costa Rica. (in Spanish)] • Hábitat actual y potencial de la danta centroamericana en la área de Conservación Arenal. [Current and potential Baird's tapir habitat in the Arenal Conservation Area. (in Spanish)]		There are no density and abundance data in these countries. For the other countries the information is limited or does not exist in certain regions of the distribution range on each country.	Panama Nicaragua Colombia Guatemala Mexico Honduras Costa Rica Belize	• Brooks, D. M.; R. E. Bodmer; S. Matola. 1997. IUCN, Gland, Switzerland and Cambridge. 164 pp. • Valdez, J. 2004. Master's thesis. Universidad Nacional, Costa Rica. • F. Carbonell & J. González. 2000. ACA-SIG-INBio.

• Ecología de la danta Centroamericana *Tapirus bairdii* en un bosque húmedo tropical de Costa Rica [Ecology of Baird's tapir (*Tapirus bairdii*) in a Costa Rican tropical rain forest. (in Spanish)] • Home range, habitat use and activity of Baird's Tapir in Costa Rica. • Abundancia y uso de habitat del tapir (*Tapirus bairdii*) en un bosque tropical humedo de Costa Rica. [Abundance and habitat use of Baird's tapir in a tropical rain forest of Costa Rica. (in Spanish)] • The Central American tapir (*Tapirus bairdii* Gill) in Northwestern Costa Rica. • A Correlation Factor to Estimate Baird's Tapir Population Density in the Rainforest. Second International Tapir Symposium. • Abundancia poblacional, movimientos y uso de hábitat de tapires en el Parque nacional Laguna Cachua, Guatemala. [Populational abundance, movements and habitat use of tapirs in the Laguna Cachua National Park, Guatemala. (in Spanish)] • Ecología de *Tapirus bairdii* (Perissodactyla: Tapiridae) en la Reserva de la Biosfera El Triunfo (Polígono I), Chiapas, México. [Ecology of *Tapirus bairdii* (Perissodactyla: Tapiridae) in the El Triunfo Biosphere Reserve (Polygon I), Chiapas, Mexico. (in Spanish)]				• Foerster, C. R. 1998. . Master's thesis, Universidad Nacional, Costa Rica. • Foerster, C. & Vaughan, C. 2002. Biotropica 34(3): 423-437 • Naranjo, E. J. 1995a. Vida Silvestre Neotropical 4: 20-31 • Williams, K. D. 1984. Ph.D. Thesis, Michigan State University, United States. • Valdez J. & C. Foerster. 2004. Conference Report, Panama, 2004. • Ruiz. 2005. Abstract of 2004 research projects of the General Research Management. San Carlos University. Guatemala. • Lira-Torres, I.; Naranjo, E. J.; Guiris, D. M. & Cruz-Aldán, E. 2004. Acta Zoológica Mexicana (n.s.) 20(1):1-21 San Cristóbal de Las Casas, Chiapas, Mexico. 41pp.

• Situación actual del tapir en Mexico. [Current tapir situation in Mexico. (in Spanish)]				• March, I. J. 1994. CIES, Centro de Investigaciones Ecológicas del Sureste, Serie Monográfica N°1.
• Estimaciones de Abundancia y Densidad en Poblaciones de Fauna Silvestre Tropical. [Tropical wildlife density and abundance estimation. (in Spanish)]				• Naranjo, E. J. 2000. Pp 37–46. In: Cabrera, E. C. Mercolli, y R. Resquin. (Eds). Manejo de Fauna Silvestre en Amazonia y Latinoamérica. Asunción, Paraguay.
• Population Ecology and Conservation of Ungulates in the Lacandon Forest, Mexico.				• Naranjo, E. J. 2002. Ph.D. Thesis, Florida University, United States.
• Ecology and Conservation of Baird's Tapir in the Lacandon Forest, Mexico.				• Naranjo, E. J., Bolaños, J & R. E. Bodmer. 2001. First International Tapir Symposium. San José, Costa Rica.
• Relación entre impacto de la cacería, y abundancia, densidad y uso de hábitat de la danta centroamericana *Tapirus bairdii* en la Reserva de la Biosfera La Sepultura, Chiapas, México. [Relationship between hunting impact and abundance, density and habitat use of Baird's tapir (*Tapirus bairdii*) in the Biosphere Reserve La Sepultura, Chiapas, Mexico. (in Spanish)]				• Galvéz, R. 2000. Bachelor's Thesis.

• Ecologia del Tapir (*Tapirus bairdii*) en la Reserva de la Biosfera La Sepultura, Chiapas, México. [Ecology of Baird's tapir (*Tapirus bairdii*) in La Sepultura Biosphere Reserve Chiapas, Mexico. (in Spanish)] • Population Ecology and Conservation of Baird's Tapir (*Tapirus bairdii*) in the Lacandon Forest, Mexico. • Preliminary notes on the conservation status of Baird's Tapir *Tapirus bairdii* in northeastern Honduras. • A frontier model for landscape ecology: the tapir in Honduras. • Notes on the relative abundance and hunting of Baird's tapir in the Rus-Rus Region of la Moskitia, Honduras: a proposed biological reserve. • The effect of hunting on tapirs in Belize.				• Naranjo E. J. & Cruz-Aldán, E. 1998. Acta Zool. Mex.(n.s.) 73: 111-123. • Naranjo E. J. & R. E. Bodmer. 2002. Tapir Conservation: The Newsletter of the Tapir Specialist Group. 11(2) • Flescher, K. 1999. Oryx 33: 294-300. • Flesher, K. & E. Ley. 1996. Environmental and Ecological Statistics, 3(2):119-125 • Estrada, N. 2004. Tapir Conservation: The Newsletter of the Tapir Specialist Group. 13(1) • Fragoso, J. M. 1991. Pp. 154-173 In: Robinson, J.G. and K. H. Redford (eds). Neotropical Wildlife Use and Conservation. The University of Chicago Press. Chicago, Illinois, United States

SEED DISPERSAL • Seeds in tapir dung in Santa Rosa National Park, Costa Rica. • Riqueza y Abundancia de Escarabajos Coprófagos de lãs excretas de Tapir en la Reserva de la Biosfera "El Triunfo (Polígono I) Chiapas, México. [Richness and abundance of coprophagous scarabs of tapir feces in the Biosphere Reserve "El Triunfo (Polygon I) Chiapas, Mexico. (in Spanish)]		There are no data on seed dispersal by Baird's tapir in these countries. For the other countries the information is limited or does not exist in certain regions of the distribution range on each country.	Belize Colombia Guatemala Honduras Nicaragua Panama Costa Rica Mexico	• Janzen, D. H. 1982. Brenesia 19/20:99-128 • Hernández Ch. G. 2002. Bachelor's Thesis.
NATURAL PREDATION • Hábitos alimentarios de jaguar *Panthera onca* y el puma *Puma concolor* en la Sierra Madre de Chiapas, México. [Feeding habits of the jaguar *Panthera onca* and the puma *Puma concolor* in the Sierra Madre de Chiapas, Mexico. (in Spanish)]		There is no information related to natural predation on Baird's tapir. For this country there is limited information	Belize Colombia Costa Rica Guatemala Honduras Nicaragua Panama Mexico	• Palacios, G. 2002. Bachelor's Thesis.

PROBLEM 2: IT IS NOT KNOWN HOW PHYSICAL (NATURAL HAZARDS), CHEMICAL (CONTAMINATION AND TOXIC SUBSTANCES), BIOLOGICAL (PARASITES, BACTERIA, VIRUSES ETC.) AGENTS AND THEIR RISK FACTORS AFECT SURVIVAL OF WILD BAIRD'S TAPIR POPULATIONS. THERE IS A LACK OF KNOWLEDGE ABOUT THE REFERENCE BIOMEDICAL PARAMETERS FOR THESE POPULATIONS, THE INTERACTION OF DISEASES WITH THE SPECIES, AND ITS INTERACTION WITH DOMESTIC ANIMALS.				
Fact	**Assumption**	**Required information**	**Specific region of the problem**	**Bibliographic references**
Estudio biomédico y de sanidad en fauna silvestre Del estado de Chiapas. Sistema de investigación y posgrado de la Universidad Autónoma de Chiapas. [Biomedical and health study in the wild fauna of Chiapas State. Research and postgrad system of the Universidad Autónoma de Chiapas. (in Spanish)]		Interaction of pathogenic agents with wild populations Reference biomedical parameters for the species: • Hematology • Blood chemistry • Hormonal cycle • Serology • Parasitology etc. Interaction of domestic animals with wild populations Mortality due to natural hazards For this country there is limited information	Guatemala Panama Nicaragua Colombia Honduras Costa Rica Belize Mexico	Güiris A. D. M. 2003. pp 45
Análisis bacteriológico de uma bronconeumonía en *Tapirus bairdii* del estado de Chiapas. memoria: XVIII congreso panamericano de ciências veterinarias. [Bacteriological analysis of a bronchopneumonia in *Tapirus bairdii* of Chiapas State. Memoir: XVIII Pan-American Congress of Veterinary Sciences. (in Spanish)]				Güiris A. D. M., Rojas H. N.M., Bastard C.W., Pérez E. M.E., Cruz A.E. Havana from 18 to 22 November, 2002. Palacio de las convenciones de la Habana, Cuba.

Identificación de la microbiota bacteriana em coprocultivos de *Tapirus bairdii* y equinos domésticos en la sierra madre de Chiapas, México. [Identification of bacterial microbiota of stool culture of *Tapirus bairdii* and domestic equidae in the Sierra Madre de Chiapas, Mexico. (in Spanish)				Pérez E., R., Güiris A., D., Cruz A., E., Pérez E., M. 2005. Bachelor's Thesis
Identification of aerobic bacteria from internal organs of *Tapirus bairdii* from Miguel Álvarez del Toro Zoo, Chiapas, Mexico.				Güiris A., D., Samayoa O., Y., Cruz A., E. Lira T., I. 2001 Congress: First International Tapir Symposium 2001 Costa Rica. San josé, Costa Rica. November 3-8. 2001.
Miopatía por captura en um tapir centramericano (*Tapirus bairdii*) silvestre en uma reserva de la biosfera Del estado de Chiapas. Presentación de un caso. [Myopathy due to capture in a wild Baird's tapir (*Tapirus bairdii*) in a Biosphere Reserve at Chiapas State, Mexico. Presentation of a case. (in Spanish)]				Güiris A. D. M, Sigler M., L., Gallegos M., J., Cruz A., Memoir: XIII Wild fauna symposium. Gral. M.V. Manuel Cabrera Valtierra. nov./22-25/1995. Organized: Fac. Medicina Veterinaria y Zoot. UNAM and Universidad de Colima.
Parasitosis gastroentérica comparativa entre *Tapirus bairdii* y equinos domésticos en la Sierra Madre de Chiapas, México. [Comparative gastroenteral parasitosis between *Tapirus bairdii* and domestic equidad in the Sierra Madre de Chiapas, Mexico. (in Spanish)]				Sosa P., J., Cruz A., E., Pérez E., M., Güiris A., D. 2003. Bachelor's Thesis.
Identification of ecto and endoparasites in the Central American tapir *Tapirus bairdii* in Chiapas, Mexico.				Lira T., I, Cruz A., E., Güiris A., D. Osório S., D., Quintero M., T. 2001. Congress: First International tapir symposium 2001 Costa Rica. San José, Costa Rica. November 3–8

Capture and Immobilization of free-living Baird´s tapirs (*Tapirus bairdii*) for an ecological study in Corcovado National Park, Costa Rica.				S. M. Hernandez-Divers and C. R. Foerster. Dec-2001. Corcovado, Costa Rica.
Immobilization of free-ranging Baird´s Tapir (*Tapirus bairdii*)				Paras-Garcia A. Foerster C. R. *et al.* 1996. Proc Am Assoc Zoo Vet.
Dermatopatías en *Tapirus bairdii* cautivo. [Dermatopathies in captive *Tapirus bairdii*. (in Spanish)]				Güiris A., D. Rojas, H., N., Berovides A., V., Cruz A., E., Bastard G., C. 2005. Estúdios biomédicos y de sanidad animal en fauna nativa cautiva y silvestre Del Estado de Chiapas. Proyecto UNACH. [Biomedical and health studies in the captive and wild native fauna of Chiapas State. UNACH Project.]
Parasitosis en *Tapirus bairdii*. [Parasitosis in *Tapirus bairdii* (in Spanish)]				Güiris A., D. Sosa P. J. Peréz E., M., Rojas, H., N., Berovides A., V., Cruz A., E., Bastard G., C. 2005. Estúdios biomédicos y de sanidad animal en fauna nativa cautiva y silvestre Del Estado de Chiapas. Proyecto UNACH. [Biomedical and health studies in the captive and wild native fauna of Chiapas State. UNACH Project.]
Serología de *Brucella abortus* y *Leptospira interrogans* em *Tapirus bairdii*. [Serology of *Brucella abortus* and *Leptospira interrogans* in *Tapirus bairdii*. (in Spanish)]				Güiris A., D., Cruz A., E., 2003. Estúdios biomédicos y de sanidad animal en fauna nativa cautiva y silvestre Del Estado de Chiapas. Proyecto UNACH. [Biomedical and health studies in the captive and wild native fauna of Chiapas State. UNACH Project.]

Microbiota en *Tapirus bairdii* silvestre del Estado de Chiapas. [Microbiota in wild *Tapirus bairdii* of Chiapas State. (in Spanish)]				Güiris A., D. Rojas, H., N., Berovides A., V., Cruz A., E., Bastard G., C. 2005. Estúdios biomédicos y de sanidad animal en fauna nativa cautiva y silvestre Del Estado de Chiapas. Proyecto UNACH. [Biomedical and health studies in the captive and wild native fauna of Chiapas State. UNACH Project.]

PROBLEM 3: ORGANIZATIONS (GOVERNMENTS, NGOS, PUBLIC AND PRIVATE UNIVERSITIES, PRIVATE CONSERVATION ORGANIZATIONS ETC.) IN THE REGION DO NOT CONTRIBUTE IN A MORE EFFECTIVE MANNER FOR BAIRD'S TAPIR CONSERVATION.				
Fact	**Assumption**	**Required information**	**Specific region of the problem**	**Bibliographic references**
Inadequacy of the administrative resources for field work	Transparency mechanisms are supposed to exist, although not in accordance with the needs of researchers and, in most cases, are not available.	The one that has been published in professional subjects such as Public Administration.	The whole region	
Poor regional and inter-institutional cooperation in order to optimize resources: medium term evaluation reports and project conclusion reports.		• Available inter-institutional agreements • Research projects of the different institutions working with Baird's tapir. • Material resources, team and infrastructure inventory of the different institutions linked to Baird's tapir conservation. • Information about projects under development. • Database of researchers and institutions involved with Baird's tapir.	The whole region	
Few specialized human resources / studies and/or diagnosis of the institutional needs for capacity-building		• Database of existing capacity-building programs in the region. • Availability of current international courses. • Database of existing projects. • Database of funding sources for capacity-building programs.	The whole region	
Baird's tapir is not a charismatic species, therefore it is not considered a priority species for fund raising / Selection criteria of donor organizations; the national conservation strategies etc.		• List of institutions which provide funding for conservation of tapirs and other species • Database on the investment made on Baird's tapir conservation projects up to date.	The whole region apart from Belize	

Scarce availability of material resources, teams, and infrastructure		• Material resources, human resources and infrastructure inventory of each one of the institutions involved with Baird's tapir conservation. • List of funding sources which allow investment on material resources, human resources and infra-structure. • List of equipment, human resources and suppliers. • Administrative methods and requirements for acquisition of equipment and teams abroad.	The whole region	
Non-existence of National Action Plans for Baird's Tapir Conservatiob in each range country Colombia National Action Plan Mexico National Action Plan National biodiversity strategies on each country. Legislation of systems of protected areas etc.		National Action Plan for Baird's Tapir Conservatiob in each range country	The whole region apart from Mexico and Colombia	
Labor instability in administrative and research posts	Institutional memoir of the organizations which work on Baird's tapir conservation	• Policies or administrative-labor regulations at an institutional level • Profile of the main decision making posts.		
Lack of institutions to back up and cary out research projects (Honduras and Guatemala, biomedical aspects)		• Database of the current institutions whose policies include, which are willing to and which have capacity to work with conservation. • Diagnosis of the environmental profile of each country.	Nicaragua Honduras Guatemala (only on Baird's tapir biomedical issues)	

PROBLEM 4: ADMINISTRATIVE NORMS AND PROCESSES ARE NOT EFFICIENT AT THE REGIONAL LEVEL AND HINDER CONSERVATION ACTIONS, WHICH SUMS UP INTO LACK OF ENFORCEMENT, ABSENCE OF NORMS AND RULES; OBSTACLES FOR FORMALITIES AND PERMITS; FIELD WORK INSECURITY AND INCOMPATIBILITY BETWEEN RESEARCHERS AND GOVERNMENT OBJECTIVES.				
Fact	**Assumption**	**Required information**	**Specific region of the problem**	**Bibliographic references**
Customs formalities Permit requests for collection, capture and immobilization of wild life CITES permit requests Norms on handling anesthetic agents and biological substances Phyto-zoo-sanitary rules Reported guerilla and drug traffic problems on Baird's tapir distribution range			Regional problem. In the particular case of Costa Rica there is an excess of legislation which benumbs the research process.	

GOALS

PROBLEM 1: THE INFORMATION ON BAIRD'S TAPIR ECOLOGICAL AND BIOLOGICAL MONITORING IS INCOMPLETE.
1.1 After one year, to have agreed on a standard methodology for population evaluation for specific research topics, which will start to be applied on each country.
1.2. In 2010, the region will have 16 research projects, all leading to scientific publications; these will fill the information gaps, and will focus on the research topics already prioritized in the 2005 Baird's Tapir PHVA Workshop.
1.3. To identify, after one year, the reference genetics laboratories in order to analyze the samples that can be preserved, mainly in the cases where there is no one who carries out the analyses.
1.4. To have, every two years, a periodic evaluation of the aims and progresses of the goals and actions.

PROBLEM 2: IT IS NOT KNOWN HOW PHYSICAL (NATURAL HAZARDS), CHEMICAL (CONTAMINATION AND TOXIC SUBSTANCES), BIOLOGICAL (PARASITES, BACTERIA, VIRUSES ETC.) AGENTS AND THEIR RISK FACTORS AFECT SURVIVAL OF WILD BAIRD'S TAPIR POPULATIONS. THERE IS POOR KNOWLEDGE OF THE REFERENCE BIOMEDICAL PARAMETERS FOR THESE POPULATIONS, THE INTERACTION OF DISEASES WITH THE SPECIES, AND ITS INTERACTION WITH DOMESTIC ANIMALS.
2.1. To have, after one year, a standardization of protocols for biomedical research.
2.2. To identify, after of one year, the reference laboratories for evaluating the samples that can be preserved, mainly in the cases where there is no one who carries out the analysis.
2.3. In 2010, the region will have at least one research per range country leading to scientific publications; these will fill the information gaps, and will focus on the research topics already prioritized in the 2005 Baird's Tapir PHVA Workshop.
2.4. To have, every two years, a periodic evaluation of the aims and progresses of the goals and actions.

PROBLEM 3: ORGANIZATIONS (GOVERNMENTS, NGOS, PUBLIC AND PRIVATE UNIVERSITIES, PRIVATE CONSERVATION ORGANIZATIONS ETC.) IN THE REGION DO NOT CONTRIBUTE IN A MORE EFFECTIVE MANNER FOR BAIRD'S TAPIR CONSERVATION.
3.1. To have National Action Plans for Baird's Tapir Conservation in each range country by the end of 2007.
3.2. In 2007, the TSG will build and implement at least three partnerships/cooperation agreements in the region and at the country level.
3.3. In 2010, every range country will have the integration of new researchers and institutions, forming a working team which allows fulfilling its research needs.
3.4. Until 2006, each range country will have a committee to promote the liaison among the institutions working with Baird's tapir research and new institutions, represented by one person committed with information diffusion and the work with tapirs' conservation.
3.5. To compile and distribute, in six months, a list of organizations which provide funding, capacity-building programs at the national and international levels, institutions directly or indirectly involved with Baird's tapir conservation, their abilities, action focus, as well as their material resources and equipment which can be borrowed, donated or interchanged.
3.6. To have, in 2006, an implemented annual database listing the financial contributtions made for tapir conservation projects and programs.

PROBLEM 4: DIFFUSION, INTERCHANGE AND ACCESS TO SCIENTIFIC INFORMATION ARE SCARCE (LACK OF INCENTIVE, LANGUAGE, FINANCIAL AND CULTURAL ASPECTS).
4.1. From this Baird's Tapir PHVA Workshop on, that we manage to send all PDFs or scientific articles about research projects that have been carried out up to date to the TSG and the *Tapir Conservation* Newsletter and that this goes on along time.

PROBLEM 5: THE ADMINISTRATIVE NORMS AND PROCESSES AT THE REGIONAL LEVEL ARE NOT EFFICIENT AND HINDER CONSERVATION ACTIONS, WHICH SUMS UP INTO LACK OF ENFORCEMENT, ABSENCE OF NORMS AND RULES; OBSTACLES FOR FORMALITIES AND PERMITS; FIELD WORK INSECURITY AND INCOMPATIBILITY BETWEEN RESEARCHERS AND GOVERNMENT OBJECTIVES.
5.1. To achieve, for 2006, TSG support for speeding up the required formalities and permits for research projects in favor of the Baird's tapir (in the case of those countries in which the problem occurs: Guatemala, Costa Rica and probably others).
5.2. To produce, until 2006, along with national security officials, a list and a map of areas in which there is insecurity due to social or political conflicts and bring this document to public opinion.
5.3. To raise awareness of governments about the need of a written commitment to the working stability and professional profile in key positions, as well as the importance of Baird's tapir conservation.

ACTION PLAN

PROBLEM 1: THE INFORMATION ON BAIRD'S TAPIR ECOLOGICAL AND BIOLOGICAL MONITORING IS INCOMPLETE.

GOAL 1: AFTER ONE YEAR, TO HAVE AGREED ON A STANDARD METHODOLOGY FOR POPULATION EVALUATION FOR SPECIFIC RESEARCH TOPICS, WHICH WILL START TO BE APPLIED ON EACH COUNTRY.

ACTIONS:
1. To compile and interchange research methods and protocols.
2. Meeting at the national level to define methods for each country.
3. Meeting to unify methods at the regional level.

Responsibility	Deadline	Collaborators	Resources and costs	Results and/or products	Consequences of inaction	Obstacles
Action 1: TSG Country Coordinators	2 months	Researchers on each country	Human efforts	Methodology compendium	Non comparable research projects among different areas of the region	That the documents are not sent
Action 2: TSG Country Coordinators	4 months	Researchers on each country	Human efforts and electronic media	Action lines defined and prioritized	Research projects do not address Baird's tapir conservation needs	That there is no representativeness of the countries
Action 3: TSG Country Coordinators	6 months	Researchers on each country	Human efforts Resources to help the International Tapir Symposium (tickets and stay)	Unified methodologies	Non comparable research projects among different areas of the region	That there is no consensus and/or representativeness

PROBLEM 1: THE INFORMATION ON BAIRD'S TAPIR ECOLOGICAL AND BIOLOGICAL MONITORING IS INCOMPLETE.

GOAL 2: IN 2010, THE REGION WILL HAVE 16 RESEARCH PROJECTS LEADING TO SCIENTIFIC PUBLICATIONS WHICH WILL FILL THE INFORMATION GAPS.

ACTIONS:

1. To define priority research topics proposed on this Baird's Tapir PHVA Workshop.
2. To define priority research areas for each range country.
3. To summon new researchers to carry out the projects.
4. To help in the preparation, fund raising and carrying out of research projects
5. To help in the process of publishing the results

Responsibility	Deadline	Collaborators	Resources and costs	Results and/or products	Consequences of inaction	Obstacles
Actions 1 and 2: TSG Country Coordinators	6 months	Researchers on each country	Human resources and funding to help the International Tapir Symposium (see previous actions)	Action lines defined and prioritized	Research projects do not address Baird's tapir conservation needs	That there is no representativeness of the countries
Action 3: TSG Country Coordinators	2 months after action 2	Researchers in general	Electronic, written and spoken media	A group of researchers interested in establishing and carrying out the research projects	We would not have new researchers	- Lack of commitment of the responsible persons and partners - Poor effectiveness of the diffusion media to be employed - Lack of interest by the researchers
Action 4: TSG Members in the region	1 year and a half	Researchers	Time of TSG members	Research projects established and running	Information gaps	- Lack of time of TSG members in order to help - That the necessary funding is not obtained
Action 5: TSG Members in the region	5 years	Researchers	Time of TSG members	Publication	Risk of no publication Poor diffusion of the research results	Poor communication between the person responsible for the project and the advisor

PROBLEM 1: THE INFORMATION ON BAIRD'S TAPIR ECOLOGICAL AND BIOLOGICAL MONITORING IS INCOMPLETE.

GOAL 3: TO IDENTIFY THE GENETICS, SIG AND BROMATOLOGY REFERENCE LABORATORIES.

ACTIONS:
1. To make a list of reference laboratories in the region with the capability of processing and analyzing genetic and bromatology samples and using SIG to plot them.

Responsibility	Deadline	Collaborators	Resources and costs	Results and/or products	Consequences of inaction	Obstacles
Action 1: Genetics: Gustavo Gutiérrez, Costa Rica SIG: Epigmenio Cruz Aldán, Mexico Bromatology: Nereyda Estrada, Honduras	6 months	Researchers in the region and TSG Genetics Committee (Anders Gonçalves da Silva, Brazil)	Time of the responsible persons and electronic media	List of reference laboratories	Lack of knowledge of the facilities which can process the samples	Lack of commitment of the responsible persons Lack of contacts for the development of the list

PROBLEM 1: THE INFORMATION ON BAIRD'S TAPIR ECOLOGICAL AND BIOLOGICAL MONITORING IS INCOMPLETE.

GOAL 4: TO HAVE, EVERY TWO YEARS, A PERIODIC EVALUATION OF THE AIMS AND PROGRESSES OF THE GOALS AND ACTIONS.

ACTIONS:
1. To include a meeting at the International Tapir Symposium of the TSG for such evaluation.

Responsibility	Deadline	Collaborators	Resources and costs	Results and/or products	Consequences of inaction	Obstacles
Action 1: Patrícia Medici, TSG Chair & Eduardo Naranjo, Mexico, TSG Baird's tapir coordinator (coordinate meeting)	On every International Tapir Symposium as of 2008	TSG Country Coordinators and symposium participants	None	Evaluation report	Lack of continuity	Time and space availability

PROBLEM 2: IT IS NOT KNOWN HOW THE PHYSICAL (NATURAL HAZARDS), CHEMICAL (CONTAMINATION AND TOXIC SUBSTANCES), BIOLOGICAL (PARASITES, BACTERIA, VIRUSES ETC.) AGENTS AND THEIR RISK FACTORS AFECT SURVIVAL OF WILD BAIRD'S TAPIR POPULATIONS. THERE IS POOR KNOWLEDGE OF THE REFERENCE BIOMEDICAL PARAMETERS FOR THESE POPULATIONS, THE INTERACTION OF DISEASES WITH THE SPECIES, AND ITS INTERACTION WITH DOMESTIC ANIMALS.

GOAL 1: TO HAVE, AFTER ONE YEAR, A STANDARDIZATION OF PROTOCOLS FOR BIOMEDICAL RESEARCH.

ACTIONS:
1. To disseminate the available protocols
2. National distribution for revision and evaluation on each country

Responsibility	Deadline	Collaborators	Resources and costs	Results and/or products	Consequences of inaction	Obstacles
Action 1: Darío Marcelino Guiris Andrade, Mexico	1 month	Chiapas Team TSG Veterinary Committee (Javier Sarria Perea, Colombia)	None	Each country has its own protocols	Loss of biomedical information	None
Action 2: TSG Country Coordinators	6 months	Researchers, veterinarians, health and sanitation authorities etc.	US$ 100 / country	Proposal of a standardized protocol	Lack of results comparison and no support for its implementation	Lack of responses

PROBLEM 2: IT IS NOT KNOWN HOW THE PHYSICAL (NATURAL HAZARDS), CHEMICAL (CONTAMINATION AND TOXIC SUBSTANCES), BIOLOGICAL (PARASITES, BACTERIA, VIRUSES ETC.) AGENTS AND THEIR RISK FACTORS AFECT SURVIVAL OF WILD BAIRD'S TAPIR POPULATIONS. THERE IS POOR KNOWLEDGE OF THE REFERENCE BIOMEDICAL PARAMETERS FOR THESE POPULATIONS, THE INTERACTION OF DISEASES WITH THE SPECIES, AND ITS INTERACTION WITH DOMESTIC ANIMALS.

GOAL 2: IN 2010, THE REGION WILL HAVE AT LEAST ONE RESEARCH PER RANGE COUNTRY LEADING TO SCIENTIFIC PUBLICATIONS; THESE WILL FILL THE INFORMATION GAPS, AND WILL FOCUS ON THE RESEARCH TOPICS ALREADY PRIORITIZED IN THE 2005 BAIRD'S TAPIR PHVA WORKSHOP.

ACTIONS:
1. To involve biomedical sciences professionals in projects on each country
2. Active participation in the projects

Responsibility	Deadline	Collaborators	Resources and costs	Results and/or products	Consequences of inaction	Obstacles
Action 1: Project managers	Continuous	Professionals, NGOs	US$ 100 / country	Multidisciplinary team formed	Poor contribution of research projects	Lack of professional interest
Action 2: Project managers, main researchers	Continuous	Clinical laboratories, national and international researchers	US$ 700/animal/sample	Publication of biomedical results	Delay of Knowledge for management	That there are no projects and/or funding for projects

PROBLEM 2: IT IS NOT KNOWN HOW THE PHYSICAL (NATURAL HAZARDS), CHEMICAL (CONTAMINATION AND TOXIC SUBSTANCES), BIOLOGICAL (PARASITES, BACTERIA, VIRUSES ETC.) AGENTS AND THEIR RISK FACTORS AFECT SURVIVAL OF WILD BAIRD'S TAPIR POPULATIONS. THERE IS POOR KNOWLEDGE OF THE REFERENCE BIOMEDICAL PARAMETERS FOR THESE POPULATIONS, THE INTERACTION OF DISEASES WITH THE SPECIES, AND ITS INTERACTION WITH DOMESTIC ANIMALS.

GOAL 3: TO IDENTIFY, AFTER OF ONE YEAR, THE REFERENCE LABORATORIES ON BIOMEDICAL ISSUES FOR EVALUATING THE SAMPLES THAT CAN BE PRESERVED, MAINLY IN THE CASES WHERE THERE IS NO ONE WHO CARRIES OUT THE ANALYSIS.

ACTIONS:

1. To compile and distribute the national list of laboratories working with biomedical issues.

Responsibility	Deadline	Collaborators	Resources and costs	Results and/or products	Consequences of inaction	Obstacles
Action 1: Marco Benítez and Darío Marcelino Guiris Andrade, Mexico; Jeannette Urdiales, Guatemala; Cintia Zelaya, Honduras; Jeffrey Ortiz, Costa Rica; Carlos Caballeros, Panama; and Olga Montenegro, Colombia	6 months	TSG Country Coordinators	US$ 100 / country	List of qualified and certified laboratories	Unreliable results and analysis, high costs	None

PROBLEM 3: ORGANIZATIONS (GOVERNMENTS, NGOS, PUBLIC AND PRIVATE UNIVERSITIES, PRIVATE CONSERVATION ORGANIZATIONS ETC.) IN THE REGION DO NOT CONTRIBUTE IN A MORE EFFECTIVE MANNER FOR BAIRD'S TAPIR CONSERVATION.

GOAL 1: TO HAVE NATIONAL ACTION PLANS FOR BAIRD'S TAPIR CONSERVATION IN EACH RANGE COUNTRY BY THE END OF 2007.

ACTIONS:
1. Fund management for the process of elaboration of each country's National Action Plan for Baird's Tapir Conservation.
2. Preparation of the draft of each country's National Action Plan for Baird's Tapir Conservation.
3. Presentation and validation of the National Action Plans for Baird's Tapir Conservation in each range country.
4. Final printing and official presentation of the National Action Plans for Baird's Tapir Conservation in each range country.

Responsibility	Deadline	Collaborators	Resources and costs	Results and/or products	Consequences of inaction	Obstacles
Action 1: TSG Country Coordinators	1 year	Patrícia Medici, TSG Chair & TSG Regional Action Planning Committees	US$ 500 / range country	Funding is available	Delay in the elaboration of each range country's National Action Plan for Baird's Tapir Conservation	Scarce availability for this issue
Action 2: TSG Country Coordinators and TSG Regional Action Planning Committees	6 months after getting the necessary funding	Researchers, governmental institutions, NGOs, communities	US$ 2,000 / range country	Draft of each range country's National Action Plan for Baird's Tapir Conservation	Delay in the elaboration of each country's National Action Plan for Baird's Tapir Conservation	Availability of time to prepare it, low representativeness from the sectors, lack of interest, fund availability
Action 3: TSG Country Coordinators	6 months after the final draft	Audience at the presentation event	US$ 3,000 / range country	Document validated by all actors	Delay in the editing and publication of the final document and expiring the validity period of the draft	Scarce availability of funding, low representativeness or attendance
Action 4: TSG Country Coordinators and TSG Regional Action Planning Committees	4 months after the validation	Governments, NGOs, and IUCN/SSC Conservation Breeding Specialist Group (CBSG)	US$ 4,000 for printing US$ 2,000 for the presentation	National Action Plan for Baird's Tapir Conservation for each country have been printed and distributed.	Waste of time and effort. Lack of divulgation and implementation	Scarce availability of funding. Lack of governmental support and/or interest

PROBLEM 3: ORGANIZATIONS (GOVERNMENTS, NGOS, PUBLIC AND PRIVATE UNIVERSITIES, PRIVATE CONSERVATION ORGANIZATIONS ETC.) IN THE REGION DO NOT CONTRIBUTE IN A MORE EFFECTIVE MANNER FOR BAIRD'S TAPIR CONSERVATION.

GOAL 2: TO COMPILE AND DISTRIBUTE, IN SIX MONTHS, A LIST OF ORGANIZATIONS WHICH PROVIDE FUNDING, CAPACITY-BUILDING PROGRAMS AT THE NATIONAL AND INTERNATIONAL LEVELS, INSTITUTIONS DIRECTLY OR INDIRECTLY INVOLVED WITH BAIRD'S TAPIR CONSERVATION, THEIR ABILITIES, ACTION FOCUS, AS WELL AS THEIR MATERIAL RESOURCES AND EQUIPMENT WHICH CAN BE BORROWED, DONATED OR INTERCHANGED.

ACTIONS:
1. To compile and distribute the list of funding sources.

Responsibility	Deadline	Collaborators	Resources and costs	Results and/or products	Consequences of inaction	Obstacles
Action 1: Cintia Zelaya, Honduras; Juan de Dios Valdez Leal, Mexico; Olivier Chassot, Costa Rica; Rocío Polanco, Colombia	6 months	Working team of the responsible person	Computers, internet access, offices of responsible persons	Lists	Delays in the management	Time available

PROBLEM 3: ORGANIZATIONS (GOVERNMENTS, NGOS, PUBLIC AND PRIVATE UNIVERSITIES, PRIVATE CONSERVATION ORGANIZATIONS ETC.) IN THE REGION DO NOT CONTRIBUTE IN A MORE EFFECTIVE MANNER FOR BAIRD'S TAPIR CONSERVATION.

GOAL 3: BY THE END OF 2007 THE TSG WILL IMPLEMENT AT LEAST THREE REGIONAL AND SIX INTER-INSTITUTIONAL AGREEMENTS (BI- AND TRI-NATIONAL PROJECTS, INTERCHANGE PROGRAMS).

ACTIONS:
1. To identify, discuss and technically approve the ideas of the regional projects in the International Tapir Symposium
2. Preparation and signature of regional agreements for the projects

Responsibility	Deadline	Collaborators	Resources and costs	Results and/or products	Consequences of inaction	Obstacles
Action 1: TSG Country Coordinators and TSG Regional Action Planning Committees	4 months	Regional managers, meeting attendees, researchers	Included in the fund management of the meeting	Approved project proposals	Persistence of isolated projects, little regional impact	Time availability
Action 2: TSG Baird's Tapir Coordinator – Eduardo Naranjo, Mexico,	2006	TSG Country Coordinators	US$ 600	Signed agreement	Persistence of isolated projects, little regional impact	Little political commitment, incompatibility of objectives

PROBLEM 3: ORGANIZATIONS (GOVERNMENTS, NGOS, PUBLIC AND PRIVATE UNIVERSITIES, PRIVATE CONSERVATION ORGANIZATIONS ETC.) IN THE REGION DO NOT CONTRIBUTE IN A MORE EFFECTIVE MANNER FOR BAIRD'S TAPIR CONSERVATION.

GOAL 4: UNTIL 2006, EACH RANGE COUNTRY WILL HAVE A COMMITTEE TO PROMOTE THE LIAISON AMONG THE INSTITUTIONS WORKING WITH BAIRD'S TAPIR RESEARCH AND NEW INSTITUTIONS, REPRESENTED BY ONE PERSON COMMITTED WITH INFORMATION DIFFUSION AND THE WORK WITH TAPIRS' CONSERVATION.

ACTIONS:

1. To carry out the creation of the Regional Action Planning Committees proposed during the Second International Tapir Symposium held in Panama in 2004.

Responsibility	Deadline	Collaborators	Resources and costs	Results and/or products	Consequences of inaction	Obstacles
Action 1: TSG Country Coordinators	1 year		US$ 2,000	Regional Action Planning Committees established and operating	Difficulty for the elaboration of each range country's National Action Plan for Baird's Tapir Conservation	Lack of funding and time availability

PROBLEM 3: ORGANIZATIONS (GOVERNMENTS, NGOS, PUBLIC AND PRIVATE UNIVERSITIES, PRIVATE CONSERVATION ORGANIZATIONS ETC.) IN THE REGION DO NOT CONTRIBUTE IN A MORE EFFECTIVE MANNER FOR BAIRD'S TAPIR CONSERVATION.

GOAL 5: IN 2010, EVERY RANGE COUNTRY WILL HAVE THE INTEGRATION OF NEW RESEARCHERS AND INSTITUTIONS, FORMING A WORKING TEAM WHICH ALLOWS FULFILLING ITS RESEARCH NEEDS.

ACTIONS:

1. To promote, in different opportunities and events, the work of IUCN/SSC Tapir Specialist Group (TSG).

Responsibility	Deadline	Collaborators	Resources and costs	Results and/or products	Consequences of inaction	Obstacles
Action 1: Sergio Midence, Honduras; Epigmenio Cruz Aldán, Mexico; Rafael Samudio, Panama; Karla Aparicio, Panama; and José Roberto Ruiz Fuamagalli, Guatemala		TSG Regional Action Planning Committees	Brochures, folders, and other promotional materials of IUCN/SSC Tapir Specialist Group (TSG) US$ 2,000	Integration of new researchers and institutions	Little participation, lack of knowledge	Time availability

PROBLEM 3: ORGANIZATIONS (GOVERNMENTS, NGOS, PUBLIC AND PRIVATE UNIVERSITIES, PRIVATE CONSERVATION ORGANIZATIONS ETC.) IN THE REGION DO NOT CONTRIBUTE IN A MORE EFFECTIVE MANNER FOR BAIRD'S TAPIR CONSERVATION.

GOAL 6: TO HAVE, IN 2006, AN IMPLEMENTED ANNUAL DATABASE LISTING THE FINANCIAL CONTRIBUTIONS MADE FOR TAPIR CONSERVATION PROJECTS AND PROGRAMS.

ACTIONS:
1. Elaboration of a database listing the financial contributions made for tapir conservation projects and programs.

Responsibility	Deadline	Collaborators	Resources and costs	Results and/or products	Consequences of inaction	Obstacles
Action 1: Karla Aparicio, Panama; Olivier Chassot, Costa Rica; TSG Regional Action Planning Committees		Patrícia Medici, TSG Chair & project managers, researchers, NGOs, Government	Internet, fax, telephone	Database	Lack of reference on costs	Little information provided by the actors

PROBLEM 4: DIFFUSION, INTERCHANGE AND ACCESS TO SCIENTIFIC INFORMATION ARE VERY SCARCE (LACK OF INCENTIVE, LANGUAGE, FINANCIAL AND CULTURAL ISSUES).

GOAL 1: TO IMPROVE THE COMPILATION AND DISTRIBUTION OF SCIENTIFIC ARTICLES AND ANY OTHER INFORMATION ON BAIRD'S TAPIR.

ACTIONS:

1. To make the TSG Website available for the diffusion of articles or information published in other media.
2. To make a list of indexed journals where one can publish.

Responsibility	Deadline	Collaborators	Resources and costs	Results and/or products	Consequences of inaction	Obstacles
Action 1: Francisco Castañeda, Guatemala; Juan de Dios Valdez Leal, Mexico; Jeffrey Ortiz, Costa Rica; Nereyda Estrada, Honduras; Rafael Samudio, Panama; and Rocío Polanco, Colombia	2 months	TSG Virtual Library Coordinators: Harald Beck, Mathias Tobler & Gilia Angell	Researchers in the region	To make TSG Website known as a dissemination medium To have access to the information	That is not possible to carry out divulgation in an appropriate way That there is no access to the available information on Baird's tapir	Lack of commitment of the responsible persons
Action 2: Genetics: Gustavo Gutiérrez, Costa Rica Biomedical: Jeannette Urdiales, Guatemala Ecology and social anthropology: Jeffrey Ortiz, Costa Rica	6 months	TSG Virtual Library Coordinators: Harald Beck, Mathias Tobler & Gilia Angell	Electronic media	List of indexed journals by research area	Lack of knowledge about the journals where one can publish Publication in journals not indexed and of restricted distribution	Lack of commitment of the responsible persons

PROBLEM 5: THE ADMINISTRATIVE NORMS AND PROCESSES AT THE REGIONAL LEVEL ARE NOT EFFICIENT AND HINDER CONSERVATION ACTIONS, WHICH SUMS UP INTO LACK OF ENFORCEMENT, ABSENCE OF LAWS, NORMS AND RULES; OBSTACLES FOR FORMALITIES AND PERMITS; FIELD WORK INSECURITY AND INCOMPATIBILITY BETWEEN RESEARCHERS AND GOVERNMENT OBJECTIVES.

GOAL 1: TO SPEED UP THE REQUIRED FORMALITIES AND PERMITS FOR RESEARCH PROJECTS IN FAVOR OF THE BAIRD'S TAPIR.

ACTIONS:

1. To get formal endorsement from the IUCN/SSC Tapir Specialist Group (TSG) to speed up formalities and the obtaining of permits in the respective countries.
2. Approaching the governing body to raise the need for speeding up formalities and the obtaining of permits in each country.

Responsibility	Deadline	Collaborators	Resources and costs	Results and/or products	Consequences of inaction	Obstacles
Action 1: TSG Country Coordinators	1 month	Patrícia Medici, TSG Chair & Gilia Angell, TSG Marketing Committee Coordinator	Electronic media	TSG formal endorsement	Do not get the endorsement and thus do not achieve the goal	That the endorsement is not recognized in the respective countries
Action 2: TSG Country Coordinators	6 months		Formal endorsement letter from TSG, pamphlets, time of each TSG Country Coordinator	It is hoped to speed up formalities and permit acquisition. To get TSG known To raise awareness about the need of Baird's tapir conservation	Do not achieve the goal	Depends on the interest shown by governing bodies

PROBLEM 5: THE ADMINISTRATIVE NORMS AND PROCESSES AT THE REGIONAL LEVEL ARE NOT EFFICIENT AND HINDER CONSERVATION ACTIONS, WHICH SUMS UP INTO LACK OF ENFORCEMENT, ABSENCE OF LAWS, NORMS AND RULES; OBSTACLES FOR FORMALITIES AND PERMITS; FIELD WORK INSECURITY AND INCOMPATIBILITY BETWEEN RESEARCHERS AND GOVERNMENT OBJECTIVES.

GOAL 2: TO HAVE DISCUSSED WITH EACH COUNTRY'S AUTHORITIES, UP TO 2006, THE ISSUE OF INSECURITY IN THE WORKING SITES.

ACTIONS:
1. Approaching the authorities of each country in order to discuss the insecurity issue.
2. To prepare a list of areas where there is insecurity due to social or political conflicts and place them on a map.
3. To disseminate to the researchers the list or map of the risk sites.

Responsibility	Deadline	Collaborators	Resources and costs	Results and/or products	Consequences of inaction	Obstacles
Action 1: Francisco Castañeda, Guatemala; Georgita Ruíz, Mexico; José Joaquin Calvo, Costa Rica; Rubén Sinclair, Honduras; Sergio Midence, Honduras; Olga Montenegro, Colombia; and Rafael Samudio, Panama	6 months		Time of responsible persons	To make local authorities understand the current problems To attempt raising solutions	Not achieving the goal	Depends on the interest shown by governing bodies
Action 2: Francisco Castañeda, Guatemala; Georgita Ruíz, Mexico; José Joaquin Calvo, Costa Rica; Rubén Sinclair, Honduras; Sergio Midence, Honduras; Olga Montenegro, Colombia; and Rafael Samudio, Panama	6 months after the approach	Researchers of the areas	GIS, Electronic media, Appropriate software (already in the countries)	List and map with the insecure areas on each country	That the new actors do not know the risk areas	Lack of commitment of the responsible persons Institutional hermetecism of the authorities
Action 3: Francisco Castañeda, Guatemala; Georgita Ruíz, Mexico; José Joaquin Calvo, Costa Rica; Rubén Sinclair, Honduras; Sergio Midence, Honduras; Olga Montenegro, Colombia; and Rafael Samudio, Panama	6 months after the approach		Electronic media	Widespread knowledge of the risk areas	Risk for the researchers	Lack of commitment of the responsible persons

Baird's Tapir (*Tapirus bairdii*) Conservation Workshop Population and Habitat Viability Assessment (PHVA)

Belize, Central America
15 to 19 August, 2005

Section 3

Habitat Management Working Group Report

Habitat Management

Participants

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PROBLEMS

BRAINSTORMING FOR DEFINITION OF PROBLEMS

- Habitat loss
- Habitat fragmentation
- Habitat degradation
- Border limits
- Insufficiency of protected areas
- Social problems
- Drug trafficking
- Guerrilla
- Instability
- Demographic pressure
- Lack of information on Baird's tapir habitat use
- Lack of information interchange
- Lack of communication between researchers and decision makers
- Lack of law enforcement
- Hunting
- Lack of a standardized methodology for Baird's tapir monitoring on the regional scale
- Corruption
- Mega-projects
- Highways
- Mining
- Oil exploitation
- Pipelines
- Dams
- Habitat contamination
- Climactic change
- Introduction of exotic species
- Illegal logging
- Wetlands drainage
- Forest fires
- Conflicts with farmers
- Crop invasion (human/tapir conflict)
- Lack of incentives for habitat conservation
- Lack of competence in habitat management
- Agricultural borders expansion
- Little involvement of communities in species protection
- Lack of knowledge of the sustainable rate of forest use

- Extensive cattle ranching
- Lack of co-management in the protected areas
- Ungovernableness
- Bad management of the resources for conservation
- Empire of the NGOs
- Lack of knowledge on Baird's tapir natural history
- Lack of economic alternatives
- Poorness
- Land ownership
- Lack of delimitation of protected areas
- Conflicts with the protected areas
- Personal conflicts with conservation promoters
- Forest depreciation
- Lack of criteria for the management of protected areas

PROBLEM GROUPING

Main problem	Specific problems	Location
Habitat loss and degradation	Fragmentation	Regional
	Wetlands drainage	CR, N, G
	Agricultural border expansion	Regional
	Understory clearing (forest cutting)	N, H, CR, G
	Wood extraction	Regional
	Unsustainable forest use	Regional
	Illegal logging	Regional
	Invasion of protected areas	CR, N, H, G
	Contamination	G
	Land use change	Regional
	Extensive cattle ranching	Regional
	Forest fires	Regional
	Demographic pressure	Regional
	Highways	Regional
	Mining and extraction of materials	N, CR, G
	Oil exploitation	B, G
	Unplanned colonization	Regional
	Incompatible production models	Regional
	Dams	CR, B, (G)
Lack of scientific research and monitoring of Baird's tapir habitat	Lack of information on Baird's tapir habitat use	Regional
	Lack of information on Baird's tapir habitat availability	Regional
	Lack of information interchange among researchers	Regional
	Lack of management criteria for the Baird's tapir habitat	Regional
	Lack of communication between researchers and decision makers	Regional
	Lack of a standardized methodology of regional scale monitoring	Regional
	Lack of knowledge on Baird's tapir natural history	Regional
	Lack of knowledge of the sustainable rate of forest use	Regional
Deficiencies of the system of protected areas (PA)	Insufficiency of protected areas	Regional
	Lack of buffer zones	Regional
	Lack of management plans	CR, N, H
	Lack of integration of the different actors into the management	Regional
	Lack of delimitation of the boundaries of the PAs	CR, N, H
	Lack of criteria for PAs management	Regional
	Habitat vulnerability in unprotected areas	Regional
	Inadequate PA design	Regional
	Conflicts over PA boundaries	Regional
	Lack of incentives for habitat conservation	Regional
	Lack of integrated management of Baird's tapir habitat among the countries	Regional

Lack of implementation of the environmental legislation in force	Lack of political will Lack of control over habitat loss and degradation processes Corruption Lack of awareness of the Justice operators Inadequate distribution of resources for conservation Scarce conservation criteria Lack of management capacity	Regional Regional Regional Regional Regional Regional Regional

DEFINITION OF CONCEPTS

The mechanisms which cause the decrease in extent and quality of the natural ecosystems where Baird's tapir occurs include fragmentation processes through wetlands drainage, the gradual and constant expansion of the agricultural frontier, impacts of extensive cattle ranching, clearing practices associated with wood extraction, natural or induced forest fires, illegal logging and, lastly, changes in land use. In some cases, these habitat degradation processes become express themselves in the invasion of protected areas. Besides demographic pressure, other factors influencing ecosystem fragmentation are the regional scale mega-projects, which translate into the layout of new paved highways, the construction of dams and the oil exploitation, jeopardizing population movement in the natural biological corridors.

The knowledge on Baird's tapir habit is insufficient, disperse and it has not been disseminated or shared with decision makers and the populations which directly impact on it. It is necessary to generate information on Baird's tapir habitat use, on habitat availability for the species, to interchange information among researchers, to work out management criteria for Baird's tapir habitat based on a standardized methodology of regional monitoring, to develop efficient communication channels among researchers and decision makers.

The system of protected areas is not sufficient to preserve the tapir population and there are not many joint regional planning efforts in tapir habitat management. In many cases it is necessary to focus efforts in the buffer zones of the protected areas, to develop and implement management plans in agreement with the communities using the natural resources, in order to avoid conflicts, to ensure ecological, administrative, and financial viability, to define the boundaries of the protected areas and to provide incentive.

The conservation policies of the different countries in the region are aimed at ecosystem protection and do not always cover all the distribution range of the Baird's tapir, which reinforces the need to focus efforts outside protected areas. In some cases, the bad management of conservation financial resources and the lack of management capacity prevent wild areas to fulfill their functions.

PROBLEM PRIORITIZATION

1. **Habitat loss and degradation:** natural and anthropogenic factors like wetlands drainage, forest fires and unsustainable forest use lead to the decrease of the coverage and quality of the natural ecosystems where the Baird's tapir occurs.

2. **Lack of scientific research and monitoring of Baird's tapir habitat:** the knowledge on Baird's tapir habitat is insufficient, disperse and it has not been disseminated or shared with decision makers and the populations which directly impact on it.

3. **Deficiency of the system of Protected Areas (PA):** the current system of Protected Areas is not sufficient to preserve the Baird's tapir populations and suffers from the lack of joint regional planning efforts.

4. **Lack of implementation of the environmental legislation in force:** the lack of management competence and political will prevent enforcement of the current legislation in favor of Baird's tapir habitat protection.

DATA ASSEMBLY

PROBLEM 1: LACK OF SCIENTIFIC RESEARCH AND MONITORING OF BAIRD'S TAPIR HABITAT				
Fact	**Assumption**	**Required information**	**Specific region of the problem**	**Bibliographic references**
Baird's tapir habitat use		Nicaragua (RBRSJ and Bosawas)	Lacandon	Muench & Naranjo
		Panama	Laguna Lachua	Ruiz 2005 (in prep.)
		PA Sur de Petén	Reserva Biosfera Maya	WCS 2005 (in prep.)
		Manchón-Guamuchal	PN Corcovado	Foerster 1998; Naranjo 1995
		PN Tortuguero	Rus Rus	Estrada 2004
		Cordillera Talamanca	Belize	Matola 1997
		PN Braulio Carrillo	Arenal-Tilarán	Carbonell & González 2000
		PN Volcán Tenorio	Lacandon	Naranjo & Bodmer
			PN Corcovado	Foerster & Vaughan 2002
			Honduras	Marineros & Martínez 2005
Population density			RB El Triunfo	Lira *et al.* 2004
			Lacandon	Naranjo & Bodmer
			Barra del Colorado	Naranjo 1995
			PN Corcovado	Váldez & Foerster 2004
			PN Corcovado	Foerster 2002
			Cordillera Talamanca	Tobler 2002
			Río Platano	Talavera (2004-2005)
			San Juan-La Selva	Chassot *et al.* 2005
Habitat characterization			Panama	Barongi *et al.* 1994
	Monitoring of the	Costa Rica	Oaxaca	Lira *et al.* 2005
Distribution	game animals	Panama	Corazón del CBM	Flesher 1999
		Guatemala	Honduras	Portillo 2005
		Nicaragua	Tahwaka-Patuca	Estrada 2004
			Pta Manabique / S. Minas	Morales (in prep.)
			Patuca, Tahwaka, Rus Rus, Mocorom,	UMB (2002-2005)
Monitoring of priority fauna			Warunta, Pico Bonito, Lacandon	
				Sánchez *et al.* 2001
Habitat fragmentation			Barra del Colorado	
		Methodology for monitoring	All countries	Terwilliger 1978
Natural history		Baird's tapir habitat		

PROBLEM 2: HABITAT LOSS AND DEGRADATION

Fact	Assumption	Required information	Specific region of the problem	Bibliographic references
Multi-temporal change of use			Regional	CCAD
			Belize	
			Colombia	Instituto Geográfico Agustín Codazzi (IGAC)
			Colombia	IDEAM / WWF / Fundación Natura
			Panama	ANAM / CBMAP / ANCON
			Guatemala	CEMEC
			Costa Rica	SINAC-ING-MICIT / CCT
			Honduras	Ministry of the interior/Home Office
			Nicaragua	MAGFOR / MARENA
			Mexico	INEGI
Forest fires reports			Mexico	SEMARNAT
			Guatemala	CONAP & INAB
			Honduras	Climactic change / SERNA
			Costa Rica	CONIFOR
			Colombia	CODECHOCO
			Colombia	CORPOURABA
Risk maps			Belize	
			Nicaragua	INITER
			Mexico	Civil defense / SEDENA
			Guatemala	MAGA
			Costa Rica	CNE
			Honduras	COPECO
			Panama	SINAPROC / Civil defense
				INGEOMINAS Institute
			Colombia	IDEAM
			Colombia	

PROBLEM 3: DEFICIENCY OF THE SYSTEM OF PROTECTED AREAS (PA)

Fact	Assumption	Required information	Specific region of the problem	Bibliographic references
Inventories of Protected Areas			All countries	Mesoamerican Biological Corridor
			Panama	ANAM / CBAP
			Costa Rica	SINAC-MINAE
			Nicaragua	MARENA
			Guatemala	CONAP
			Colombia	MAVDT
			Honduras	COHDEFOR
			Belize	
			Mexico	CONAN
				CONABIO
				IHNE
Biological Corridors			Regional	Mesoamerican Biological Corridor
				Proarca
Biosphere Reserves			Regional	UNESCO
PA administration			Regional	Proarca
Management plans			Regional	TNC
Capacity-building fot natural resources users			Regional	TNC
PA consolidation			Regional	Conservation International
Private conservation			Regional	CEDARENA / TNC
			Colombia	Asociación Red de Reservas de la Sociedad Civil
				Coope Sol i Dar
Shared management				

GOALS AND ACTION PLAN

PROBLEM 1: NATURAL AND ANTHROPOGENIC FACTORS LIKE WETLANDS DRAINAGE, FOREST FIRES AND UNSUSTAINABLE FOREST USE LEAD TO THE DECREASE OF THE COVERAGE AND QUALITY OF THE NATURAL ECOSYSTEMS WHERE BAIRD'S TAPIR OCCURS.

GOAL 1: TO REDUCE THE PROCESSES OF BAIRD'S TAPIR HABITAT DEGRADATION AND LOSS IN THE PRIORITY AREAS.

ACTIONS:
1. To conceive and carry out one degraded habitat recovery project within Baird's tapir distribution range on each range country.
2. To provide effective coordination among the institutions working in the Baird's tapir distribution range.
3. To implement one pilot project of agroforestry productive model for each range country which are compatible with the adequate management of the Baird's tapir habitat.
4. To support forest fires prevention programs in the critical zones for Baird's tapir survival.

Responsibility	Deadline	Collaborators	Resources and costs	Results and/or products	Consequences of inaction	Obstacles
Action 1: TSG Country Coordinators	2006	Communities, Environmental Ministries, NGOs	US$ 320,000	Recovery of 3,200 ha of critical Baird's tapir habitat	There is no recovery of critical Baird's tapir habitat	Lack of technical expertise on ecological restoration
Action 2: Eduardo Naranjo, Mexico, TSG Baird's Tapir Coordinator	2005-2010	GOs (Education Ministries and others), Armed Forces and Police, Communities, National Armies, NGOs	US$ 80,000	Improvement of the inter-institutional coordination mechanisms in each country	There is no improvement of the inter-institutional work in favor of the adequate management of Baird's tapir	Lack of interest of some institutions in coordinating inter-institutional actions
Action 3: TSG Country Coordinators	2007	NGOs, Universities, Education Ministries, Communities	US$ 160,000	To demonstrate the possibility to balance productive activities with conservation of Baird's tapir habitat	Productive models which make clear the adequate management of Baird's tapir habitat are not developed	There is no consensus on the sustainability criteria of agro-forestry productive models

Action 4: TSG Country Coordinators and TSG Regional Action Planning Committees	2007	GOs, Communities, Fire Brigades	US$ 8,000	Prevention of forest fires in critical zones for Baird's tapir survival	Zones of critical importance for Baird's tapir survival keep suffering degradation	There are no forest fighting programs in some of the zones of critical importance for Baird's tapir survival

PROBLEM 2: THE KNOWLEDGE ON BAIRD'S TAPIR HABITAT IS INSUFFICIENT, DISPERSE AND IT HAS NOT BEEN DISSEMINATED OR SHARED WITH DECISION MAKERS AND THE POPULATIONS WHICH DIRECTLY IMPACT ON IT.

GOAL 1: TO PROMOTE THE CONSERVATION OF BAIRD'S TAPIR HABITAT USING SCIENTIFIC-BASED KNOWLEDGE.

ACTIONS:
1. To determine the exact distribution of Baird's tapir.
2. To identify priority zones of critical habitat for Baird's tapir survival
3. To characterize Baird's tapir habitat use in its whole distribution range.
4. To systematize the available information on Baird's tapir.
5. To share the scientific knowledge with decision makers which have an influence on Baird's tapir habitat

Responsibility	Deadline	Collaborators	Resources and costs	Results and/or products	Consequences of inaction	Obstacles
Action 1: Eduardo Naranjo, Mexico, TSG Baird's Tapir Coordinator	2006	TSG, Universities, NGOs, GOs	US$ 1,000	1:50,000 digital map of Baird's tapir global distribution	Lack of detailed knowledge on Baird's tapir distribution	There is a need for informants on Baird's tapir distribution in the poorly documented regions of its distribution
Action 2: TSG Country Coordinators	2007	TSG, Universities, NGOs, GOs	US$ 8,000	1:50,000 digital map of priority zones of critical habitat for Baird's tapir survival	Lack of detailed knowledge on Baird's tapir distribution	There is a need for baseline information on the priority zones of critical habitat for Baird's tapir conservation
Action 3: TSG Baird's Tapir Coordinator – Eduardo Naranjo, Mexico	2007	TSG, Universities, NGOs, GOs	US$ 8,000	Availability of a document with the information on Baird's tapir habitat use in its whole distribution range	Lack of detailed knowledge on Baird's tapir habitat characterization	Information gaps on some parts of Baird's tapir habitat
Action 4: TSG Baird's Tapir Coordinator – Eduardo Naranjo, Mexico	2007	TSG, Universities, NGOs, Environmental Ministries	US$ 15,000	A B.S. thesis on Baird's tapir	Lack of a reference document on Baird's tapir	Lack of cooperation of some researchers
Action 5: Eduardo Naranjo, Mexico, TSG Baird's Tapir Coordinator	2007	TSG, Universities, NGOs, GOs	US$ 16,000	Local and governmental decision makers trained on Baird's tapir ecology	Lack of knowledge for Baird's tapir conservation on the side of decision makers	Lack of inter-institutional coordination

PROBLEM 3: THE CURRENT SYSTEM OF PROTECTED AREAS IS NOT SUFFICIENT TO PRESERVE THE BAIRD'S TAPIR POPULATIONS AND SUFFERS FROM THE LACK OF JOINT REGIONAL PLANNING EFFORTS.

GOAL 1: TO STRENGHTEN AND IMPROVE THE SYSTEM OF PROTECTED AREAS USING SCIENTIFIC-BASED CRITERIA OF HABITAT PLANNING AND MANAGEMENT.

ACTIONS:
1. To evaluate the efficiency of the protected areas from the perspective of the Baird's tapir habitat.
2. To advise on changes in the zoning of protected areas based on the ecological needs of Baird's tapir in its distribution range.
3. To conceive and implement joint management programs of Baird's tapir habitat in internationally shared ecosystems.
4. To identify initiatives of shared administration of protected areas within Baird's tapir distribution range.
5. To include Baird's tapir habitat management criteria in the initiatives of shared administration of protected areas.
6. To identify initiatives of biological corridors within Baird's tapir distribution range.
7. To include Baird's tapir habitat management criteria in the initiatives of biological corridors.

Responsibility	Deadline	Collaborators	Resources and costs	Results and/or products	Consequences of inaction	Obstacles
Action 1: TSG Country Coordinators	2008	TSG, Communities, Universities, NGOs, GOs, State and Municipal Executive	US$ 16,000	Assessment of the effectiveness of protected areas in relation to Baird's tapir habitat	Lack of a baseline on the effectiveness of the system of protected areas in relation to Baird's tapir habitat	Lack of baseline information on the protected areas
Action 2: TSG Country Coordinators	2009	TSG, Communities, Universities, NGOs, GOs	US$ 16,000	Proposals of changes in the zoning of protected areas based on the ecological needs of Baird's tapir in its distribution range	A functional deficiency of the system which affects Baird's tapir habitat conservation	Lack of involvement and political decision by the high level decision makers of the protected areas
Action 3: TSG Baird's Tapir Coordinator – Eduardo Naranjo, Mexico	2009	TSG, Universities, NGOs, Environmental Ministries	US$ 32,000	Conservation planning of the specific populations of Baird's tapir	Distinct habitat management of the populations shared among several countries	Lack of coordination and divergence on technical criteria among the countries

Responsibility	Deadline	Collaborators	Resources and costs	Results and/or products	Consequences of inaction	Obstacles
Action 4: TSG Country Coordinators	2008	TSG, Communities, Universities, NGOs, GOs	US$ 8,000	Technical data sheets of initiatives of shared administration of protected areas within Baird's tapir distribution range	No database on initiatives of shared administration of protected areas within Baird's tapir distribution range	Lack of support to the initiatives of shared administration of protected areas within Baird's tapir distribution range
Action 5: TSG Country Coordinators	2009	TSG, Communities, Universities, NGOs, GOs	US$ 16,000	Authorities of protected areas informed and aware about the Baird's tapir habitat requirements	Baird's tapir spatial requirements are not included in the management of jointly administered protected areas	Lack of consensus among the managers about the need to incorporate management criteria for the Baird's tapir habitat
Action 6: TSG Country Coordinators	2008	TSG, Communities, Universities, NGOs, GOs	US$ 8,000	Technical data sheets of initiatives of biological corridors within the Baird's tapir distribution range	The opportunity to increase the potential habitat of the Baird's tapir is lost	Lack of an updated database on biological corridors in the different countries within the Baird's tapir distribution range
Action 7: TSG Country Coordinators	2009	TSG, Communities, Universities, NGOs, GOs	US$ 16,000	Managers of biological corridors informed and aware about the Baird's tapir habitat requirements	The potential to preserve Baird's tapir habitat is not maximized	Lack of consensus among the managers of biological corridors about the need to incorporate management criteria for the Baird's tapir habitat

PROBLEM 3: THE CURRENT SYSTEM OF PROTECTED AREAS IS NOT SUFFICIENT TO PRESERVE THE BAIRD'S TAPIR POPULATIONS AND SUFFERS FROM THE LACK OF JOINT REGIONAL PLANNING EFFORTS.

GOAL 2: TO INCLUDE BAIRD'S TAPIR HABITATS THAT ARE NOT COVERED BY THE NATIONAL SYSTEMS OF PROTECTED AREAS WITHIN SOME MANAGEMENT CATEGORY.

ACTIONS:
1. To support the implementation of biological corridors within the Baird's tapir distribution range.
2. To identify potential sites of Baird's tapir habitat for inclusion under some management category.
3. To draw up technical proposals for delimitation of areas of critical importance for the Baird's tapir.
4. To submit proposals of inclusion of Baird's tapir habitat to the decision makers

Responsibility	Deadline	Collaborators	Resources and costs	Results and/or products	Consequences of inaction	Obstacles
Action 1: TSG Country Coordinators	2007-2010	Biological Corridors Commissions	US$ 32,000	Consolidation of the initiatives of biological corridors within the Baird's tapir distribution range	The opportunity to increase the potential Baird's tapir habitat is lost	There are no established communication channels between the TSG and the initiatives of biological corridors
Action 2: TSG Country Coordinators	2007	GOs, Universities, NGOs	US$ 16,000	List of potential sites of Baird's tapir habitat for inclusion under some management category	There is not enough data to recommend the inclusion of Baird's tapir habitat within the protected areas	Lack of reliable information on Baird's tapir habitat use in the protected areas
Action 3: TSG Country Coordinators	2008	GOs, Universities, NGOs	US$ 16,000	National proposals for inclusion of the Baird's tapir habitat under some management category	There is no technical basis to recommend the inclusion of Baird's tapir habitat within the protected areas	There are no inter- and multi-disciplinary effort in the technical drawing up of the proposals
Action 4: TSG Country Coordinators	2009	GOs, Universities, NGOs	US$ 8,000	Decision makers have the information on the inclusion of the Baird's tapir habitat under some management category at their disposal.	There is no increase in the extent of Baird's tapir habitat in the protected areas	There is no political support from the GOs.

PROBLEM 4: THE LACK OF MANAGEMENT COMPETENCE AND POLITICAL WILL PREVENT ENFORCEMENT OF THE CURRENT LEGISLATION IN FAVOR OF BAIRD'S TAPIR HABITAT PROTECTION.

GOAL 1: TO STRENGTHEN THE MANAGEMENT CAPACITY OF THE GOVERNMENTAL INSTITUTIONS RESPONSIBLE FOR LAW ENFORCEMENT.

ACTIONS:
1. To provide capacity-building for decision makers which have influence on Baird's tapir habitat.
2. To promote environmental awareness of staff members of the governmental institutions responsible for enforcement of legislation about the Baird's tapir habitat.

Responsibility	Deadline	Collaborators	Resources and costs	Results and/or products	Consequences of inaction	Obstacles
Action 1: TSG Country Coordinators	2008	TSG, NGOs, Universities	US$ 24,000	Decision makers informed and aware about the habitat requirements of the Baird's tapir	The implementation of a legal framework supporting Baird's tapir habitat is not promoted	Lack of interest of decision makers about Baird's tapir situation
Action 2: TSG Country Coordinators	2009	TSG, Communities, Universities, NGOs, GOs, Bar Council, Judiciary, Police	US$ 16,000	Staff members of the governmental institutions responsible for enforcement of legislation about the Baird's tapir habitat informed and aware about the Baird's tapir habitat requirements	There is no increase in legal decisions in favor of the Baird's tapir habitat	Lack of interest about Baird's tapir situation by the staff members of the governmental institutions responsible for law enforcement

Baird's Tapir (*Tapirus bairdii*) Conservation Workshop Population and Habitat Viability Assessment (PHVA)

Belize, Central America
15 to 19 August, 2005

Section 4

Human Impact Working Group Report

Human Impact

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The approach of this group was based on the need, identified by the Baird's Tapir PHVA Workshop participants, to implement communication and education initiatives in favor of the Baird's tapir. Since the issues tackled by the other groups trust on education and communication in order to be effective and significant, identifying education and communication challenges and solutions was seen as a vital factor for the conservation recommendations originated from the Baird's Tapir PHVA Workshop.

PROBLEMS

BRAINSTORMING FOR DEFINITION OF PROBLEMS

1. Hunting: Sportive
Subsistence: Panama, Costa Rica, Honduras, Mexico, Nicaragua.
"Revenge": Costa Rica
Traditional: Panama, Honduras
Commercial: Honduras, Nicaragua

WHY IS IT CARRIED OUT? Protein Acquisition
Prey size
Male chauvinism
Offending authorities
Cultural and Heritage
Acquisition of economical resources

2. Human settlements: wood extraction, land use changes, cattle ranching settlements, dams, contamination, road opening, fires, mining etc.

3. Area size (small)

4. Tourism

PROBLEM PRIORITIZATION

1) Lack of general information (programs, scientific data) and interest (economical and human resources) on Baird's tapir at the local and international levels.

2) The lack of environmental criteria in the development plans of both governments and private companies causes loss of Baird's tapir habitat and populations.

3) The unsustainable hunting has caused a decrease of Baird's tapir populations.

4) The lack of scientific information limits the design and implementation of educational programs (schools, high schools and rural communities) at the local level in Belize.

DATA ASSEMBLY

PROBLEM 1: LACK OF GENERAL INFORMATION (PROGRAMS, SCIENTIFIC DATA) AND INTEREST (ECONOMICAL AND HUMAN RESOURCES) ON BAIRD'S TAPIR AT THE LOCAL AND INTERNATIONAL LEVELS.

Independently of the inherent problem of the quantification and qualification of knowledge and public concerns in relation to Baird's tapir conservation without carrying out costly international surveys, the group has determined that there are enough resources and knowledge on Baird's tapir among workshop participants in order to make some general considerations about Baird's tapir knowledge.

In order to evaluate the facts and assumptions on this particular topic, the group has decided to make an informal survey among the participants to evaluate the prevalence of the public knowledge at the country, regional and international levels.

Range Countries: seven knowledge indicators were chosen, and it was asked to the representative experts of each one of the Baird's tapir range countries if those indicators were valid for their countries. The only country which was not represented was Nicaragua.

The following table shows the working group deliberations:

Indicator (tapir specific)	Costa Rica	Colombia	Belize	Honduras	Guatemala	Mexico	Panama	Nicaragua	TOTAL
Curriculum has a focus on conservation	Yes	Yes	Yes	No	Yes	No	Yes	No	5 Yes 3 No
NGOs with Baird's tapir conservation programs	Yes	Yes	Yes	No	No	Yes	No	No	4 Yes 4 No
Seen on communication media (TV, radio, magazines)	Yes	No	Yes	No	No	No	Yes	No	3 Yes 5 No
National animal	No	No	Yes	No	No	No	No	No	1 Yes 7 No
Present in the folklore, stories, culture, religion	Yes	Yes	Yes	Yes	Yes	Yes	Yes	?	7 Yes 1 ?
Present in the pop culture (T-shirts, logos, souvenir, posters, stamps etc.)	Yes	No	Yes	No	Yes	Yes	No	Yes	5 Yes 3 No
Present in zoos	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	8 Yes
TOTAL	6 Yes	4 Yes	6 Yes	2 Yes	4 Yes	4 Yes	4 Yes	2 Yes	-

<u>Local conclusions:</u> Based on this survey, we found out that Belize and Costa Rica seem to have the highest level of general knowledge on Baird's tapir, while Colombia, Guatemala, Mexico and Panama have average knowledge levels, and Honduras and Nicaragua show low levels. Some aspects that must be taken into account in these conclusions are: there was no Nicaraguan present and Colombian data can not distinguish between Baird's tapir and the other tapir species which occur in the country.

<u>Regional conclusions:</u> Based on this survey, we can assume that the countries have a medium to low level of knowledge in the Baird's tapir range countries.

<u>International conclusions:</u> Adjusting the criteria of each country to determine the international level of knowledge on Baird's tapir, the following indicators were employed: 1) Integration of the tapirs as an education focus in international curricula, 2) NGOs with programs focused on Baird's tapir conservation, 3) Media coverage of issues related to the tapir, 4) Tapir's cultural meaning, 5) The tapirs are integrated to the popular culture and 6) The tapirs are exhibited in the zoos. The indicators were determined with reference to all tapir species and not specifically to the Baird's tapir. Looking at these criteria, the group concluded that there is a low level of knowledge of these species in international terms. Notwithstanding the existence of a group of conservationist organizations related to the tapir (*e.g.* Tapir Preservation Fund, EAZA Tapir TAG, AZA Tapir TAG, and the IUCN/SSC Tapir Specialist Group), and the existence of tapirs in various countries, these species do not arouse any other indicator. The group's general feeling was that the public as a whole do not take the tapirs into account the same way it does with other charismatic mega-vertebrates. In fact, the working group members believe that outside the Baird's tapir range countries the species is almost unknown by the international community. This includes a lack of knowledge by funding agencies, decision makers, and the general public.

Data collection: the necessary information to support such data at the national and international levels would be:

1) Examples of education curricula focused on tapirs and evidence both that information is being used and who is using it.
2) Name of conservationist organizations with programs focused on the tapir conservation.
3) Examples of media advertising focused on the tapir.
4) Examples of folkloric art, stories, culture and religion focused on the tapir.
5) Examples of the tapir integrated to the local culture.
6) List of zoos which exhibit tapirs.

PROBLEM 2: THE LACK OF ENVIRONMENTAL CRITERIA IN THE DEVELOPMENT PLANS OF BOTH GOVERNMENTS AND PRIVATE COMPANIES CAUSES LOSS OF BAIRD'S TAPIR HABITAT AND POPULATIONS.				
Fact	**Assumption**	**Required information**	**Specific region of the problem**	**Bibliographic references**
Potential animal for the tourism and potential areas for tourism with Baird's tapir			Arenal Conservation Area, Costa Rica	Carbonell y González (2000)
		List of Baird's tapir occurrence sites with well established tourism programs (potential models)		
	Visitors in large groups in tapir areas			
	High impact hotels in tapir areas			
Tapirs are captured to be exhibited in hotels and restaurants			Nicaragua and Honduras	Nicaragua: Matola, Cuarón & Rubio Honduras: Estrada *et al.* (2005)
At the Sirena Station in Corcovado National Park, Costa Rica, the tourism activity influences the tapirs' behavior. They only leave at night.			Costa Rica	Foerster, C. & Vaughan, C. 2002. Biotropica 34(3): 423-437 Foerster, C. R. 1998. Master's Thesis, Universidad Nacional, Costa Rica
In Honduras, for the construction of damns, people are displaced and transferred to protected areas, where the land has no owners.			Honduras	Rubén Sinclair (pers. com.)
In Honduras, the people who live at the border, where war has taken place, are transferred to protected areas, and livestock farmers buy them from the peasants.			Honduras	Diagnósticos Participativos Comunitarios de ICADE en RB Tawahka (2000) [ICADE Communitarian Participative Diagnoses at Tawahka Biological Reserve (2000) (in Spanish)]
Usurpation of lands in protected areas			Honduras	Rubén Sinclair (pers. com.)

In Chiapas, Mexico, the peasants demand land, which are bought by NGOs, with funding from bank loans.			Mexico	Daniel Gómez (pers. com.)
Contamination of water used by the tapirs, caused by human settlements (Corcovado National Park)			Costa Rica	Foerster, C. & Vaughan, C. 2002. Biotropica 34(3): 423-437
The construction of wire fences between neighboring estates and inside protected areas limits the tapirs' free movement.			Costa Rica	Carbonell and González (2000)
People take advantage of forest fires inside Protected Areas in order to settle within them.			Guatemala	Manolo García (pers. com.)
The settlement of livestock farmers in the BOSAWAS reserve causes deforestation in this reserve.			Nicaragua	Pedro López
The establishment of settlements in the Maya Woods causes the annual loss of 4% of its forest cover			Mexico	INEGI 2000
Habitat loss due to colonization at the El Guabo sector (Nueva Zelandia, Culubre, Valle Libre, Bocas del Toro and Comarca Ngobe-Bugle)			Panama	Baird's Tapir PHVA Workshop Report, Panama, 1994
Calillo hydroelectric project which aims to dam up parts of the Macal and Raspaculo rivers in Belize will flood 1459 acres or 590 ha of critical Baird's tapir habitat	The environmental impact report took into account all the necessary measures to ensure that the impact on the fauna and flora were minimal The habitat is not going to be changed	The measures which are going to be taken in order to ensure that the tapir habitat is not going to be changed Additional investments in conservation projects by the end of the project Criteria employed to approve the Environmental Impact Report	Río Arriba del Macal Region, Belize	Eugene Ariola, Program for Belize, Belize Humberto Wholers, Belize Zoo, Belize Biological Diversity Info

PROBLEM 3: THE UNSUSTAINABLE HUNTING HAS CAUSED A DECREASE OF BAIRD'S TAPIR POPULATIONS.				
Fact	**Assumption**	**Required information**	**Specific region of the problem**	**Bibliographic references**
1. Subsistence hunting	Medicinal use	Number of hunted animals	Belize, Colombia, Costa Rica, Mexico, Nicaragua, and Panama	Mammals Red Book of Colombia Foerster 1998, 2000 Carbonell & González 2000 Lira-Torres *et al.* 2004 Lira-Torres *et al.* 2005 Baird's Tapir PHVA Workshop Report, Panama, 1994 Bennett 1962 Torres de Araúz 1972
2. Poaching	Hunting for vengeance	Selection of preferred hunting sites by the hunters	Colombia, Costa Rica, Guatemala, Honduras, Mexico, and Panama	Chassot, O.; G. Monge & V. Jiménez 2005 Lira-Torres *et al.* 2005 Naranjo E. & C. Vaughan 2000 Guiris *et al.* Carbonell & González 2000 Baird's Tapir PHVA Workshop Report, Panama, 1994
3. Crop protection			Costa Rica and Honduras	Foerster 1998, 2000
4. Commercial hunting			Honduras and Panama	Libro Rojo de los Mamíferos de Ecuador [Mammals Red Book of Ecuador] Ventocilla 1997
5. Hunting for skin			Costa Rica	Medina, A. Marineros, L. & F. Martínez. Sandoval 2005 Carbonell & González 2000
6. Traditional hunting	The meat has aphrodisiac properties		Panama	Ventocilla 1997 Baird's Tapir PHVA Workshop Report, Panama, 1994

PROBLEM 4: THE LACK OF SCIENTIFIC INFORMATION LIMITS THE DESIGN AND IMPLEMENTATION OF EDUCATIONAL PROGRAMS (SCHOOLS, HIGH SCHOOLS AND RURAL COMMUNITIES).				
Fact	**Assumption**	**Required information**	**Specific region of the problem**	**Bibliographic references**
National Animal Characteristics of the school curriculum Baird's tapir has press coverage at least once a year (April Birthday)	Frequent press coverage The majority of Belizeans know the Baird's tapir Conservation ethics is part of the national identity	Evaluation of the distribution and populations Information is needed on the levels of information and attitude towards the Baird's tapir and its conservation, related with the educational programs success Curricula examples	The whole Belize	Humberto Wohlers (pers. comm.)

GOALS

PROBLEM	LOCAL GOALS	REGIONAL GOALS
1) Lack of general information (programs, scientific data) and interest (economical and human resources) on Baird's tapir at the local and international levels.	1. To increase by 75% (along 4 years) the knowledge of rural communities, urban areas, decision-makers, schools and high schools, and personnel involved with natural resources management about the Baird's tapir. 2. To improve by 50% the knowledge on Baird's tapir of NGOs, communication media, zoological institutions, universities, financial and support agencies, within a 5-year period. 3. To manage getting the Baird's tapir to be a charismatic species through clear and concise messages.	1. To improve by 50% the knowledge on Baird's tapir of NGOs, communication media, zoos, universities, financial and support bodies, within a 5-year period. 2. To propose the Baird's tapir as a Mesoamerican fauna symbol in a 5-year period
2) The lack of environmental criteria in the development plans of both governments and private companies causes loss of Baird's tapir habitat and populations.	1. To have environmental plans from the government and private companies which include protection of Baird's tapir and its habitat in four countries in a period of five years. 2. To develop and approve laws, over the next five years, to protect Baird's tapirs and their habitat. 3. To implement alternative systems of production as an income source for rural communities. With this, we aim at improving the conservation of Baird's tapir and its habitat, in 25% of the priority areas, in the next five years. 4. Within five years, the Baird's tapir will be recognized as a priority species for conservation in all range countries.	1. To propose the Baird's tapir as a Mesoamerican fauna symbol in a 5-year period

3) The unsustainable hunting has caused a decrease of Baird's tapir populations.	1. To reduce illegal hunting by 20% in the next five years in the areas where Baird's tapir lives in. 2. To establish, within four years, national legislations to punish actions against the integrity of Baird's tapir and its habitat in Honduras, Nicaragua and Guatemala. 3. To have the current legislation implemented by the responsible authorities within two years in all range countries involved. 4. To promote the establishment of a body of officials trained in law enforcement. 5. To raise awareness, where it is most needed, about the importance of Baird's tapir. 6. To count on the active participation of local communities in the conservation of Baird's tapirs and their habitat.	1. To establish programs in the region focused on those areas where illegal hunting occurs
4) The lack of scientific information limits the design and implementation of educational programs (schools, high schools and rural communities) at the local level.	1. To define, within one year and based on the available information, the priority sites to channel conservation actions. 2. To have 50% of the institutions, researchers and communities technically trained in information production and management within two years and a half. 3. To have an accessible information and documentation center on the Baird's tapir and its habitat, within four years.	

ACTION PLAN

PROBLEM 1: LACK OF GENERAL INFORMATION (PROGRAMS, SCIENTIFIC DATA) AND INTEREST (ECONOMICAL AND HUMAN RESOURCES) ON BAIRD'S TAPIR AT THE LOCAL AND INTERNATIONAL LEVELS.

GOAL 1: TO INCREASE BY 75% (ALONG 4 YEARS) THE KNOWLEDGE OF RURAL COMMUNITIES, URBAN AREAS, DECISION-MAKERS, SCHOOLS AND HIGH SCHOOLS, AND PERSONNEL INVOLVED WITH NATURAL RESOURCES MANAGEMENT ABOUT THE BAIRD'S TAPIR.

SUB-GOAL 1: To increase the knowledge of rural communities, including indigenous communities, on Baird's tapir, but respecting their traditional knowledge and culture on the topic.

ACTIONS:

1. **To design and implement a communitarian program to raise awareness on the Baird's tapir and rescue the traditional knowledge.**

o To define 2 or 3 pilot communities per country in order to focus the actions
o To design a model program for community-based environmental education, which includes information on the mechanism to gain access to the payment of environmental services to be used for conservation of the Baird's tapir and its habitat.
o To seek funding for designing the programs to be implemented in pilot communities

Responsibility: TSG Country Coordinators will negotiate with the responsible authorities for them to implement the actions

2. **To create, on each country, a network of the Baird's tapir promoters at the community level, including researchers, community leaders, schoolteachers etc.**

Responsibility: TSG Country Coordinators

3. **To carry out workshops on communitarian planning of productive alternatives (ecotourism, craftwork, environmentally friendly agricultural cultivation etc.)**

Responsibility: Governmental agencies responsible for the issue on each range country, in coordination with non-governmental groups.

PROBLEM 1: LACK OF GENERAL INFORMATION (PROGRAMS, SCIENTIFIC DATA) AND INTEREST (ECONOMICAL AND HUMAN RESOURCES) ON BAIRD'S TAPIR AT THE LOCAL AND INTERNATIONAL LEVELS.

GOAL 1: TO INCREASE BY 75% (ALONG 4 YEARS) THE KNOWLEDGE OF RURAL COMMUNITIES, URBAN AREAS, DECISION-MAKERS, SCHOOLS AND HIGH SCHOOLS, AND PERSONNEL INVOLVED WITH NATURAL RESOURCES MANAGEMENT ABOUT THE BAIRD'S TAPIR.

SUB-GOAL 2: To design a Baird's tapir dissemination campaign aimed at the urban community.

ACTIONS:

1. **To design promotion campaigns in the zoological institutions holding tapirs in their collections**

o To develop a list of actions that each zoological institution can implement in order to promote the Baird's tapir.

Responsibility: TSG Zoo Committee Members.

Results and/or products: Communities actively committed with the conservation of the Baird's tapir.

2. **To launch a media campaign in the main cities within the Baird's tapir distribution range**

3. **To emphasize, through an environmental conference aimed at organizations, institutions and the civil society, the importance of the conservation of the Baird's tapir**

Responsibility: Ruben Sinclair, Honduras

4. **To declare 2007 as the "Year of the Tapir"**

Responsibility: TSG Marketing Committee and TSG Education & Outreach Committee

PROBLEM 1: LACK OF GENERAL INFORMATION (PROGRAMS, SCIENTIFIC DATA) AND INTEREST (ECONOMICAL AND HUMAN RESOURCES) ON BAIRD'S TAPIR AT THE LOCAL AND INTERNATIONAL LEVELS.

GOAL 1: TO INCREASE BY 75% (ALONG 4 YEARS) THE KNOWLEDGE OF RURAL COMMUNITIES, URBAN AREAS, DECISION-MAKERS, SCHOOLS AND HIGH SCHOOLS, AND PERSONNEL INVOLVED WITH NATURAL RESOURCES MANAGEMENT ABOUT THE BAIRD'S TAPIR.

SUB-GOAL 3: To focus on environmental education about the Baird's tapir at the schools

ACTIONS:

1. To include information on Baird's tapir at the school curriculum of the different countries.

o To investigate how new elements are incorporated at the school curricula on each country, to design curricula that are adequate to each country, using Belize as a model, and to integrate it to the schools.

Responsibility: TSG Country Coordinators together with the educational authorities on each country.

2. To carry out school teachers' capacity-building workshops on the subject of the Baird's tapir.

Responsibility: TSG Country Coordinators together with the educational authorities on each country.

3. To promote school contests on Baird's tapir issues.

Responsibility: TSG Country Coordinators and TSG Education & Outreach Committee together with NGOs in range countries.

4. To make an interactive CD for the schools on the Baird's tapir problems.

Responsibility: TSG Education & Outreach Committee & TSG Marketing Committee

PROBLEM 1: LACK OF GENERAL INFORMATION (PROGRAMS, SCIENTIFIC DATA) AND INTEREST (ECONOMICAL AND HUMAN RESOURCES) ON BAIRD'S TAPIR AT THE LOCAL AND INTERNATIONAL LEVELS.

GOAL 1: TO INCREASE BY 75% (ALONG 4 YEARS) THE KNOWLEDGE OF RURAL COMMUNITIES, URBAN AREAS, DECISION-MAKERS, SCHOOLS AND HIGH SCHOOLS, AND PERSONNEL INVOLVED WITH NATURAL RESOURCES MANAGEMENT ABOUT THE BAIRD'S TAPIR.

SUB-GOAL 4: To raise awareness of decision-makers with respect to the importance of conservation of the Baird's tapir and its habitat.

ACTIONS:

1. **To compile a list of key employees and decision makers on each country and plan a visit by the TSG Country Coordinators in order to ensure that they receive information on the importance of the conservation of the Baird's tapir and its habitat.**

Responsibility: TSG Country Coordinators

PROBLEM 1: LACK OF GENERAL INFORMATION (PROGRAMS, SCIENTIFIC DATA) AND INTEREST (ECONOMICAL AND HUMAN RESOURCES) ON BAIRD'S TAPIR AT THE LOCAL AND INTERNATIONAL LEVELS.

GOAL 2: TO IMPROVE BY 50% THE KNOWLEDGE ON BAIRD'S TAPIR OF NGOS, COMMUNICATION MEDIA, ZOOLOGICAL INSTITUTIONS, UNIVERSITIES, FINANCIAL AND SUPPORT AGENCIES, WITHIN A 5-YEAR PERIOD.

SUB-GOAL 1: To assure that non-governmental organizations include Baird's tapir conservation on their agendas.

ACTIONS:

1. **To identify NGOs in order to visit and involve them with Baird's tapir conservation.**

Responsibility: TSG Country Coordinators

PROBLEM 1: LACK OF GENERAL INFORMATION (PROGRAMS, SCIENTIFIC DATA) AND INTEREST (ECONOMICAL AND HUMAN RESOURCES) ON BAIRD'S TAPIR AT THE LOCAL AND INTERNATIONAL LEVELS.

GOAL 2: TO IMPROVE BY 50% THE KNOWLEDGE ON BAIRD'S TAPIR OF NGOS, COMMUNICATION MEDIA, ZOOLOGICAL INSTITUTIONS, UNIVERSITIES, FINANCIAL AND SUPPORT AGENCIES, WITHIN A 5-YEAR PERIOD.

SUB-GOAL 2: That the international zoological institutions holding tapirs develop and implement awareness campaigns.

ACTIONS:

1. To develop a list of actions that each zoo can implement to promote the tapir.

Responsibility: TSG Zoo Committee

2. To get zoological institutions to support *In-Situ* conservation efforts

PROBLEM 1: LACK OF GENERAL INFORMATION (PROGRAMS, SCIENTIFIC DATA) AND INTEREST (ECONOMICAL AND HUMAN RESOURCES) ON BAIRD'S TAPIR AT THE LOCAL AND INTERNATIONAL LEVELS.

GOAL 2: TO IMPROVE BY 50% THE KNOWLEDGE ON BAIRD'S TAPIR OF NGOS, COMMUNICATION MEDIA, ZOOLOGICAL INSTITUTIONS, UNIVERSITIES, FINANCIAL AND SUPPORT BODIES, WITHIN A 5-YEAR PERIOD.

SUB-GOAL 3: To assure that potential funding sources include Baird's tapir conservation in their lists of funding priorities.

ACTIONS:

1. To identify potential donors in order to visit and involve them with Baird's tapir conservation.

Responsibility: Gilia Angell and Jeffrey Flocken, TSG Marketing Committee

PROBLEM 1: LACK OF GENERAL INFORMATION (PROGRAMS, SCIENTIFIC DATA) AND INTEREST (ECONOMICAL AND HUMAN RESOURCES) ON BAIRD'S TAPIR AT THE LOCAL AND INTERNATIONAL LEVELS.

GOAL 3: TO MANAGE GETTING THE BAIRD'S TAPIR TO BE A CHARISMATIC SPECIES THROUGH CLEAR AND CONCISE MESSAGES.

ACTIONS:

1. To create a caricatured mascot of the Baird's tapir for children.

Responsibility: Gilia Angell and Jeffrey Flocken, TSG Marketing Committee

2. To produce reference guides with sound messages appropriate for marketing purposes.

Responsibility: Gilia Angell and Jeffrey Flocken, TSG Marketing Committee

3. To organize a database of high resolution images to be used in the Baird's tapir advertising campaigns.

Responsibility: Gilia Angell and Jeffrey Flocken, TSG Marketing Committee

4. To produce posters, stamps, stickers, souvenirs, T-shirts etc. for dissemination of information about Baird's tapir and the problems faced by the species

Responsibility: TSG Country Coordinators

PROBLEM 2: THE LACK OF ENVIRONMENTAL CRITERIA IN THE DEVELOPMENT PLANS OF BOTH GOVERNMENTS AND PRIVATE COMPANIES CAUSES LOSS OF BAIRD'S TAPIR HABITAT AND POPULATIONS.

GOAL 1: TO HAVE ENVIRONMENTAL PLANS FROM THE GOVERNMENT AND PRIVATE COMPANIES WHICH INCLUDE PROTECTION OF BAIRD'S TAPIR AND ITS HABITAT IN FOUR COUNTRIES IN A PERIOD OF FIVE YEARS.

ACTIONS:

1. **To propose the Baird's Tapir Regional Conservation Plan to the different governments for their evaluation, recommendations and feedback**

Responsibility: TSG Country Coordinators

2. **To make a formal presentation of the Baird's Tapir Regional Conservation Plan to the governments of each country for its implementation.**

PROBLEM 2: THE LACK OF ENVIRONMENTAL CRITERIA IN THE DEVELOPMENT PLANS OF BOTH GOVERNMENTS AND PRIVATE COMPANIES CAUSES LOSS OF BAIRD'S TAPIR HABITAT AND POPULATIONS.

GOAL 2: TO DEVELOP AND APPROVE LAWS, OVER THE NEXT FIVE YEARS, TO PROTECT BAIRD'S TAPIRS AND THEIR HABITAT.

SUB-GOAL 1: To have policy makers persuaded about the importance of the conservation of Baird's tapir and its habitat.

ACTIONS:

1. **To compile a list of key policy makers on each country and plan a visit by the TSG Country Coordinators to ensure that they receive information on the importance of the conservation of the Baird's tapir and its habitat.**

Responsibility: TSG Country Coordinators

PROBLEM 2: THE LACK OF ENVIRONMENTAL CRITERIA IN THE DEVELOPMENT PLANS OF BOTH GOVERNMENTS AND PRIVATE COMPANIES CAUSES LOSS OF BAIRD'S TAPIR HABITAT AND POPULATIONS.

GOAL 2: TO DEVELOP AND APPROVE LAWS, OVER THE NEXT FIVE YEARS, TO PROTECT BAIRD'S TAPIRS AND THEIR HABITAT.

SUB-GOAL 2: To have, on each country, the legislation being adapted for the conservation of Baird's tapir and its habitat.

ACTIONS:

1. **To revise the current legislation and adapt it to fulfill the goal of the conservation of Baird's tapir and its habitat.**

PROBLEM 2: THE LACK OF ENVIRONMENTAL CRITERIA IN THE DEVELOPMENT PLANS OF BOTH GOVERNMENTS AND PRIVATE COMPANIES CAUSES LOSS OF BAIRD'S TAPIR HABITAT AND POPULATIONS.

GOAL 2: TO DEVELOP AND APPROVE LAWS, OVER THE NEXT FIVE YEARS, TO PROTECT BAIRD'S TAPIRS AND THEIR HABITAT.

SUB-GOAL 3: To have, on each country, the legislation being adapted for the conservation of Baird's tapir and its habitat.

ACTIONS:

1. **To enforce the current legislation in order to achieve an efficient conservation of Baird's tapir and its habitat.**

PROBLEM 2: THE LACK OF ENVIRONMENTAL CRITERIA IN THE DEVELOPMENT PLANS OF BOTH GOVERNMENTS AND PRIVATE COMPANIES CAUSES LOSS OF BAIRD'S TAPIR HABITAT AND POPULATIONS.

GOAL 3: TO IMPLEMENT ALTERNATIVE SYSTEMS OF PRODUCTION AS AN INCOME SOURCE FOR RURAL COMMUNITIES. WITH THIS, WE AIM AT IMPROVING THE CONSERVATION OF BAIRD'S TAPIR AND ITS HABITAT, IN 25% OF THE PRIORITY AREAS, IN THE NEXT FIVE YEARS

ACTIONS:

1. **To carry out workshops on communitarian planning of productive alternatives (ecotourism, craftwork, environmentally friendly agricultural cultivation etc.)**

Responsibility: Local and international NGOs

PROBLEM 3: THE UNSUSTAINABLE HUNTING HAS CAUSED A DECREASE OF BAIRD'S TAPIR POPULATIONS.

GOAL 1: TO REDUCE ILLEGAL HUNTING BY 20% IN THE NEXT FIVE YEARS IN THE AREAS WHERE BAIRD'S TAPIR LIVES IN.

ACTIONS:

1. **To act as consultant in the conflicts between tapirs and humans caused by resource competition through the development of methods for their mitigation in a workshop at the next International Tapir Symposium.**
2. **To carry out workshops and/or personal interviews with hunters and community leaders in priority areas with hunting records, including the current legislation in the theme.**

Responsibility	Deadline	Collaborators	Resources and costs	Results and/or products	Consequences of inaction	Obstacles
Action 1: Siân Waters, United Kingdom	2006		Case studies on each country	Development of mitigation methods in response to the needs of each country Personnel in the range countries prepared to deal with the problem	Maintenance of tapirs death toll caused by resource competition with humans	Lack of funding, lack of interest and poor communication
Action 2: Sergio Midense, Honduras	3 years	TSG Country Coordinators will contact organized communitarian groups	US$ 3,000 per workshop 1 workshop per priority area 3-5 facilitators	Participants list, 40 people per workshop (4 workshops), report of each workshop shared with each community which has taken part	Communities will keep on without getting information on the importance of Baird's tapir conservation	Lack of funding, lack of interest from local communities in taking part

PROBLEM 3: THE UNSUSTAINABLE HUNTING HAS CAUSED A DECREASE OF BAIRD'S TAPIR POPULATIONS.

GOAL 2: TO REDUCE ILLEGAL HUNTING BY 20% IN THE NEXT FIVE YEARS IN THE AREAS WHERE BAIRD'S TAPIR LIVES IN.

SUB-GOAL 1: To have the current legislation implemented by the responsible authorities within two years in all range countries involved.

ACTIONS:

1. **To build the capacity and equip officers through workshops, in order to enforce current conservation laws in 30% of the communities close to Baird's tapir habitat.**
2. **To raise awareness of the persons in charge of the governmental environmental institutions through personal interviews, letters, and delivering them an informational pack.**

Responsibility	Deadline	Collaborators	Resources and costs	Results and/or products	Consequences of inaction	Obstacles
Action 1: Alberto Mendoza, United States	August, 2007	Adrian Benedetti, Panama; Juan J. Rojas, Costa Rica; Rosa Pérez, Guatemala; Richard Sheffield, Mexico	3 facilitators US$5,000-US$10,000 for the workshops and US$5,000 for each team in priority areas	4 workshops, 100% of field officers trained	Offenses against the Baird's tapir go unpunished	Lack of funding and interest
Action 2: Georgita Ruiz, Mexico	2 years	José Joaquín Calvo, Costa Rica; Karla Aparicio, Panama; Eduardo Naranjo, Mexico; Roberto Ruiz, Guatemala; Nereyda Estrada, Honduras; Olga Montenegro, Colombia	Person in charge and assistant	Enforcement of laws which protect the Baird's tapir	Offenses against the Baird's tapir go unpunished	Consent to be received

PROBLEM 3: THE UNSUSTAINABLE HUNTING HAS CAUSED A DECREASE OF BAIRD'S TAPIR POPULATIONS.

GOAL 2: TO REDUCE ILLEGAL HUNTING BY 20% IN THE NEXT FIVE YEARS IN THE AREAS WHERE BAIRD'S TAPIR LIVES IN.

SUB-GOAL 2: To actively involve the communities in fighting against Baird's tapir illegal hunting through an environmental education program.

ACTIONS:

1. **To carry out workshops with the communities and establish a continuous program using the Baird's tapir as a flagship species and investigate in the traditional knowledge.**
2. **To set up a volunteering program of park rangers in the communities close to the Baird's tapir areas.**
3. **To investigate successful ecotourism projects in order to present plans to the local communities located within the Baird's tapir habitat.**

Responsibility	Deadline	Collaborators	Resources and costs	Results and/or products	Consequences of inaction	Obstacles
Action 1: Sergio Midense, Honduras	3 years	TSG Country Coordinators will contact organized community groups	US$ 3,000 per workshop 1 workshop per priority area 3-5 facilitators	Participants list, 40 people per workshop (4 workshops), report of each workshop shared with each community which has taken part	Communities will keep on without getting information on the importance of Baird's tapir conservation	Lack of budget, poor interest of the communities in taking part
Action 2: Sergio Midense, Honduras	3 years	TSG Country Coordinators will contact organized community groups	US$ 3,000 per community area, basic materials	List of volunteers and reports produced by them	The communities will not take possession of the process	Lack of budget, poor interest of the communities in taking part
Action 3: Olivier Chassot, Costa Rica	3 years	TSG Country Coordinators	US$ 1,000	A package with successful plans and communities informed on alternatives	Communities will not have the necessary information to make decisions.	Inability to compile information, lack of budget

PROBLEM 4: THE LACK OF SCIENTIFIC INFORMATION LIMITS THE DESIGN AND IMPLEMENTATION OF EDUCATIONAL PROGRAMS AT THE LOCAL LEVEL.

GOAL 1: TO DEFINE, BASED ON THE AVAILABLE INFORMATION, THE PRIORITY SITES TO CHANNEL CONSERVATION ACTIONS.

ACTIONS:

1. **To contact researchers in each range country in order to define the priority sites and help raising funds and managing capacity-building programs aiming at establishing a research and environmental education program in each range country.**

Responsibility	Deadline	Collaborators	Resources and costs	Results and/or products	Consequences of inaction	Obstacles
Action 1: Siân Waters, United Kingdom	5 years	TSG Country Coordinators, TSG Education & Outreach Committee and AZA and EAZA zoological institutions	US$ 10,000	New outreach and education programs	The lack of information on Baird's tapir conservation in priority communities will keep on going	Lack of funding and lack of communication

PROBLEM 4: THE LACK OF SCIENTIFIC INFORMATION LIMITS THE DESIGN AND IMPLEMENTATION OF EDUCATIONAL PROGRAMS AT THE LOCAL LEVEL.

GOAL 2: TO DEFINE, BASED ON THE AVAILABLE INFORMATION, THE PRIORITY SITES TO CHANNEL CONSERVATION ACTIONS.

SUB-GOAL 1: To have an accessible information and documentation center on the Baird's tapir and its habitat.

ACTIONS:

1. **To translate the TSG Website into Spanish and use this website for storing the relevant information.**
2. **To actively ask researchers and personnel of national parks, zoos and universities for relevant information related to tapirs.**
3. **To provide capacity-building to technical institutions and members of local communities in data collection and management through field training.**
4. **To identify, compile and distribute information from the traditional knowledge to allow for a good management of the species through a program of environmental interpretation.**

Responsibility	Deadline	Collaborators	Resources and costs	Results and/or products	Consequences of inaction	Obstacles
Action 1: Gilia Angell, TSG Marketing Committee	Continuous program	Georgita Ruiz, Mexico and Adrian Benedetti, Panama	No costs	A website translated to Spanish and better information exchange	The information exchange problem will keep on going	Lack of time
Action 2: Siân Waters, United Kingdom	1 year		No costs	Information will be available in the TSG Website		Lack of cooperation
Action 3: Iván Lira Torres, Mexico	3 years	TSG Country Coordinators will contact scientists in their countries	US$ 20,000/year per country	List of researchers and communities involved. Two ongoing research projects every 2 years		Lack of budget and lack of researchers and interested communities
Action 4: Fabricio Carbonell & Feng Mei Wu, Costa Rica	3 years	TSG Country Coordinators will contact development agencies in their countries	US$ 50,000/year per country	One publication per country, two workshops a year on each country, participants list, reports, CDs, posters and stories		Lack of funding and lack of interest on the side of the ethnic groups

Baird's Tapir (*Tapirus bairdii*)
Conservation Workshop
Population and Habitat Viability Assessment (PHVA)

Belize, Central America
15 to 19 August, 2005

Section 5

Population Biology and Simulation Modeling Working Group Report

Population Biology and Simulation Modeling

Participants

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Introduction

Baird's tapir (*Tapirus bairdii*) is distributed broadly across Central America, ranging from northern Mexico to Colombia, except El Salvador. Despite this broad area of occurrence, the species is fragmented into a large number of smaller subpopulations occupying many isolated habitat remnants. This isolation and fragmentation puts many smaller tapir populations at risk of local extinction, often with little chance of population re-establishment when habitats do not have sufficient geographic connection to neighboring pieces of forest. The situation is compounded by the fact that different forms of human activity – namely hunting and continued habitat loss – may increase the risk of local population extinction, especially as human populations continue to increase in the region. Successful tapir conservation will depend on a scientifically rigorous method for identifying the quantitative impacts of these risks and to help biologists decide on the best available population management strategies.

Population Viability Analysis (PVA) can be an extremely useful tool for assessing current and future risk of wildlife population decline and extinction. In addition, the need for and consequences of alternative management strategies can be modeled to suggest which practices may be the most effective in conserving Baird's tapir in its wild habitat. *VORTEX*, a simulation software package written to conduct PVA, was used here as a tool to study the interaction of a number of Baird's tapir life history and population parameters treated stochastically, to explore which demographic parameters may be the most sensitive to alternative management practices. Because of the wide-distribution of Baird's tapir, spanning several countries across many different ecological conditions, detailed modeling of each distinct subpopulation in existence was practically impossible. Therefore, a more general approach to modeling was employed – one that focused on assessing the effects of principal threats on populations across a wide range of numbers of individuals (from 10 to 2,500) under different conditions. This process has enabled us to create a large set of possible scenarios that approximate real populations in the wild, allowing us to produce conservation guidelines for population managers to adopt in any part of the species' distribution.

The *VORTEX* package is a simulation of the effects of deterministic forces as well as demographic, environmental, and genetic stochastic events on wild populations. *VORTEX* models population dynamics as discrete sequential events (*e.g.* births, deaths, sex ratios among offspring, catastrophes etc.) that occur according to defined probabilities. The probabilities of events are modeled as constants or random variables that follow specified distributions. The package simulates a population by stepping through the series of events that describe the typical life cycles of sexually reproducing, diploid organisms.

VORTEX is not intended to give absolute answers, since it is projecting stochastically the interactions of the many parameters used as input to the model and because of the random processes involved in nature. Interpretation of the output depends upon our knowledge of the biology of Baird's tapir, the environmental conditions affecting the species, and possible future changes in these conditions. For a more detailed explanation of *VORTEX* and its use in population viability analysis, refer to a brief description in Appendix I as well as Lacy (2000) and Miller & Lacy (2003).

PROBLEMS

BRAINSTORMING

- Impact of hunting in local populations (local extinctions)
- Lack of data on the precise distribution of the species
- Opening of new roads
- Environmental variability
- Lack of governance
- Isolation of populations, which increases the risks of extinction
- Introduction of diseases in wild populations
- Effects of wild fires
- Natural disasters / drought / floods
- Urban development
- Drug trafficking and guerrillas
- Hunting for subsistence and due to conflict (i.e. as a reaction to damage to crops)
- Cultural changes in rural/indigenous communities
- Changes in consumer habits
- Lack of protected areas in the species' range
- Problems in the design of protected areas/ lack of protected areas in the different regions
- Industrial / Oil / Gas development
- Economic and public policy
- Extraction of timber and other forest products (reduction in the quality of habitat and reduction in the carrying capacity)
- Intensification and expansion of cattle ranching / competition (habitat and food)
- Public's lack of knowledge on the species
- Difficulty in defining a "viable population"
- Road-kill (at least 5 documented cases since 2005 in Belize)

Threats

1. Habitat loss and conversion
2. Illegal hunting
3. Lack of public policies for the species protection
4. Presence of natural and anthropogenic phenomena (severe and light)
5. Education and communication
6. Introduced diseases
7. Political instability

Once the problems faced by the species were defined, the group identified a series of issues about the use of the computer model *VORTEX*, which simulates the probability of extinction of a species.

1. Defining a "viable population."

It is currently difficult to define what is a viable population of tapirs. Research on the species is still relatively new, and therefore there is a paucity of precise information on the variables usually required to define viability. To be able to define viability, it is necessary to quantify the following variables: population sizes, structure, genetic variability, the quantity and quality of available habitat, and the effect of threats on these populations.

2. One should consider the information deficits.

Sound and up-to-date information on the distribution, abundance, population dynamics, genetics, diseases, and habitat availability, among other variables are needed. Nevertheless, for many of these variables and in some regions, the information available is of insufficient quality or quantity for a robust PHVA. It is necessary, therefore, to gather this type of information to allow for the design of effective measures for conservation and management of both native and captive populations.

3. To evaluate the necessity to analyze populations at several spatial scales.

Given that there is considerable environmental variation across the Baird's tapir's distribution, it is necessary to analyze the threat factors and the information needs particular to each region. In addition, given that there are some large populations at the regional scale, it is necessary to focus on them, as they are the most likely to persist on the long-term.

4. To include threat factors in the analysis.

The main threats affecting the survival of Baird's tapir across its distribution include: habitat loss and conversion, hunting and introduction of diseases, which reduce the size of populations, compromising their viability in the long-term. Other threats include inconsistencies and deficiencies in public policies, deficiencies in education and communication, and political instability, which make it harder to design and implement conservation actions and management. Natural phenomena of varying intensity also represent a threat because they can have considerable effects on small populations. The intensity and severity of these factors vary geographically in accordance with the peculiarities of each country.

Baseline Input Parameters for Simulation Modeling Scenario Settings

In developing our baseline model, we intend to simulate a Baird's tapir population that is free of human interference. In other words, we want to observe the growth dynamics of a population that is able to grow at the rate that is expected based on our understanding of the basic biology of the species. Then, with this information in hand, we can "perturb" the system by adding in natural and anthropogenic threats. In this way, we can investigate the impacts that humans are having on tapir population viability in order to determine the best ways that successful tapir management may be achieved.

Species description

Definition of extinction: We have defined extinction to mean the total removal of at least one sex. In other words, we are not looking at the decline of the population below some threshold size (otherwise known as quasi-extinction).

Inbreeding depression: *VORTEX* includes the ability to model the detrimental effects of inbreeding through reduced survival of offspring through their first year. *VORTEX* default values that describe the nature and severity of inbreeding depression were employed throughout the exercise.

These default values – 3.14 lethal equivalents per individual, with 50% of the total genetic load derived from lethal alleles – are based on a detailed statistical study of the effects of inbreeding on more than 40 captive mammal populations (Ralls *et al.* 1988). We do not have any evidence of inbreeding depression from wild or captive Baird's tapir populations, however we decided to investigate the potential effects of inbreeding depression in small populations; more specifically, we included inbreeding depression in models with an initial population size (N_0) of 125 or less.

Concordance of environmental variation (EV) between reproductive rates and survival rates: There is no evidence of such concordance in tapirs. Baird's tapirs in Corcovado National Park, Costa Rica, kept breeding throughout the last severe droughts of El Niño in 1997/98 (Charles Foerster, pers. obs.). Other lines of evidence also support this assumption; large, long-lived and slow growing animals show little correlation between breeding and survival.

Reproductive system

Breeding system: Monogamous. Although current direct and indirect evidence from field studies (in the Americas) and camera traps (Sumatra and Peninsular Malaysia) indicate that tapirs are not monogamous and probably facultatively polygynous, we parameterized it as monogamous because *VORTEX* is not spatially explicit and the selection of a polygynous system would suggest a panmictic scenario, which is less similar to what current data suggest than monogamy.

Age of first reproduction: *VORTEX* precisely defines reproduction as the time at which offspring are born, not simply the age of sexual maturity. The program uses the mean age rather than the earliest recorded age of offspring production. In captivity Baird's tapirs are known to sire their first offspring as young as 2 years old (Joseph Roman, pers. comm.). Albeit, in the wild female Baird's tapirs are reported to reach sexual maturity at 2 to 3 years of age, and males at 3 (Williams 1991). Because conditions are assumed to be harsher in the wild than in captivity, it was assumed that both males and females Baird's tapir reach sexual maturity at 3 year of age.

Maximum age of reproduction: *VORTEX* initially assumes that animals can reproduce (at the normal rate) throughout their adult life. We set this maximum age at 20 years. According to Robinson and Redford (1986), the average age of last reproduction for tapirs is 23.5 years. The only available data is on longevity, with 29.3 years as the record from the Dallas zoo (Yin 1967). As a conservative estimate, the wild tapirs are modeled to reproduce up until 20 years of age.

Longevity: Data from the Dallas Zoo indicate 29.3 years (Yin 1967). According to MacKinnon (1985), the lifespan of a Malay tapir is about 30 years.

Maximum number of offspring per year: Tapirs have a gestation period of about 401 days (13.4 months), range from 390 to 407, and rarely do females give birth to more than one young per gestation (Read 1986; Barongi 1986). Adult females generally produce one calf, and rarely two, every two years (Anderson 1982; Lekagul and McNeely 1977). Even though there is at least one record of twins born in a zoo (Dr. Vellayan pers. comm.), tapirs produce 1 calf per parturition.

Sex ratio at birth: Sex ratio at birth is assumed to be 50%. There is no *a priori* evidence to suggest a skewed sex ratio at birth. Field data from Corcovado National Park shows a larger (although not significant) percent of males (Charles Foerster, pers. obs.). Zoo records from the Zoo Negara in Malaysia show birth rates with a 50% sex ratio (Dr. Vellayan pers. comm.).

Female breeding success: We assume that, on average, about 60% of adult females will successfully breed each year. Data on gestation and lactation comes mainly from Read (1986), which would suggest that inter-birth interval in captivity is 18.5 months (554 days; range = 496 to 602) (or 50% of females available in any given year). Other zoo evidence and field observations in Corcovado National Park (Charles Foerster, pers. obs.) indicate that females may become pregnant while lactating, which can reduce the interval to as few as 16 months (4 female Baird's tapirs, 4-9 years observations). Further, some females may lose their offspring during lactation, stillbirth, or neonatal deaths and come into estrus soon afterwards. The model assumes 45% females reproducing in a given year to account for an inter-birth interval of approximately 16 months.

Environmental variation in breeding: Annual environmental variation in female reproduction is modeled in *VORTEX* by specifying a standard deviation (SD) for the proportion of adult females that successfully produce offspring within a given year. No data are available for this parameter. Given their body size and reproductive rate, it is expected that Baird's tapirs show very little variation (Robinson and Redford 1986). Assuming no variation in breeding may be less realistic than assuming some variation. Thus, 22% of the mean rate, or 10%EV, is considered as a small value and used in the simulation.

Density dependent reproduction: *VORTEX* can model density dependence with an equation that specifies the proportion of adult females that reproduce as a function of the total population size. In addition to including a more typical reduction in breeding in high-density populations, the user can also model an Allee effect: a decrease in the proportion of females that bread at low population density due, for example, to difficulty in finding mates that are widely dispersed across the landscape. We did not have specific data on the presence, mode, or intensity of density dependence on reproductive success in Baird's tapir. Consequently, we chose to not include such a mechanism in our PVA models.

Mortality rates

The data available on mortality rates for Baird's tapir in the wild is limited to Charles Foerster's study in Corcovado National Park, Costa Rica. Four lines of evidence can be used to assume realistic rates (see Salas and Kim 2002). First, the mortality schedule must follow a Type I pattern. Second, using allometric regressions of body mass and life history parameters, Robinson and Redford (1986) placed the American tapirs in a category of animals with 20% or less survival to age of last reproduction. Baird's tapirs should be expected to follow this pattern. Thirdly, the population should show a growth rate between 3-4%, as expected from allometric relationships (Robinson and Redford 1986). Finally, Charles Foerster reports evidence of risk-prone behavior in sub-adults of Baird's tapir in Corcovado National Park, and Patrícia Medici reports similar behavior for sub-adult male Lowland tapir (*Tapirus terrestris*) in Morro do Diabo State Park, Brazil. Therefore, mortality rates for sub-adult males were assumed to be slightly higher than for females to take into account the risk prone behavior.

Based on the above information, the survival rates were set at:

	Female as %	Male as %
Mortality from Age 0 to 1 (SD)	10 (±2)	10 (±2)
Mortality from Age 1 to 2 (SD)	15 (±2)	15 (±2)
Mortality from Age 2 to 3 (SD)	20 (±5)	25 (±5)
Annual Mortality After Age 3 (SD)	7 (±2)	7 (±2)

With the above values, the survival probability to age of last reproduction is 17.8% for females and 16.7% for males.

Catastrophes

Catastrophes are singular environmental events that are outside the bounds of normal environmental variation affecting reproduction and/or survival. Natural catastrophes can be tornadoes, floods, droughts, disease, or similar events. These events are modeled in *VORTEX* by assigning an annual probability of occurrence and a pair of severity factors describing their impact on mortality (across all age-sex classes) and the proportion of females successfully breeding in a given year. These factors range from 0.0 (maximum or absolute effect) to 1.0 (no effect), and are imposed during the single year of the catastrophe, after which time the demographic rates rebound to their baseline values.

We chose to not include catastrophes in our models. The environment was assumed to be sufficiently stable, and the other threats facing the species (see below) of sufficient severity, that the imposition of additional model complexity was not desirable. It is conceivable, however, that events such as drought, fire, or disease may play a significant role in tapir population dynamics in this geographic area.

Mate monopolization

In many species, some adult males may be socially restricted from breeding despite being physiologically capable. This can be modeled in *VORTEX* by specifying a portion of the total pool of adult males that may be considered "available" for breeding each year. Evidence from Baird's tapirs in Corcovado National Park (Charles Foerster, pers. obs.) clearly shows a territorial behavior and males securing access to only one female. Data from lowland tapirs in Morro do Diablo State Park, Brazil (Patrícia Medici, pers. obs.) suggests that dispersing sub-adult males occupy marginal territories, having little access to females. Therefore, we assumed that 90% of males would be available to reproduction each year.

Initial population size and carrying capacity

VORTEX distributes the specified initial population among age-sex classes according to a stable age distribution that is characteristic of the mortality and reproductive schedule described previously. In addition, the carrying capacity, K, for a given habitat patch defines an upper limit for the population size, above which additional mortality is imposed randomly across all age classes in order to return the population to the value set for K.

Our baseline population model uses an arbitrary initial population size of 100 individuals and a carrying capacity of 200. In subsequent models, because of the extensive distribution and the many countries treated within this workshop, we modeled several initial population sizes and carrying capacities based on what workshop participants thought plausible. Initial population sizes varied from 10 to 2500, and carrying capacity was specified as either equal to initial population size (i.e. $K=N_0$) or equal to twice the initial population size (i.e. $K=2N_0$). Finally, it was assumed that EV does not affect K because of the large size of the species.

POPULATION SIZES IN EACH SUBREGION (ESTIMATES)				
	Country	**Aprox. Area**	**N**	**Habitat**
Zoque Forest	Mexico	6,303	1,240	Tropical Rainforest and Cloud Forest
Maya Forest	Mexico-Guatemala-Belize	26,364 (not counting Belize because of insufficient data)	4,936	Tropical Rainforest
Mosquitia Forest	Honduras-Nicaragua	18,000	2,430	Tropical Rainforest
Lower San Juan River Basin	Nicaragua-Costa Rica	3,000	600	Tropical Rainforest
Darien-Talamanca	Costa Rica-Panama-Colombia	35,917	7,377	Tropical Rainforest
TOTAL			**16,583**	

Iterations and years of projection

All population projections (scenarios) were simulated 500 times. Each projection extends to 100 years, with demographic information obtained at annual intervals. We opted to use a time span of 100 years because it is far enough into the future so as to decrease the chances of omitting a yet unknown event, but also not too short to fail to observe a slowly developing event. All simulations were conducted using *VORTEX* version 9.57 (July 2005).

Table 1 below summarizes the baseline input dataset upon which all subsequent *VORTEX* models are based.

Table 1. Demographic input parameters for the baseline VORTEX model of Baird's tapir population dynamics throughout the species' range. See accompanying text for more information.

Model Input Parameter	Baseline value
Breeding System	Monogamous
Age of first reproduction (♀ / ♂)	3 / 3
Maximum age of reproduction	20
Inbreeding depression?	Yes
Lethal equivalents	3.14
Annual % adult females reproducing (SD)	45 (10)
Density dependent reproduction?	No
Maximum litter size	1
Overall offspring sex ratio	0.5
Adult males in breeding pool	90%
% annual mortality, ♀ / ♂ (SD)	
0 – 1	33.0 / 33.0 (7.0)
1 – 2	15.0 / 15.0 (3.0)
2 – 3	20.0 / 25.0 (5.0)
3 – +	7.0 / 7.0 (2.0)
Catastrophes	None
Initial population size (N_0)	10 - 2500
Carrying capacity	$K = N_0$; $K = 2N_0$

Additional input settings for risk assessment models

Hunting: Workshop participants identified hunting of tapirs by local human populations as a potential major threat to future tapir population survival. In order to evaluate this threat, we developed a set of additional modeling scenarios where different levels of hunting were added to the values of adult mortality that defines our baseline tapir model. Specifically, we added 0.5%, 2.0%, or 4.0% annual mortality (representing "low", "medium", and "high" levels, respectively) to both male and female adult rates. While the lower levels of hunting used here are considered to be more representative of current conditions across much of the species' range, we were interested in evaluating the effect of increased hunting levels in the future under conditions of, for example, higher human population density. Using this system, then, a "medium" level hunting scenario would be characterized by adult mortality rates set at 9.0% instead of the baseline level of 7.0%.

Habitat loss: In addition to hunting of local tapir populations, human activity across the species' range is leading to the steady loss of forest habitat. As listed elsewhere in this working group report, average annual rates of forest loss range from 0.5% in Colombia to more than 3.0% in Honduras. The rapid rate of deforestation seen in Honduras, if carried forward at the same rate, would lead to a deterministic certainty of tapir population extinction in approximately 30 years. We therefore chose to simulate less rapid rates of forest loss in order to investigate the more subtle interaction between this threat and the basic biology of the species and other threats to population survival. Specifically, we simulated annual loss of forest through a linear reduction in the habitat carrying capacity, K. "Low" and "high" rates of loss corresponded to 0.5% and 0.75% annual reduction in K, respectively. Under these conditions, the habitat carrying capacity would be reduced by 50% or 75% of the original value over a period of 100 years.

Habitat loss models were not constructed for those scenarios in which $K = 2N_0$. This choice was made because such models would lead to a significant amount of redundancy in the final set of results. For example, a model with N_0 = K = 50 with no habitat loss would have functionally identical dynamics compared to a model with N_0 = 50, K = 100 and an annual rate of habitat loss of 0.5% (resulting in a final K = 50 at year 100).

Table 2. Main threats that affect population viability of tapirs classified by degree of threat.

Threats / **Country**		Loss and transformation of habitat (rate deforestation/year)*	Hunting (animals/year)	Disease (animals/year)	Natural phenomena (animals/year)
MEXICO	D	High	Medium	Low	Low
	Q	0.90%	2 in 300.000ha 0.33 in 10.000 in El Triunfo		
	S	1.2	17, 18	23	29
GUATELAMA	D	High	Low	Low	Low
	Q	1.18% for the country			
	S	3	17	24	24
BELIZE	D	Low	Low	?	Low
	Q				
	S	4	4	25	25
HONDURAS	D	High	High	?	Medium
	Q	3.20%	8 in 10 months in 70,000ha National Park Agalta		
	S	5	22	22	22
EL SALVADOR	D		Low		
	Q				
	S		Locally extinct		
NICARAGUA	D	High	High		Medium
	Q				
	S	7	22		22
COSTA RICA	D	Low	Low	Low	Low
	Q				
	S	14	15	26, 27, 31	30
PANAMA	D	Low	Medium		Low
	Q				
	S	8	9, 10		10
COLOMBIA	D	Low	Medium	?	Low
	Q	0.5%	1%		
	S	11,12	21	28	28

* 1.26% annual rate for the Central-American region, WRI 2002
D = Degree of threat
Q = Quantification
S = Source

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12. Natura 2002
13. WWF 2004. Vacíos de conservación [Conservation gaps]
14. POFIPE 2000
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16. C. R. Foester
17. E. Naranjo 2002
18. E. Naranjo 2001
19. M. Morales 2004
20. Rosales 2005
21. Héctor Restrepo, pers. com.
22. L. Marineros y H. Portillo personal appreciations. One hurricane in 1998
23. I. Lira 1999, 2001
24. R. García y M. García personal appreciation
25. E. Ariola, There is no information available
26. A. Paras 1996
27. S. L. Hernández-Divers 2001
28. O. L. Montenegro, H. Restrepo y R. Polanco
29. E. Naranjo y I. Lira personal observation (two climactic events in the last 10 years)
30. V. Villalobos personal appreciation
31. J. J. Rojas personal appreciation
32. N. Estrada, 2006

Results from Simulation Modeling Exercise

Note that detailed numerical results of all modeling scenarios are presented in Apendix I

Baseline model

As seen in Figure 1, our baseline Baird's tapir model gives a stochastic population growth r_s of 0.033. In other words, our simulated population, when free of human interference, is expected to grow in size at an average annual rate of about 3.3%. With this rate of growth, a typical population will double in size in about 20 years. The simulated population reaches the habitat carrying capacity in as little as 10 years and, because of this limit to growth, is unable to increase further. The variability seen in the population trajectories, both within and between iterations, reflects the annual uncertainty in reproduction and mortality rates that is included in the *VORTEX* model input. In addition, the inclusion of inbreeding depression is also partly responsible for this annual variability.

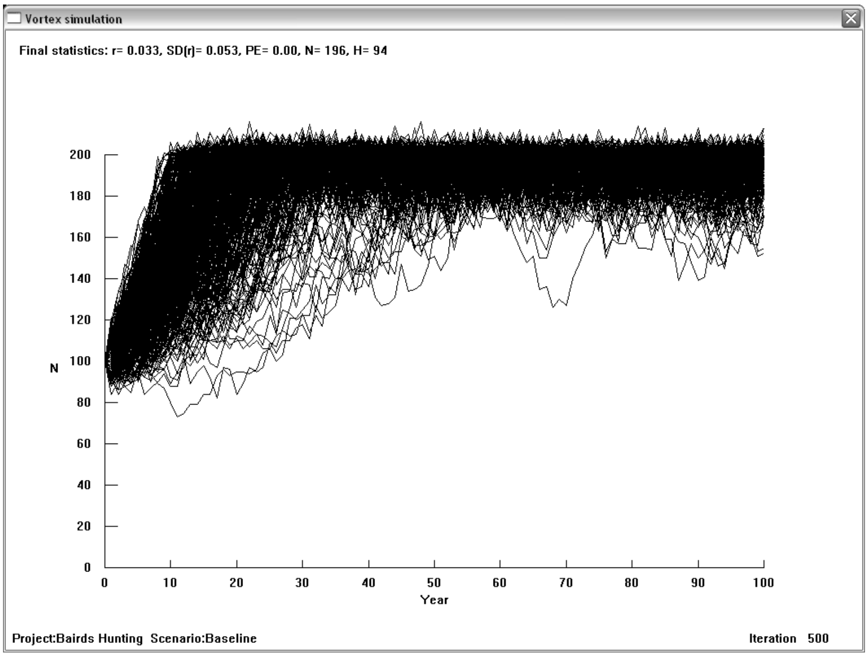


Figure 1. 100-year trajectory of the baseline *VORTEX* model of a generic Baird's tapir population. The baseline model is assumed to be free of human impact and results in a positive average stochastic population growth rate of 0.033. The graphs shows a total of 500 individual iterations that vary among trajectories through the action of stochastic demography used as model input. See accompanying text for additional information.

Our intent in this report is to describe the results of a series of risk assessment exercises, in which we investigate the impact of three individual threat factors: inbreeding depression, hunting, and habitat loss. At the end of the report, we will present a summary discussion of the ways in which these different threats interact to endanger Baird's tapir populations.

Risk Assessment I: Inbreeding Depression

Population biology theory predicts that smaller populations are at a higher risk of demographic and genetic instability than those containing a larger number of individuals. This instability increases the probability that a population can go extinct through other unpredictable (stochastic) forces. Our initial study of Baird's tapir population viability confirms this prediction. As shown in Figure 2, the smallest simulated tapir populations (N_0 = 10 and 25) have a measurable risk of extinction, even in the absence of genetic impacts brought about by inbreeding. In particular, populations of just 10 individuals (comprised of only 8 adults) show an 85% chance that extinction will occur within 100 years. Note the dramatic reduction in extinction risk when the initial population size increases from 10 to 25 individuals – the final extinction risk declines from 85% to just 10%. This observation lends some support to the existence of a sort of "extinction threshold" population size, below which the risk of losing the population rises considerably.

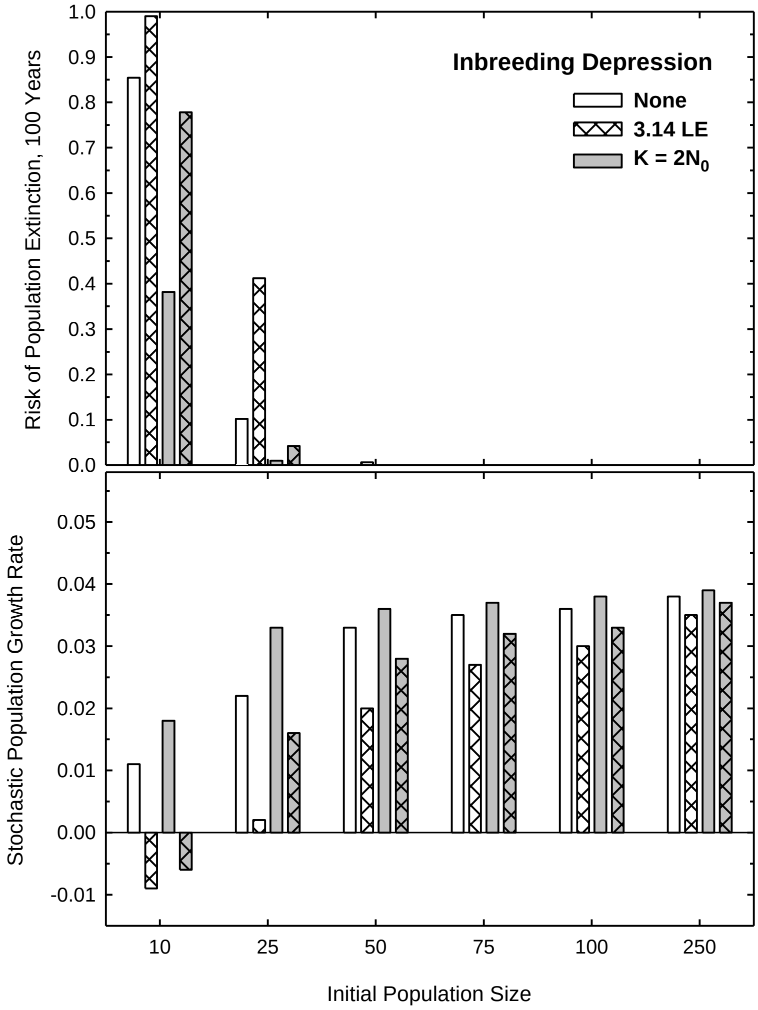


Figure 2. Extinction risk (top) and mean stochastic growth rate (bottom) of simulated Baird's tapir populations. White bars indicate scenarios where carrying capacity K is equal to initial population size N_0, while grey bars indicate $K = 2N_0$. Inbreeding depression is absent in open bars and present in hatched bars. The severity of inbreeding is equivalent to 3.14 lethal equivalents per genome, with 50% of the genetic load due to lethal alleles. See text for additional information on model parameters.

When the destabilizing effects of inbreeding depression are included, the risk of population extinction increases substantially for the smallest populations. Moreover, the population growth rate is sharply reduced and, in the case of the smallest population of 10 individuals, switches from positive to negative. It is interesting to note, however, that in populations of at least 50 individuals the risk of extinction is negligible and the impact of inbreeding on growth rates decreases to near zero by the time populations reach 250 individuals.

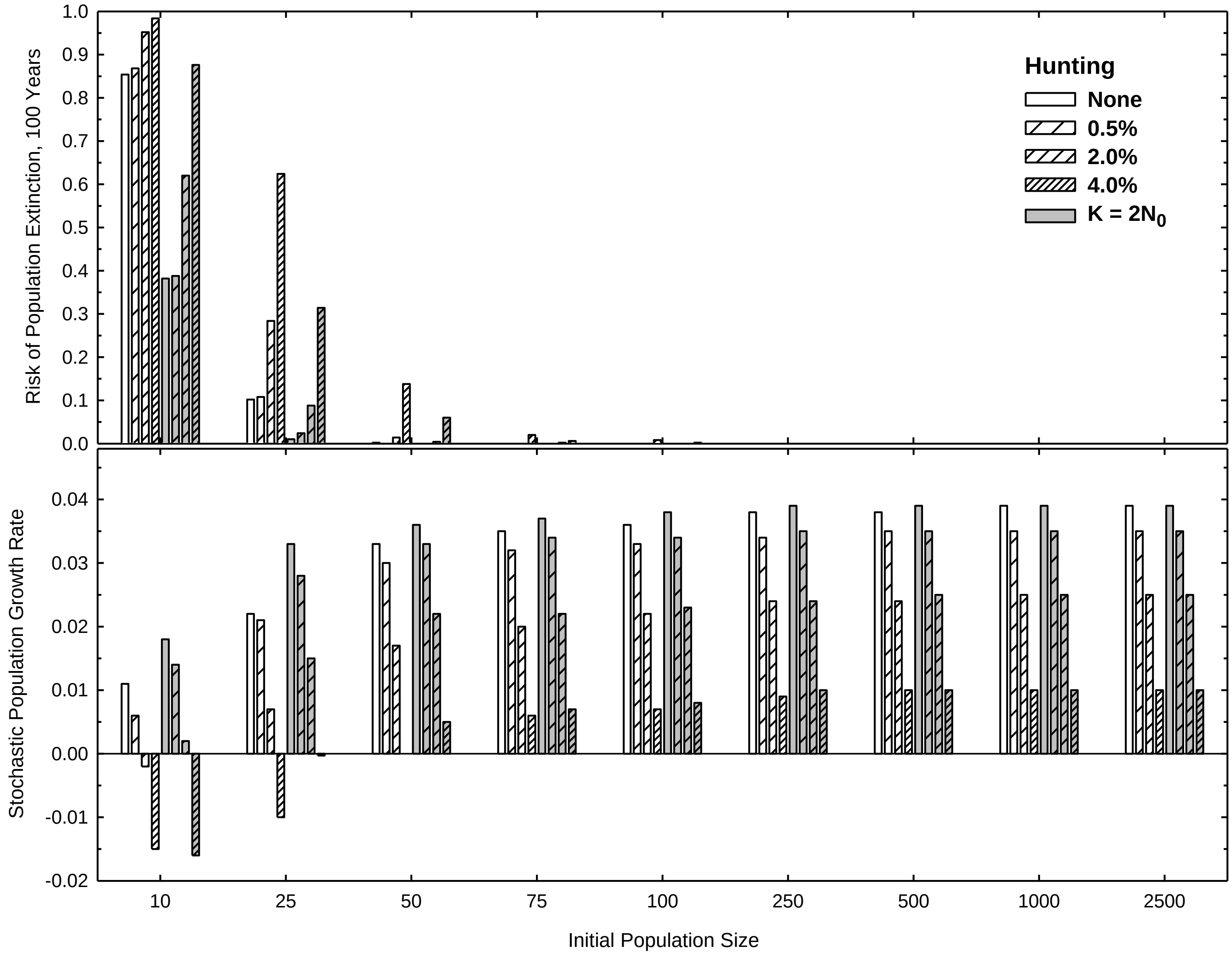
As expected, when smaller populations are given the opportunity to grow beyond their initial size (i.e., when $K > N_0$), growth rates increase and extinction risks decrease. This pattern is seen most dramatically in populations of less than 50 individuals, again confirming the susceptibility of very small populations to the consequences of inbreeding.

In summary, these models suggest that inbreeding can be a serious additional factor in the viability of Baird's tapir populations. However, the effect as modeled here does not pose a major threat to isolated populations of more than about 50-75 animals. Periodic dispersal of animals into these smaller populations (not explicitly modeled here) would reduce the rate of inbreeding through the introduction of unrelated individuals and would, therefore, lessen the impact of inbreeding depression.

Risk Assessment II: Hunting

Additional annual mortality of Baird's tapirs through hunting by local human populations increases the risk of tapir population extinction in small populations, and can dramatically reduce the long-term rate of population growth (Figure 3). As expected, this effect is most notable in the smallest populations (i.e., $N_0 < 50$) where moderate levels of hunting can drive the average growth from positive to negative. In larger populations, for which extinction risk is negligible, moderate to high levels of hunting can lead to a 50% - 75% reduction in the stochastic population growth rate. Therefore, it is important to remember that while hunting by itself may not be seen as a major risk factor for the future survival of intermediate-size tapir populations, a combination of factors may act to destabilize them and, in the long-term put them at risk of extinction.

Figure 3. Extinction risk (top) and mean stochastic growth rate (bottom) of simulated Baird's tapir populations subjected to varying levels of hunting (indicated by hatched bars). Grey bars indicate models where carrying capacity was set to twice the initial population size. See text for additional information on model parameters.



Risk Assessment III: Habitat Loss

When compared to the other threat factors already discussed, the impact of loss of habitat on the demographic performance of simulated Baird's tapir populations is relatively minor (Figure 4). Because population growth rates are assumed to remain robust in the presence of loss of habitat (and, in these particular models, in the absence of inbreeding depression and hunting-based mortality), only those populations with $N_0 < 75$ show any real reduction in overall stochastic growth dynamics. This is because they get small enough to become destabilized demographically.

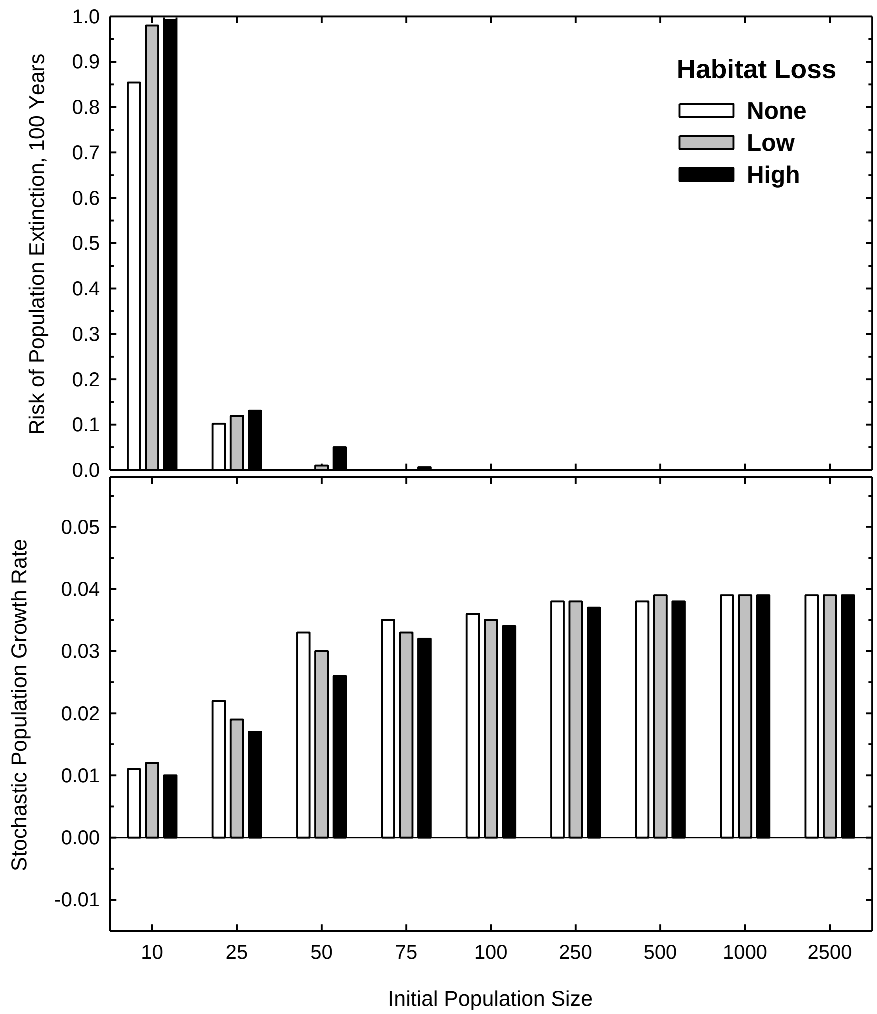


Figure 4. Extinction risk (top) and mean stochastic growth rate (bottom) of simulated Baird's tapir populations in the presence of linear declines in available habitat, modeled as declines in carrying capacity. Low and high rates of loss correspond to annual reductions in K of 0.5% and 0.75%, respectively. See text for additional information on model parameters.

It is important to remember that only moderate rates of habitat loss were considered in this set of models. For those regions or countries with higher rates of deforestation, tapir population extinction risks will of course be higher. In the case of those regions with annual rates of loss exceeding 1.0%, the risk of extinction within 100 years will grow to 100% and be determined by the specific rate of forest loss. For example, Honduras' estimated rate of annual loss of 3.2% means that, if this rate remains constant in the future, the amount of habitat available to tapirs will decline to zero in [100 / 3.2] = 31 years.

Risk Assessment IV: Combined Analysis

The results outlined above in this section treat three different threat factors – inbreeding depression, hunting-based mortality, and habitat loss – as separate processes so that we can look at their impacts in more detail. However, it is important to remember that these factors interact to increase population instability and, therefore, extinction. Consequently, we must create a series of models that include different combinations of threats so that we can more realistically characterize the risks faced by populations of varied size and distribution across the species' geographic range.

The color charts shown on the following pages are an attempt to display the results of these many analyses. The models described here include, for each initial population size N_0, four different levels of hunting-induced mortality and three levels of habitat carrying capacity loss, either in the presence or absence of inbreeding depression and when $K = N_0$ or $K = 2N_0$. The qualitative definitions of hunting and habitat loss intensity have the following quantitative characteristics:

	Hunting	Habitat Loss
None	0.0%	0.0%
Low	0.5%	0.5%
Medium	2.0%	
High	4.0%	0.75%

Therefore, in any one set of charts the "worst-case" scenario would be one in which the population size is the smallest, inbreeding depression is included, hunting-induced mortality is high (equivalent to 4.0% annually), and habitat loss is high (equivalent to 0.75% annually).

For a given chart, each box represents a particular model, and the box's color represents a level of risk to a given population with a particular set of model characteristics, as determined by the quantitative results of the *VORTEX* model. At a general level, green indicates a relatively higher level of long-term population security (i.e., viability) than yellow, with red and dark red indicating high levels of instability and risk of significant population decline and extinction. It is important to recognize that the quantitative definitions associated with each color are basically arbitrary. In other words, there are no specific and universal definitions of what is an "acceptable" level of extinction risk or an "unacceptably" low population growth rate. However, by consistent use of the criteria across all analyses, we are able to directly compare the relative impacts of different factors and/or processes on the future viability of Baird's tapir populations across their range. In this way, the definitions are robust and defensible.

Inspection of Figures 5 – 7 allows us to make the following observations:

1. Tapir populations composed of about 25 individuals or fewer exhibit significant risk of extinction, even when additional threat factors are relative mild. Extinction events tend to occur within about 30-40 years on average. This instability is strong even under conditions where the populations are not already saturated in their habitat, i.e., when $K = 2N_0$.

2. When inbreeding depression is absent, populations of about 100 – 200 tapirs appear to reach equilibrium in growth dynamics and extinction risk that is characteristic of much larger populations. However, inbreeding depression leads to a marked increase in instability of populations composed of as many as 100 tapirs. Beyond this size, inbreeding depression does not appear to be a major risk under the conditions modeled here.

3. As discussed in the earlier sections of this report, the additional mortality imposed through human hunting practices appears to have a more significant impact on overall tapir population viability when compared to the levels of annual habitat loss included in these models. This can be seen by observing the intensity of color change within a given column (holding habitat loss constant) and comparing it to that for within a given row (holding hunting rate constant).

Figure 5a. Combined PVA analysis of Baird's tapir populations. Extinction risk in models including hunting-induced mortality and habitat loss in the absence of inbreeding depression and when carrying capacity is equivalent to initial population size. Each cell represents an individual model, so this Figure displays the results from 81 separate *VORTEX* model scenarios. See text for additional details of model input and graphical nature of output.

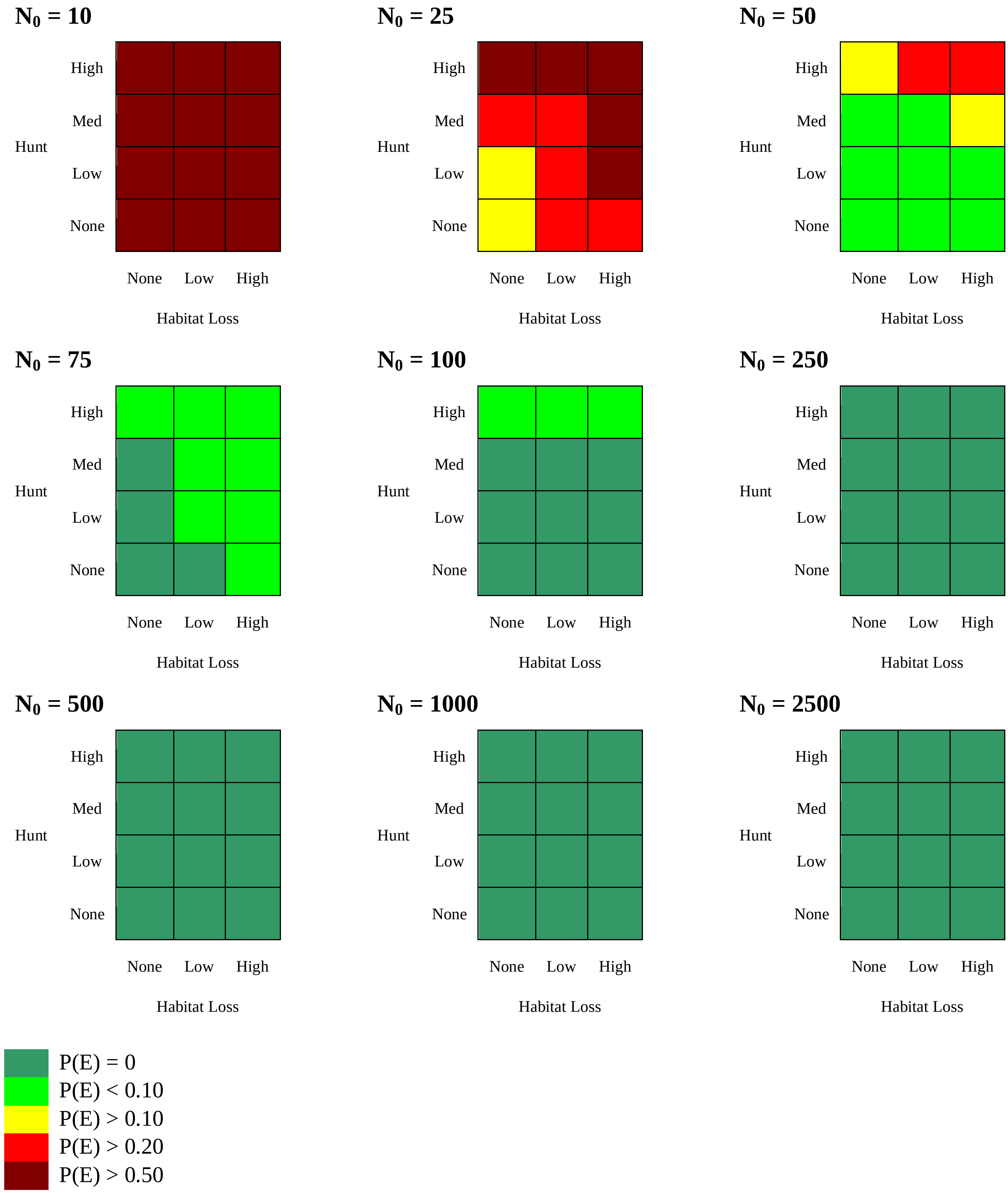


Figure 5b. Combined PVA analysis of Baird's tapir populations. Stochastic population growth rate in models including hunting-induced mortality and habitat loss in the absence of inbreeding depression and when carrying capacity is equivalent to initial population size. Each cell represents an individual model, so this Figure displays the results from 81 separate *VORTEX* model scenarios. See text for additional details of model input and graphical nature of output.

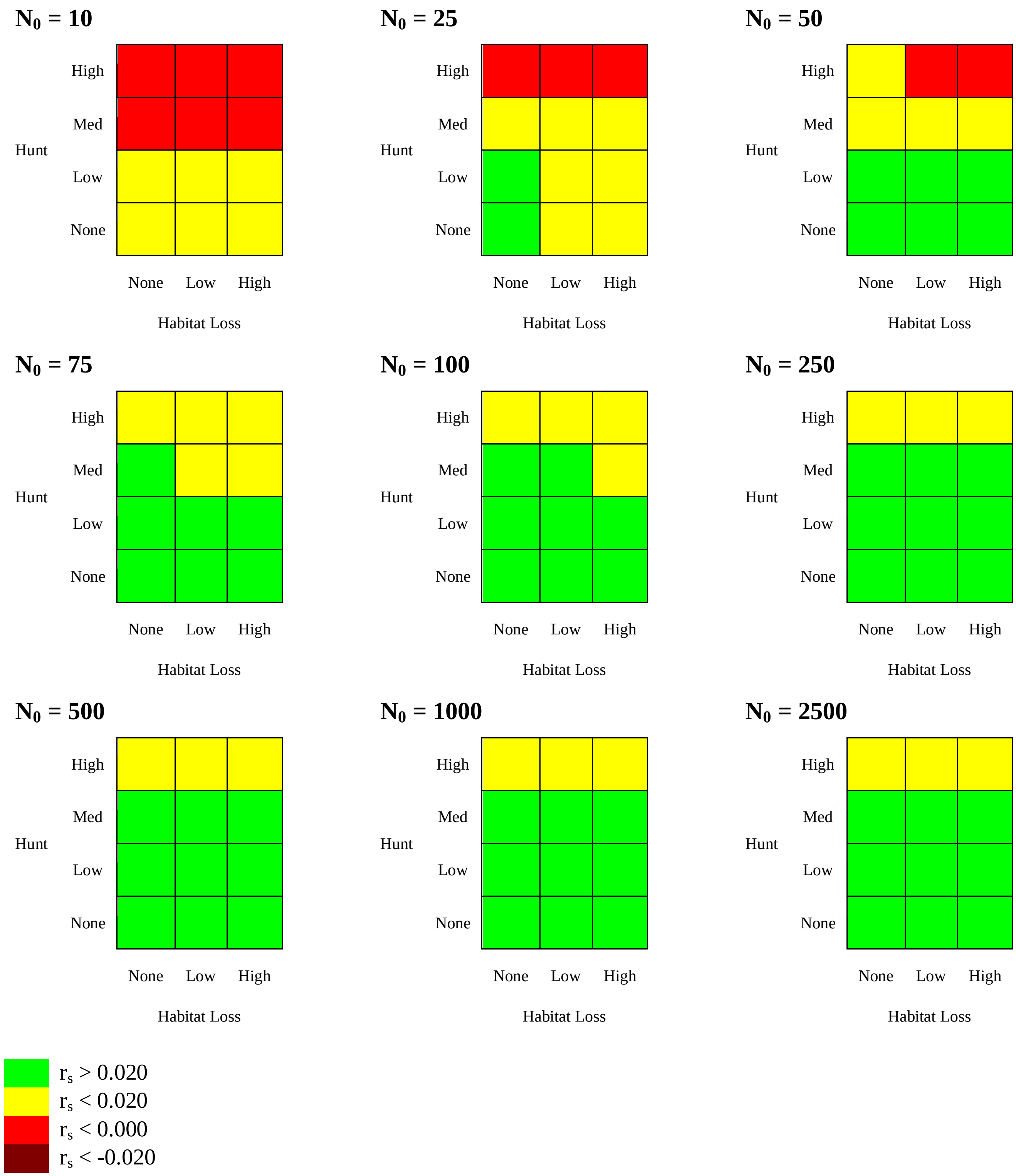


Figure 6a. Combined PVA analysis of Baird's tapir populations. Extinction risk in models including hunting-induced mortality and habitat loss in the presence of inbreeding depression and when carrying capacity is equivalent to initial population size. Each cell represents an individual model, so this Figure displays the results from 81 separate *VORTEX* model scenarios. See text for additional details of model input and graphical nature of output.

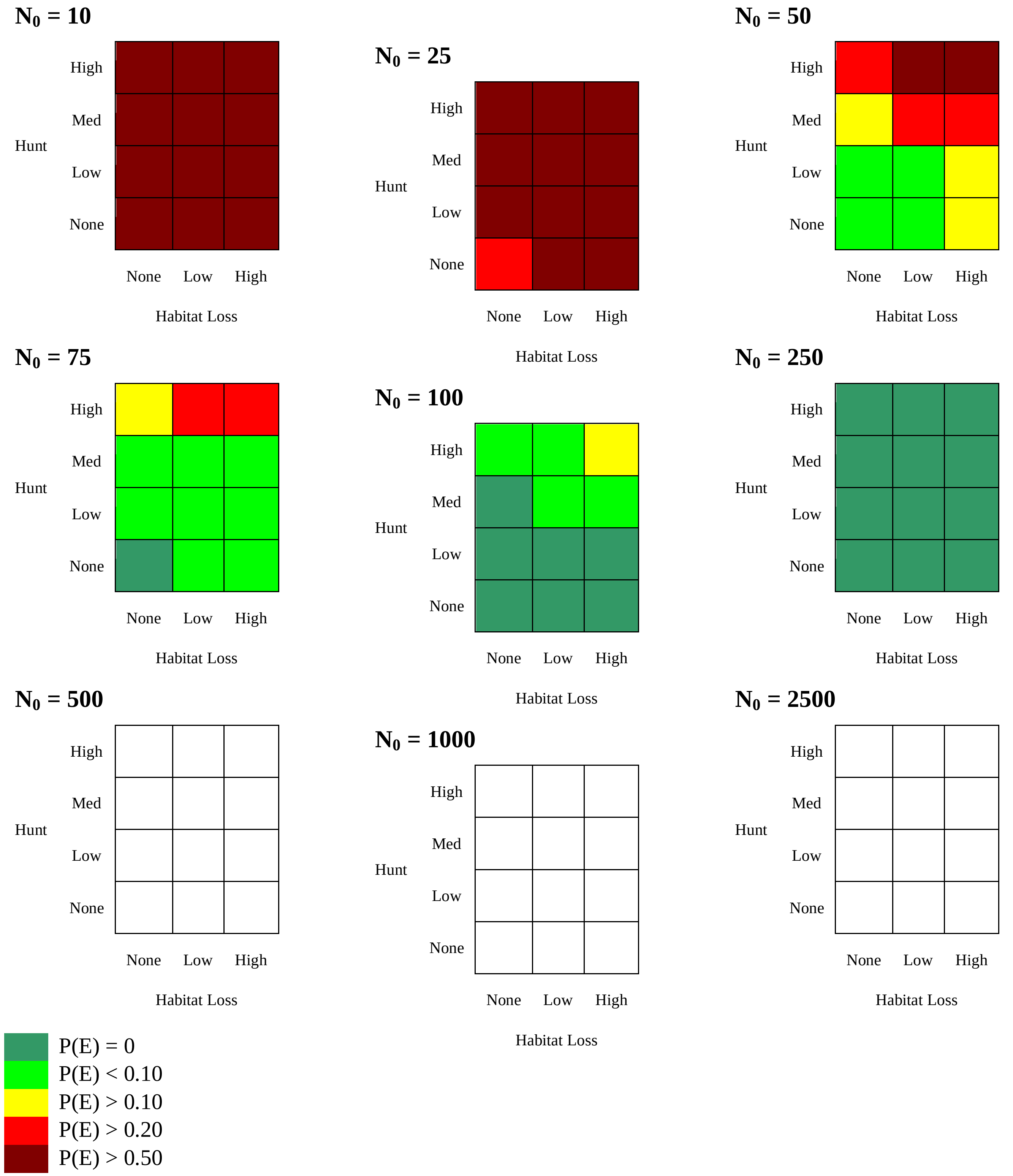


Figure 6b. Combined PVA analysis of Baird's tapir populations. Stochastic population growth rate in models including hunting-induced mortality and habitat loss in the presence of inbreeding depression and when carrying capacity is equivalent to initial population size. Each cell represents an individual model, so this Figure displays the results from 81 separate *Vortex* model scenarios. See text for additional details of model input and graphical nature of output.

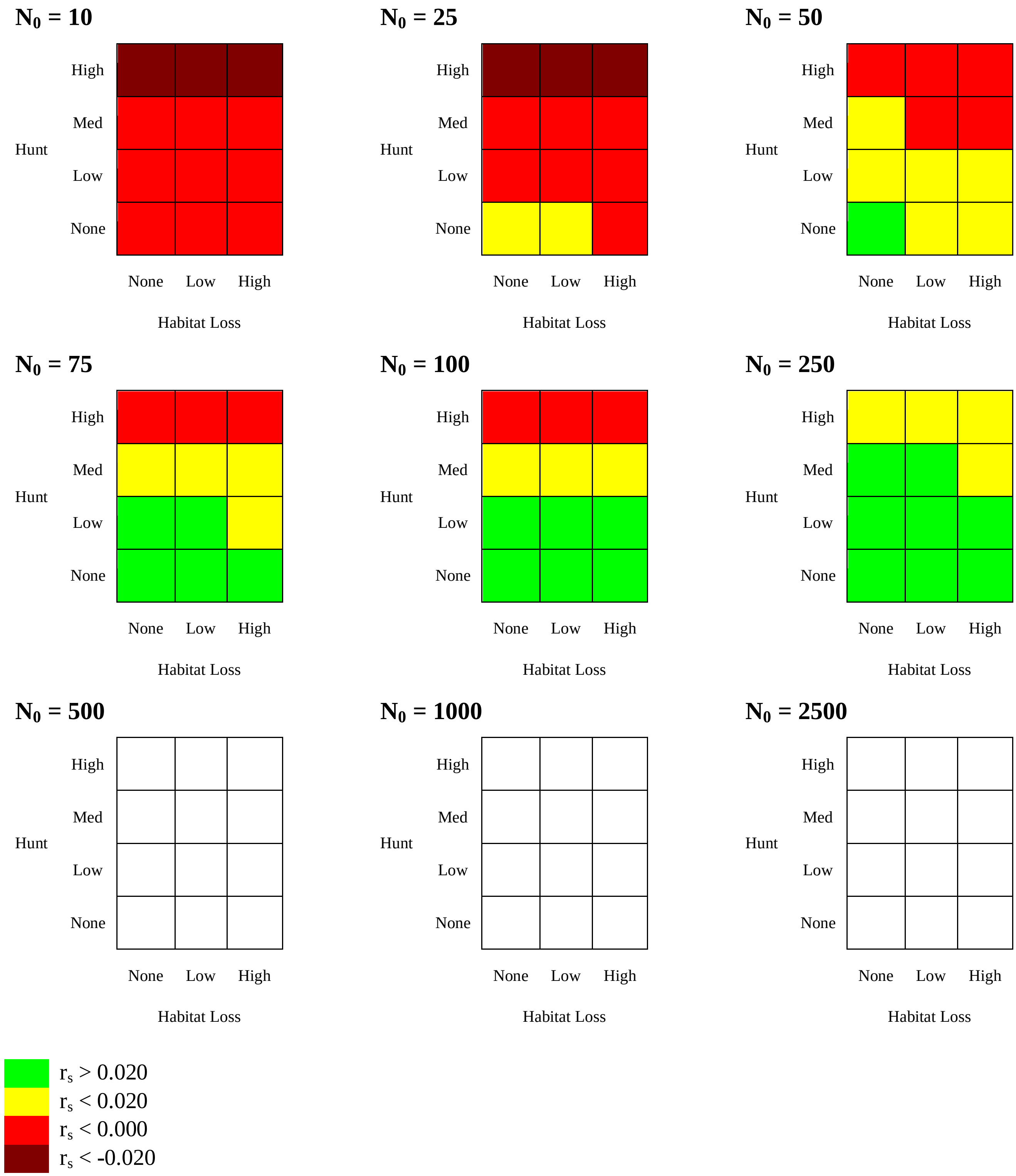


Figure 7a. Combined PVA analysis of Baird's tapir populations. Extinction risk in models including hunting-induced mortality and habitat loss and inbreeding depression when carrying capacity is equivalent to twice the initial population size. Each cell represents an individual model, so this Figure displays the results from 64 separate *Vortex* model scenarios. See text for additional details of model input and graphical nature of output.

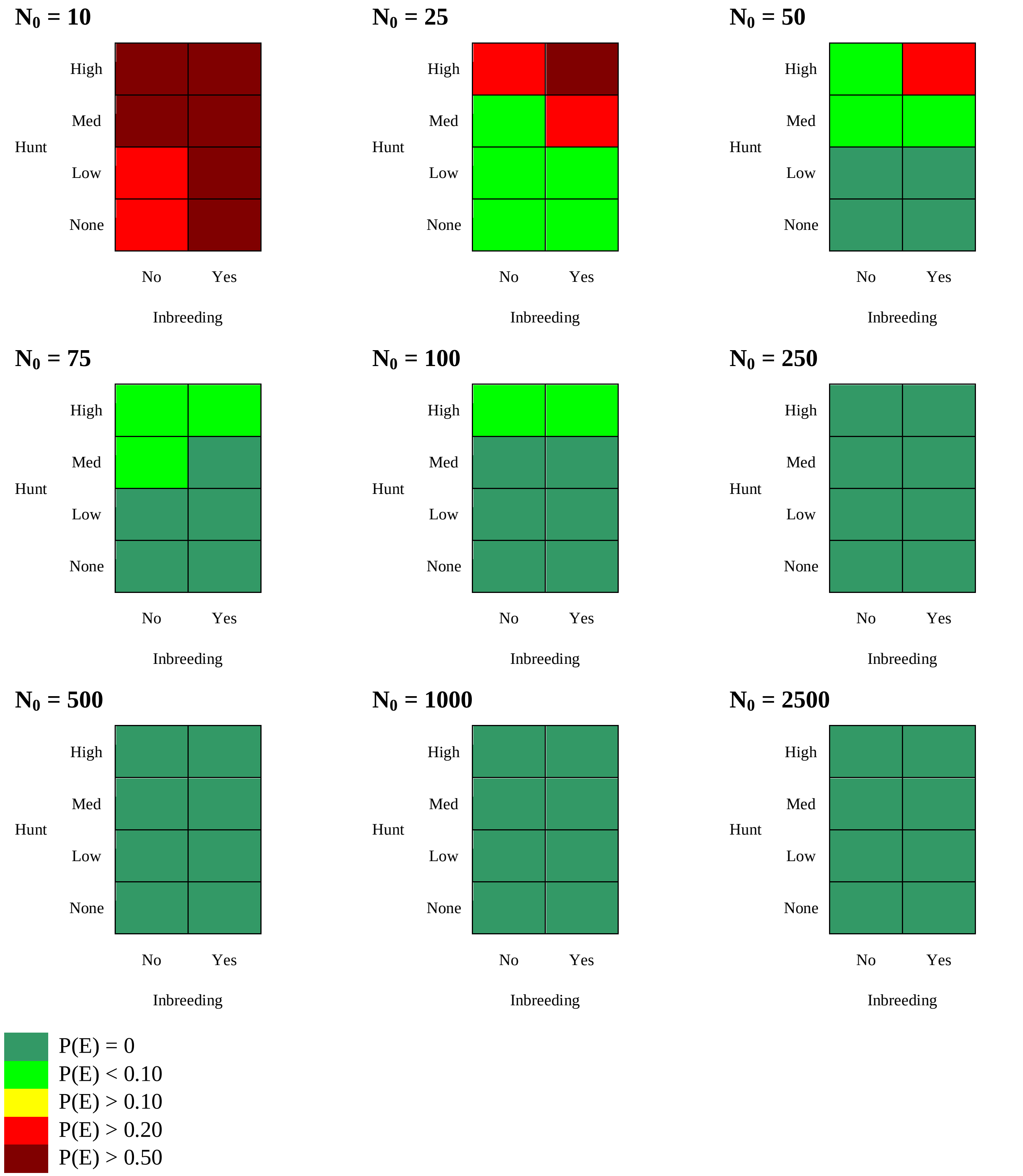


Figure 7b. Combined PVA analysis of Baird's tapir populations. Stochastic population growth rate in models including hunting-induced mortality and habitat loss and inbreeding depression when carrying capacity is equivalent to twice the initial population size. Each cell represents an individual model, so this Figure displays the results from 64 separate *Vortex* model scenarios. See text for additional details of model input and graphical nature of output.

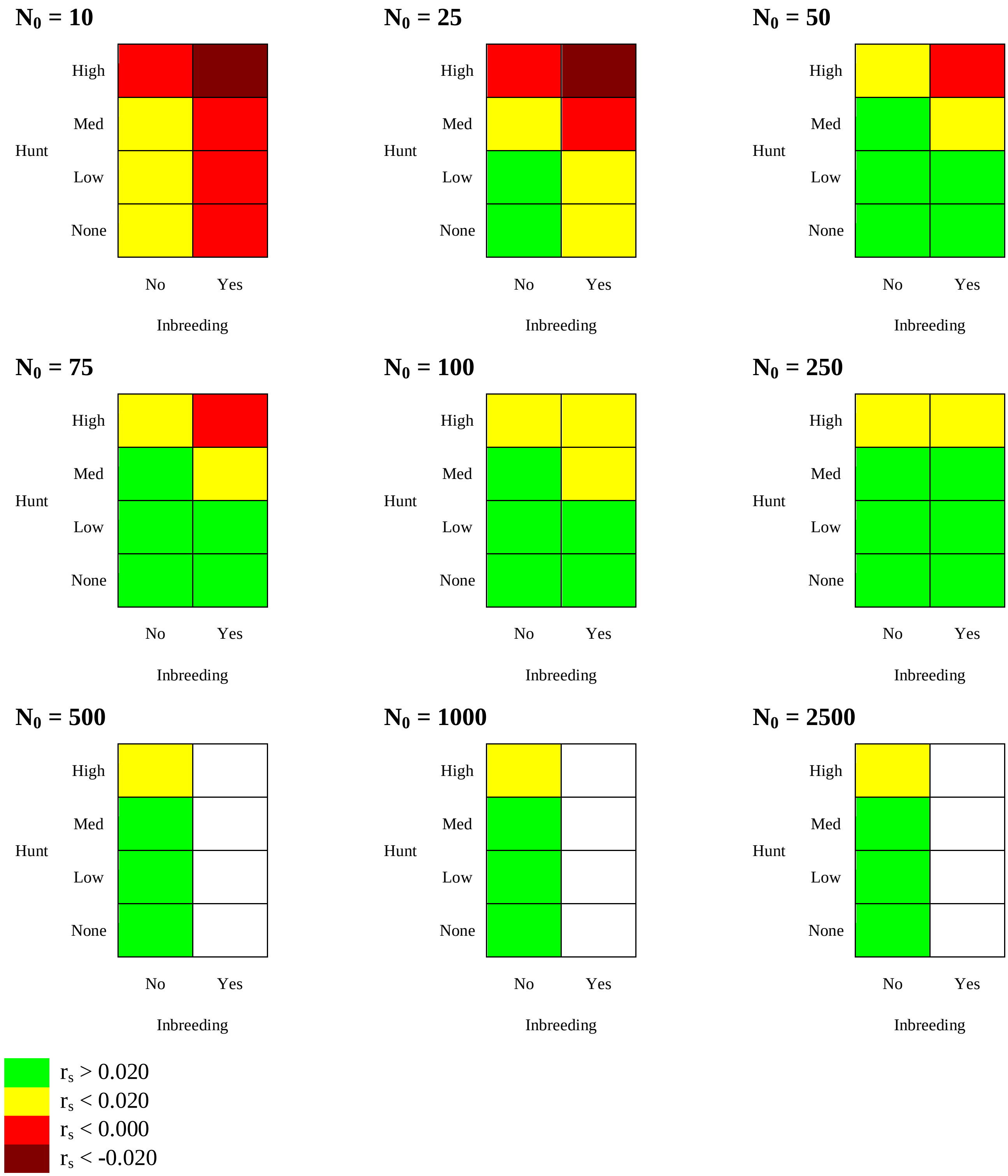
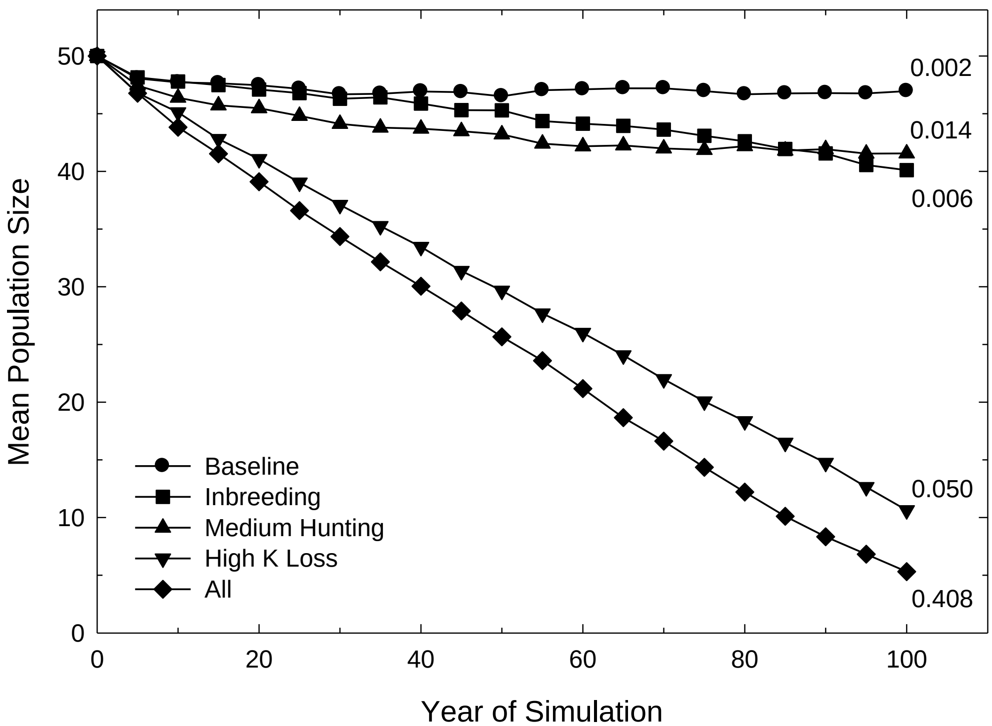


Figure 8. Projections of simulated Baird's tapir populations composed of 50 individuals under alternative threat scenarios. Numbers on the right side of the graph indicate probability of extinction within the 100-year timeframe of each simulation. "Medium" hunting corresponds to an annual increase in adult mortality of 2.0%, and "High" loss in habitat carrying capacity (K) corresponds to 0.75% annual loss. See text for additional details of model input parameters.



100-year projections for a set of selected scenarios are shown in Figure 8. In this perspective, the intensity of the interactions between threats is plainly evident: note that the risk of population extinction under a combined threat scenario is considerably greater than the simple sum of the risks from each of the individual component threats. This type of interaction is especially important for the smaller populations, where instability is greatest. This instability and resultant high risk of population decline and extinction make small populations of Baird's tapirs – and, in general, most wildlife species – high priorities for immediate conservation consideration.

PROBLEMS

1. There is no clear definition of a viable population of Baird's tapir
2. There is little information on biological and demographic parameters for the species
3. There is no analysis about the populations at distinct spatial scales
4. There is still a need to determine the threats for the species

GOALS

Once the problems were identified, the group established goals for each one of them, which can be found in the tables below:

PROBLEM 1: There is no clear definition of a viable population of Baird's tapir.

GOAL 1: To define a viable population.

PROBLEM 2: There is little information on biological and demographic parameters for the species.

GOAL 1: To produce a map of the priority areas for conservation in the distribution range of the species.

GOAL 2: To produce a current map of the distribution range of Baird's tapir in each range country, using comparable methods.

GOAL 3: To produce a synthesis of all the available information about the natural history of the species.

PROBLEM 3: There is no analysis about the populations at distinct spatial scales.

GOAL 1: To initiate inter-institutional international cooperation in shared areas between neighboring range countries for the development of conservation strategies, and generating information on abundance, population dynamics, genetics, health assessment, habitat availability and use.

GOAL 2: To produce a diagnostic (to identify necessities) about the isolated populations of Baird's tapir and propose strategies for their conservation in the long run.

GOAL 3: To focus the generation of information about abundance, population dynamics, genetics, health assessment, habitat availability and use on the five bioregions (Zoque Forest, Maya Forest, Mosquitia Forest, Lower San Juan River Basin, Darien-Talamanca), where the largest populations of Baird's tapir are found.

PROBLEM 4: There is still a need to determine the threats for the species.

GOAL 1: To quantify and document habitat loss and transformation, hunting, and disease introduction , which reduce the population sizes, reducing their viability in the long run.

GOAL 2: To document the main issues associated with incoherence in public policy, deficiencies in education and communication, and political instability that make it hard to design and implement conservation and management actions.

GOAL 3: To estimate the frequency and intensity of natural phenomena of varying intensity in each one of the range countries.

PRIORITIZED GOALS

Once the goals were established, the group prioritized them in order of importance.

1. To quantify and document habitat loss and transformation, hunting, and disease introduction that reduce the population sizes, reducing their viability in the long run and generate information on abundance, population dynamics, genetics, health assessment, habitat availability and use.
2. To produce a map of the priority areas for conservation in the distribution range of the species.
3. To initiate inter-institutional international cooperation in shared areas between neighboring range countries for the development of conservation strategies, and generating information on abundance, population dynamics, genetics, health assessment, habitat availability and use.
4. To produce a diagnostic (to identify necessities) about the isolated populations of Baird's tapir and propose strategies for their conservation in the long run.
5. To produce a current map of the distribution range of Baird's tapir in each country, using comparable methods.
6. To define a viable population.
7. To focus the generation of information about abundance, population dynamics, genetics, health assessment, habitat availability and use on the five bioregions (Zoque Forest, Maya Forest, Mosquitia Forest, Lower San Juan River Basin, Darien-Talamanca), where the largest populations of Baird's tapir are found.
8. To define the necessary habitat to maintain a viable population in the long run.
9. To define the minimum amount of genetic variation in order to guarantee a viable population.
10. To document the main issues associated with incoherence in public policy, deficiencies in education and communication, and political instability that make it hard to design and implement conservation and management actions.
11. To produce a synthesis of all the available information about the natural history of the species.
12. To estimate the frequency and intensity of natural phenomena of varying intensity in each one of the range countries.

ACTION PLAN

PROBLEM 1: THERE IS NO CLEAR DEFINITION OF A VIABLE POPULATION OF BAIRD'S TAPIR.

GOAL 1: TO DEFINE A VIABLE POPULATION.

ACTIONS:

1. To propose the criteria to define the minimum size, the minimum amount of genetic variation and the minimum area needed to maintain a viable population based on the VORTEX simulation results and other available models

Responsibility	Deadline	Collaborators	Resources and costs	Results and/or products	Consequences of inaction	Obstacles
Action 1: Eduardo Naranjo, Mexico	1 year	Olga Montenegro and Rocío Polanco, Colombia; Rony García, Guatemala; Iván Lira Torres, Mexico; and Héctor Portillo, Honduras	Time, Internet	Documents with a proposal for criteria to define a minimum viable population of Baird's tapir	Actions on non-viable populations Bias in the identification of priority areas and in decision making	Not enough information on populations

PROBLEM 2: THERE IS LITTLE INFORMATION ON BIOLOGICAL AND DEMOGRAPHIC PARAMETERS FOR THE SPECIES.

GOAL 1: TO PRODUCE A MAP OF THE PRIORITY AREAS FOR CONSERVATION IN THE DISTRIBUTION RANGE OF THE SPECIES.

ACTIONS:
1. To define the criteria to identify priority areas for the conservation of Baird's tapir for the region.
2. To produce the map of priority areas for the conservation of Baird's tapir in its distribution range, based on the criteria identified in the previous goal.

Responsibility	Deadline	Collaborators	Resources and costs	Results and/or products	Consequences of inaction	Obstacles
Action 1:	6 months	Héctor Restrepo and Olga Montenegro, Colombia; Rony García, Guatemala; Nereida Estrada and Héctor Portillo, Honduras; and Iván Lira Torres, Mexico	Time, Internet	Criteria identified	Inaccurate identification of priority areas Loss of a opportunity to work in collaboration among researchers from different countries Efforts and resources directed to non-priority areas	Communication, time
Action 2: Eduardo Naranjo, Mexico	1 year after criteria are defined	Héctor Restrepo and Olga Montenegro, Colombia; Rony García, Guatemala; Nereida Estrada and Héctor Portillo, Honduras	Satellite images, thematic cartography, geo-references data, software, hardware, salary, time	Map of priority areas		Obtaining the necessary funds and necessary information

PROBLEM 2: THERE IS LITTLE INFORMATION ON BIOLOGICAL AND DEMOGRAPHIC PARAMETERS FOR THE SPECIES.

GOAL 2: TO PRODUCE A CURRENT MAP OF THE DISTRIBUTION RANGE OF BAIRD'S TAPIR IN EACH COUNTRY, USING COMPARABLE METHODS.

ACTIONS:

1. To promote field surveys to verify presence/absence in each country and elaborate a map of the current distribution of the species.

Responsibility	Deadline	Collaborators	Resources and costs	Results and/or products	Consequences of inaction	Obstacles
Action 1: TSG Species Coordinator and Country Coordinators	2 year	TSG members and assistants to the Baird's Tapir PHVA	Time, travel costs, salary, basic maps. US$50.000,00	Current map of the species' distribution	Uncertainty about the real distribution of the species, and therefore about its actual size Isolation, fragmentation and duplication of efforts	Lack of information on the existence of some populations

PROBLEM 2: THERE IS LITTLE INFORMATION ON BIOLOGICAL AND DEMOGRAPHIC PARAMETERS FOR THE SPECIES.

GOAL 3: TO PRODUCE A SYNTHESIS OF ALL THE AVAILABLE INFORMATION ABOUT THE NATURAL HISTORY OF THE SPECIES.

ACTIONS:

1. To update the current synthesis on the natural history of Baird's tapir and make it available on the TSG Website.

Responsibility	Deadline	Collaborators	Resources and costs	Results and/or products	Consequences of inaction	Obstacles
Action 1: Eduardo Naranjo, Mexico	1 year	Olga Montenegro and Rocío Polanco, Colombia; Rony García and Manolo García, Guatemala; Iván Lira Torres, and Epigmenio Cruz, Mexico	Time, Internet	A document containing an updated synthesis on the current state of knowledge about the species	Waste time searching for information Fragmentation of information	The existence of unpublished or unavailable work

PROBLEM 3: THERE IS NO ANALYSIS ABOUT THE POPULATIONS AT DISTINCT SPATIAL SCALES.

GOAL 1: TO INITIATE INTER-INSTITUTIONAL INTERNATIONAL COOPERATION IN SHARED AREAS BETWEEN NEIGHBORING RANGE COUNTRIES FOR THE DEVELOPMENT OF CONSERVATION STRATEGIES, AND GENERATING INFORMATION ON ABUNDANCE, POPULATION DYNAMICS, GENETICS, HEALTH ASSESSMENT, HABITAT AVAILABILITY AND USE.

ACTIONS:

1. To promote the exchange of information and the coordination of shared areas, using the structure of the TSG to search for viable conservation strategies in the shared areas (discuss the actions at the III International Tapir Symposium in Argentina).

Responsibility	Deadline	Collaborators	Resources and costs	Results and/or products	Consequences of inaction	Obstacles
Action 1: TSG Country Coordinators	5 years after the present plan	TSG members and assistants to the Baird's Tapir PHVA	Time, Internet	Preliminary documents (for each country) and a document defining viable strategies List of actors committed or interested in collaborative work in the shared areas	Isolation, fragmentation and duplication of efforts	Lack of communication and will of the possible parties involved

PROBLEM 3: THERE IS NO ANALYSIS ABOUT THE POPULATIONS AT DISTINCT SPATIAL SCALES.

GOAL 2: TO PRODUCE A DIAGNOSTIC (TO IDENTIFY NECESSITIES) ABOUT THE ISOLATED POPULATIONS OF BAIRD'S TAPIR AND PROPOSE STRATEGIES FOR THEIR CONSERVATION IN THE LONG RUN.

ACTIONS:

1. To identify the areas where isolated populations are found, as well as the main threats and needs (hunting control, biological corridors, translocation) at national and sub-regional scales.

Responsibility	Deadline	Collaborators	Resources and costs	Results and/or products	Consequences of inaction	Obstacles
Action 1: Leonel Marineros, Honduras	2 years	Manolo García, Guatemala; Iván Lira Torres and Epigmenio Cruz, Mexico; Héctor Portillo, Honduras; and Olga Montenegro, Colombia	Time, Internet	List of areas with isolated populations, threats, and needs per country	Loss of small isolated populations	Lack of information about the existence of small populations

PROBLEM 3: THERE IS NO ANALYSIS ABOUT THE POPULATIONS AT DISTINCT SPATIAL SCALES.

GOAL 3: TO FOCUS THE GENERATION OF INFORMATION ABOUT ABUNDANCE, POPULATION DYNAMICS, GENETICS, HEALTH ASSESSMENT, HABITAT AVAILABILITY AND USE ON THE FIVE BIOREGIONS (ZOQUE FOREST, MAYA FOREST, MOSQUITIA FOREST, LOWER SAN JUAN RIVER BASIN, DARIEN-TALAMANCA), WHERE THE LARGEST POPULATIONS OF BAIRD'S TAPIR ARE FOUND.

ACTIONS

1. To design and promote a regional research program from which small punctual studies are derived that quantify and document the distribution, abundance, population dynamics, genetic variation, habitat availability and the health of populations of Baird's tapirs, and the effects of anthropogenic activities on these populations, particularly within the five main bio-regions (Zoque Forest, Maya Forest, Mosquitia Forest, Lower San Juan River Basin, Darien-Talamanca).

Responsibility	Deadline	Collaborators	Resources and costs	Results and/or products	Consequences of inaction	Obstacles
Action 1: Olga Montenegro, Colombia	1 year	Eduardo Naranjo and Iván Lira Torres, Mexico; Rony García and Manolo García, Guatemala; Leonel Marineros, Honduras; Rocío Polanco and Héctor Restrepo, Colombia; Anders Gonçalves da Silva, Brazil; and Alan Shoemaker, United States	Time, Internet	1. A project designed and agreed upon by the different representatives from each country 2. A list of institutions to ask for information	1. Lack of sound and up-to-date data in the near future 2. Loss of a opportunity to work in collaboration among researchers from different countries	Communication, time

PROBLEM 4: THERE IS STILL A NEED TO DETERMINE THE THREATS FOR THE SPECIES.

GOAL 1: TO QUANTIFY AND DOCUMENT HABITAT LOSS AND TRANSFORMATION, HUNTING, AND DISEASE INTRODUCTION THAT REDUCE THE POPULATION SIZES, REDUCING THEIR VIABILITY IN THE LONG RUN.

ACTIONS:

1. To compile existing information on land-use change and hunting in each country.

2. To compile existing information on physiological and behavioral parameters, as well as disease agents found in both wild and captive populations in the different regions.

Responsibility	Deadline	Collaborators	Resources and costs	Results and/or products	Consequences of inaction	Obstacles
Action 1: Héctor Portillo, Honduras	1 year	Rocío Polanco, Colombia; Iván Lira Torres, Mexico; Rony García and Manolo García, Guatemala; Eugene Ariola, Belize; Karla Aparicio, Panama; and, Fengmei Wu Chen, Costa Rica	Existing bibliography, photocopies	A document containing estimates of: 1. The annual rate of loss of habitat in each country 2. Number, sex, and age of animals hunted/year/country 3. An appraisal of the areas with the largest lack of information	Lack of trust on the modeling results Decision making based on wrong information	Lack of documented information, principally in Belize
Action 2: Iván Lira Torres, Mexico	6 months	Jeannette Urdiales, Guatemala; Javier Sarria Perea, Colombia; Pedro Aguilar Aragón, Alberto Parás, Darío Marcelino Güiris and Epigmenio Cruz, Mexico; Danilo Leandro, Costa Rica; Hector Restrepo, Leonel Marineros, Honduras; Alan Shoemaker, Alberto Mendoza, United states	Existing bibliography, photocopies	A document containing physiological and behavioral parameters, as well as disease agents found in both wild and captive populations in the different regions.	Decision making based on wrong information	Lack of documented information, principally in Belize

PROBLEM 4: THERE IS STILL A NEED TO DETERMINE THE THREATS FOR THE SPECIES.

GOAL 2: TO DOCUMENT THE MAIN ISSUES ASSOCIATED WITH INCOHERENCE IN PUBLIC POLICY, DEFICIENCIES IN EDUCATION AND COMMUNICATION, AND POLITICAL INSTABILITY THAT MAKE IT HARD TO DESIGN AND IMPLEMENT CONSERVATION AND MANAGEMENT ACTIONS.

ACTIONS:

1. To identify and invite to collaborate with the TSG key people in relevant institutions to analyze the incoherence in public policies and political instability that make it hard to implement conservation action in the Baird's tapir distribution range.

Responsibility	Deadline	Collaborators	Resources and costs	Results and/or products	Consequences of inaction	Obstacles
Action 1: Héctor Restrepo, Colombia	1 year	Manolo García and Rony García, Guatemala; Eduardo Naranjo, Mexico; and Héctor Portillo, Honduras	Time, Internet, specialized people, specialized documents	The creation of a specialist group on environmental legislation and policy that collaborates with the TSG	Persistence of confusion and incoherence in public policy Lack of knowledge on how to approach issues related to public policy	Our own lack of knowledge about politics and policy in each country

PROBLEM 4: THERE IS STILL A NEED TO DETERMINE THE THREATS FOR THE SPECIES.

GOAL 3: TO ESTIMATE THE FREQUENCY AND INTENSITY OF NATURAL PHENOMENA OF VARYING INTENSITY IN EACH ONE OF THE RANGE COUNTRIES.

ACTIONS:

1. To compile the existing available information on the frequency and intensity of natural phenomena and analyze their possible impact on populations of Baird's tapir in its distribution range.

Responsibility	Deadline	Collaborators	Resources and costs	Results and/or products	Consequences of inaction	Obstacles
Action 1: Manolo García, Guatemala	1 year	Rony García, Guatemala; Héctor Portillo, Honduras; Rocío Polanco, Colombia; Eduardo Naranjo and Epigmenio Cruz, Mexico; Karla Aparicio, Panama; and Olivier Chassot, Costa Rica	Time, Internet, basic documents	Analysis of the possible effects of natural phenomena and its periodicity in the bio-regions cited above	Difficulty in quantifying the real effects and to model population trends	Fragmented information, which is hard to obtain and not very detailed

Baird's Tapir (*Tapirus bairdii*) Conservation Workshop Population and Habitat Viability Assessment (PHVA)

Belize, Central America
15 to 19 August, 2005

Section 6

Ex-Situ Conservation Working Group Report

Ex-Situ Conservation

Participants

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Lewis Greene, Chaffee Zoo & AZA Tapir TAG & TSG, United States
Marielos de La Roca, Zoológico Nacional La Aurora, Guatemala
Pedro Aguilar Aragón, ZooMAT, Mexico
Richard Sheffield, León Zoo, Mexico
Rosa María Pérez, Zoológico Nacional La Aurora, Guatemala

PROBLEMS

The following is a list of problems which the group has identified, through a brainstorming process, as the main issues affecting the *ex-situ* conservation of Baird's tapirs.

1. LACK OF COMMUNICATION

- Lack of commitment by the zoological institutions holding Baird's tapirs in their animal collections.
- There is no leadership guiding the IUCN/SSC Tapir Specialist Group (TSG) in terms of agreements for Baird's tapir captive conservation.
- There is no continuous data updating on the institutions managing the species and on the data collected by these institutions.
- There is no mutual communication between the different zoological institutions.
- There are no bilingual questionnaires for list institutions (*e.g.* Zoos)
- There is no swiftness in replying queries between different institutions

There is a lack of communication at the national and regional levels among the institutions and people involved with Baird's tapir *ex-situ* conservation. There have not been regional scale meetings in order to achieve commitments in favor of Baird's tapir *ex-situ* conservation. When informal communication for interchange of experiences begins, data are not regularly updated. Sometimes information is requested, and the communication is not reciprocal and late at times. For example, sometimes there are no bilingual questionnaires which are sent to zoos aiming to include them in a general database.

2. LACK OF RESEARCH IN CAPTIVITY

- Lack of funding to carry out research projects and other activities.
- In the United States, the Baird's tapir suffers from competition with other captive species when it comes to research priorities.
- There are few personnel with the necessary expertise.
- Information is not shared.

There is a lack of funding to carry out research projects on captive animals. In addition, some funding sources do not have Baird's tapir captive studies as a priority, given the fact that there are other species which face bigger problems, to which funds are assigned.

In some Latin American countries, personnel that are trained on tapir management or processing of samples collected from captive animals are scarce or not available. Besides, the little that is known about it is not shared at the national and regional levels.

3. THERE ARE PROBLEMS FOR TRANSFER OF INDIVIDUAL TAPIRS BETWEEN INSTITUTIONS

- Bureaucracy in the enforcement of current legislation and agreements.
- The procedures and legislation of each country for obtaining import and export permits of wildlife are not known.
- There is no general knowledge about the rules for safe transportation of Baird's tapirs.

In many countries where Baird's tapir occurs there is much slowness and complexity to obtain import and export permits. And on many occasions the procedures are not known by users and authorities alike. In Costa Rica the legislation does not allow specimens to leave its borders. In Latin America, there is little institutional support for carrying out the interchanges which are necessary for the Baird's tapir benefit.

4. SMALL BUDGET FOR THE ZOOLOGICAL INSTITUTIONS

- Lack of cooperation among the zoological institutions.
- There are no proposals on alternative materials which could be used for exhibit construction and for Baird's tapir management.
- The minimum space which is required for an adequate maintenance of Baird's tapir in captivity is not known.
- Most Baird's tapir exhibits do not include areas to manage the animals.

In Central America, funding for the construction of adequate Baird's tapir exhibits or adaptation of the current ones is not available. In Guatemala and Panama there are the space and the animals, but there is no funding to build appropriate exhibits. A database of institutions which provide funding for the construction of exhibits is urgently needed, as well as one on the institutions holding Baird's tapirs in captivity.

5. LACK OF A REGIONAL COLLECTION PLAN (RCP)

- Poor distribution of the captive Baird's tapirs.
- Poor understanding of each range country's regulations.
- Current holders' capacity to house the species is not known.
- Consanguinity problems.
- Officers' incapacity to comprehend current norms and regulations.

Due to the lack of a Regional Collection Plan (RCP) for the maintenance of captive Baird's tapirs, various problems were identified. The Baird's Tapir Studbook (keeper – Joseph Roman, Virginia Zoo, United States) informs us that there is a poor distribution of the specimens. It is assumed that the legislation on each range country hampers the transfer of specimens and that the genetic make-up of the captive populations is negatively influenced.

DATA ASSEMBLY

PROBLEM 1: LACK OF COMMUNICATION				
Fact	**Assumption**	**Required information**	**Specific region of the problem**	**Bibliographic references**
There are no partnerships or other kinds of agreements among the different zoological institutions	N A	N A	N A	Source: Participants of the *Ex-Situ* Conservation Working Group of this Baird's Tapir PHVA Workshop
There is no database which holds updated information on the contacts	N A	N A	N A	Source: Representatives of American zoological institutions at this Baird's Tapir PHVA Workshop
There is the database of the IUCN/SSC Tapir Specialist Group (TSG)		How the involved/interested people can join this group	Central America	IUCN/SSC Tapir Specialist Group (TSG) Members. In: Baird's Tapir PHVA. Briefing Book

PROBLEM 2: LACK OF RESEARCH IN CAPTIVITY				
Fact	**Assumption**	**Required information**	**Specific region of the problem**	**Bibliographic references**
There is no priority list for Baird's tapir captive research				Source: Representatives of American zoological institutions at this Baird's Tapir PHVA Workshop
Nobody has requested research funds to the appropriate donors	There might be studentships or information on this matter, but it has not been publicized			Source: Representatives of American zoological institutions at this Baird's Tapir PHVA Workshop
	In Central America (except Belize), the Baird's tapir is not considered a charismatic species			Source: Central American participants of the *Ex-Situ* Conservation Working Group of this Baird's Tapir PHVA Workshop
In some Latin American countries there is no personnel which is trained or specialized in captive tapirs research in the field of laboratories of clinical analysis				Source: Latin American participants of the *Ex-Situ* Conservation Working Group of this Baird's Tapir PHVA Workshop
There are institutions where it is possible to provide training on the establishment and conduction of research projects, *e.g.*: Houston Zoo Inc., San Diego Zoo, Africam Safari, Private Clinic at Chiapas, and UNAM				Source: Mexican and American participants of the *Ex-Situ* Conservation Working Group of this Baird's Tapir PHVA Workshop
Known publications				Guiris AD, Moreno, Siegler M, L Gallegos, MJ and Cruz-Aldán, E. 1995. Miopatía por captura en un tapir centroamericano *Tapirus bairdii* silvestre en una reserva de la biosfera del Estado de Chiapas. Presentación de un caso. In: Memorias del XIII Simposio sobre Fauna Silvestre Gral. MV. Manuel Cabrera Valtierra UNAM. [Miopathy due to capture in a wild Baird's tapir *Tapirus bairdii* in a Biosphere Reserve of the Chiapas state. Case presentation. (in Spanish)]

				Gallegos MJ, Aguilar P, Ramirez J, Rosiles R and Guiris AD 2000. Muerte de dos ejemplares de tapir *Tapirus bairdii* asociado a enterobacterias. [Death of two tapir *Tapirus bairdii* specimens associated to enterobacteriaceae. (in Spanish)] Gallegos MJ, Sigler l, Aguilar AP, Guichard RCA, Cruz AE, Velasco SG, Morales ER and Levet BG. 2000. Rescate de un Tapir Centroamericano en el Zoológico Miguel Álvarez del Toro, México. [Rescue of a Baird's tapir at the Miguel Álvarez del Toro Zoo, Mexico. (in Spanish)] Hernández-Divers SM & Foerster C. 2001. Capture and Inmobilizations of Free-living Baird's Tapir (*Tapirus bairdii*) for an Ecological Study in Corcovado National Park, Costa Rica. In: Zoological Restraint and Anaesthesia, D. Heard (Ed.), Publisher: IVIS, Ithaca, United States.

PROBLEM 3: THERE ARE PROBLEMS FOR TRANSFER OF INDIVIDUAL TAPIRS BETWEEN INSTITUTIONS				
Fact	**Assumption**	**Required information**	**Specific region of the problem**	**Bibliographic references**
Slowness and complexity for getting export/import permits	N A	Information on the procedures	N A	Source: Participants of the *Ex-Situ* Conservation Working Group of this Baird's Tapir PHVA Workshop
In some countries, local authorities are now aware of the procedures	N A	Information on the procedures Not all Latin Americans do have the information on IATA in Spanish	N A	Source: Participants of the *Ex-Situ* Conservation Working Group of this Baird's Tapir PHVA Workshop

PROBLEM 4: SMALL BUDGET FOR AN ADEQUATE MAINTENANCE OF TAPIRS IN CAPTIVITY AND FOR THE CONSTRUCTION OF APPROPRIATE EXHIBITS				
Fact	**Assumption**	**Required information**	**Specific region of the problem**	**Bibliographic references**
Lack of funding in Central America for the construction of appropriate Baird's tapir exhibits In Guatemala there is space for growth and no funding to enlarge the exhibits		Database of institutions that provide funding for exhibit construction and also the ones holding captive tapirs		Source: Central American participants of the *Ex-Situ* Conservation Working Group of this Baird's Tapir PHVA Workshop Source: Guatemalan participants of the *Ex-Situ* Conservation Working Group of this Baird's Tapir PHVA Workshop

PROBLEM 5: LACK OF A REGIONAL COLLECTION PLAN (RCP)				
Fact	**Assumption**	**Required information**	**Specific region of the problem**	**Bibliographic references**
The Baird's Tapir Studbook informs us that there is poor distribution of the specimens among the current zoological institutions holding Baird's tapirs	The laws on each range country hamper the transfer of animais between institutions The genetic composition of the captive populations is affected by the consanguinity among individuals	Legislation and requirements of each range country Knowledge of the institution that issues CITES import or export permits on each range country Regional level priorities regarding management and research		Roman J. 2005. International Central American Tapir Studbook. Virginia Zoo. 105 p.
In Honduras, there are no appropriate places for the transfer of animals which are in illegal collections or in inadequate conditions				Honduran participants of this Baird's Tapir PHVA Workshop

GOALS

PROBLEM	GOAL	DEADLINE
1. Lack of communication among the zoological institutions holding Baird's tapirs	To achieve effective communication among the professionals involved with Baird's tapir conservation in captivity	1 month
2. Lack of a Regional Collection Plan (RCP) for the management of the captive Baird's tapirs.	To develop and implement a Regional Collection Plan (RCP).	5 years
3. There is little research on Baird's tapir at the institutions which manage it in captivity	To identify potential *Ex-situ* research projects	1 year
4. Difficulties for the interchange/transfer of animals among the interested institutions	To identify, in each range country, the current obstacles for Baird's tapir importing/exporting and transport and to get members from the region to know the procedures for carrying out such interchange/transport	3 months
5. Small budget for an adequate maintenance of tapirs in captivity and for the construction of appropriate exhibits	There will be adequate conditions for the Baird's tapirs in most of the collections in the region	5 months

ACTION PLAN

PROBLEM 1: LACK OF COMMUNICATION AMONG THE ZOOLOGICAL INSTITUTIONS HOLDING BAIRD'S TAPIRS.

GOAL: TO ACHIEVE EFFECTIVE COMMUNICATION AMONG THE PROFESSIONALS INVOLVED WITH BAIRD'S TAPIR CONSERVATION IN CAPTIVITY.

ACTIONS:
1. To create an e-mail list-serve in order to achieve fast and effective communication among the people interested in Baird's tapir *ex-situ* conservation in the region.
2. To create a bilingual questionnaire which asks the members in the region about general data and information on Baird's tapirs kept in captivity.
3. To carry out work meetings among the institutions holding captive tapirs, at the local, regional, and international levels.

Responsibility	Deadline	Collaborators	Resources and costs	Results and/or products	Consequences of inaction	Obstacles
Action 1: Alan Shoemaker, United States; Pedro Aguilar Aragón, Mexico; Alberto Mendoza, United States; and Marielos de la Roca, Guatemala	1 month		No costs	Everybody will receive constant information on the progresses of the *Ex-Situ* Conservation Working Group of this Baird's Tapir PHVA Workshop	There will not be complete communication between the members of the *Ex-Situ* Conservation Working Group of this Baird's Tapir PHVA Workshop	None
Action 2: Joseph Roman, United States	4 months	Alan Shoemaker, United States; Pedro Aguilar Aragón, Mexico; Alberto Mendoza, United States; and Marielos de la Roca, Guatemala	No costs	Bilingual questionnaire to obtain information on captive tapirs	The participation of regional zoos holding Baird's tapirs decreases	Prompt answer by all the zoos
Action 3: Richard Sheffield, Mexico and Carlos Caballero, Panama	1 meeting every 2 years for 5 years	AZCARM and zoological institutions in the region	US$ 20,000	Meetings' reports including precise and valuable information have been distributed	The deficiency to obtain precise information will continue	Funding

PROBLEM 2: THERE IS LITTLE RESEARCH ON BAIRD'S TAPIR AT THE INSTITUTIONS WHICH MANAGE IT IN CAPTIVITY.

GOAL: TO IDENTIFY POTENTIAL *EX-SITU* RESEARCH PROJECTS.

ACTIONS:

1. To define the research topics on captive tapirs. The following agenda is suggested:

a. Studies on veterinary issues
b. Behavioral studies
c. Studies on reproductive aspects
d. Nutrition

2. To seek funding to develop clearly defined research topics. The following institutions are suggested:

IUCN/SSC Tapir Specialist Group Conservation Fund (TSGCF)
Association of Zoos and Aquariums (AZA) Tapir Taxon Advisory Group (TAG)
European Association of Zoos and Aquaria (EAZA) Tapir Taxon Advisory Group (TAG)

Responsibility	Deadline	Collaborators	Resources and costs	Results and/or products	Consequences of inaction	Obstacles
Alan Shoemaker, United States	1 year	Alberto Mendoza, United States	No costs	Complete list of the priority research topics for the region TSG commits itself to help with the research projects listed under this action	Information on Baird's tapir problems will not be obtained and they will not be solved	Funds Lack of knowledge about the *ex-situ* researchers in the region

PROBLEM 3: DIFFICULTIES FOR THE INTERCHANGE/TRANSFER OF ANIMALS AMONG THE INTERESTED INSTITUTIONS.

GOAL: TO IDENTIFY, IN EACH RANGE COUNTRY, THE CURRENT OBSTACLES FOR BAIRD'S TAPIR IMPORTING/EXPORTING AND TRANSPORT AND TO GET MEMBERS FROM THE REGION TO KNOW THE PROCEDURES FOR CARRYING OUT SUCH INTERCHANGE/TRANSPORT.

ACTION:

1. To appoint one person in each country to produce a document where the procedures for obtaining permits are detailed and to list possible problems that may occur in such procedures.

Responsibility	Deadline	Collaborators	Resources and costs	Results and/or products	Consequences of inaction	Obstacles
Franklin Herrera, Guatemala; Alan Shoemaker, United States; Juan Jose Rojas, Costa Rica; Richard Sheffield, Mexico; Nereyda Estrada, Honduras; and Carlos Caballero, Panama	4 months		No costs	A guide for each range country where the procedures and possible obstacles for obtaining import/export permits are described	The genetic variability of captive animals is lost	Contacting all the persons involved Change of government personnel Law interpretation

PROBLEM 4: SMALL BUDGET FOR AN ADEQUATE MAINTENANCE OF TAPIRS IN CAPTIVITY AND FOR THE CONSTRUCTION OF APPROPRIATE EXHIBITS.

GOAL: THERE WILL BE ADEQUATE CONDITIONS FOR THE BAIRD'S TAPIRS IN MOST OF THE COLLECTIONS IN THE REGION.

ACTIONS:
1. To make a database containing a list and a description of existing Baird's tapir exhibits in the region and send it to all contacts in all range countries.
2. To compile a list of potential regional donors for the improvement of exhibits and acquisition of equipment for their maintenance and management. Each range country will look seek for funding within private, governmental, non-governmental institutions or with private individuals interested in improving the conditions of captive Baird's tapirs.
3. To identify the specimens which are illegally held in captivity.

Responsibility	Deadline	Collaborators	Resources and costs	Results and/or products	Consequences of inaction	Obstacles
Action 1: Pedro Aguilar Aragón and Epigmenio Cruz Aldán, Mexico	1 year	Alberto Mendoza, United States		Database of the current Baird's tapir holders	Bad housing conditions for the captive tapirs	Lack of interest by the institutions holding Baird's tapirs
Action 2: Efraín Ríos Castillo, Mexico	1 year	Richard Sheffield, Mexico		List of potential funding agencies	Difficulties to get funding for exhibits construction	Lack of interest by the institutions holding Baird's tapirs
Action 3: TSG Country Coordinators	2 years	National Zoo associations and local zoos		Providing a better management for captive tapirs	Risk of losing the tapirs and not counting on them for projects in favor of Baird's tapir conservation	Lack of interest of government officials and the nearby zoos in the region

PROBLEM 5: LACK OF A REGIONAL COLLECTION PLAN (RCP) FOR ADEQUATE MANAGEMENT OF CAPTIVE BAIRD'S TAPIRS.

GOAL: DEVELOPMENT AND IMPLEMENTATION OF A REGIONAL COLLECTION PLAN (RCP).

ACTIONS:
1. To identify the potential institutions in the region which are willing to participate in a Regional Collection Plan (RCP), informing them on what it consists of and which are its objectives and benefits.
2. To organize and hold a meeting to formulate the Regional Collection Plan (RCP).

Responsibility	Deadline	Collaborators	Resources and costs	Results and/or products	Consequences of inaction	Obstacles
Action 1: Joseph Roman, United States	3 months	Alberto Mendoza, United States	No costs	Development of a Regional Collection Plan (RCP) and pedigree of the Baird's tapir in the region	Loss of an opportunity in captive Baird's tapir management	Lack of interest by the institutions and other captive facilities holding Baird's tapirs
Action 2: Richard Sheffield, Mexico and Mauricio Caballero, Panama	April/2006	Alberto Mendoza, United States and Efraín Ríos Castillo, Mexico	US$ 3,000 (airfare is not included)	Development of a Regional Collection Plan (RCP)	The Regional Collection Plan (RCP) will not be developed	Lack of interest, time and funding

Baird's Tapir (*Tapirus bairdii*)
Conservation Workshop
Population and Habitat Viability Assessment (PHVA)

Belize, Central America
15 to 19 August, 2005

Section 7

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Baird's Tapir (*Tapirus bairdii*) Conservation Workshop Population and Habitat Viability Assessment (PHVA)

Belize, Central America
15 to 19 August, 2005

Section 8

Glossary

GLOSSARY

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ANAM – Autoridad Nacional del Ambiente, Panamá [National Authority of the Environment, Panama]

ANCON – Asociación Nacional para la Conservación de la Naturaleza, Panamá [National Association for the Conservation of Nature]

AP – Área Protegida [Protected Area]

WPA – Wild Protected Area

AZA – Association of Zoos and Aquariums, United States

AZCARM – Asociación de Zoológicos, Criaderos y Acuarios de México [Association of Zoos, Breeding Units and Aquaria of Mexico]

CBMAP – Corredor Biológico Mesoamericano del Atlántico Panameño [Mesoamerican Biological Corridor of the Panamanian Atlantic]

CBSG – Conservation Breeding Specialist Group

CBSS – Corredor Biológico San Juan-La Selva [San Juan-La Selva Biological Corridor]

CCAD – Comisión Centroamericana de Ambiente y Desarrollo [Centro American Comission of Environment and Development]

CCT – Centro Científico Tropical [Tropical Scientific Center]

CEDARENA – Centro de Derecho Ambiental y de los Recursos Naturales [Center of Law of Environmental and Natural Resources]

CEMEC – Centro de Monitoreo y Evaluación, Guatemala [Center of Monitoring and Evaluation, Guatemala]

CEPF – Critical Ecosystem Partnership Fund, Conservation International

CI – Conservation International

CITES – Convention on International Trade in Endangered Species of Wild Flora and Fauna

CNE – Comisión Nacional de Prevención de Riesgos y Atención de Emergencias, Costa Rica [National Comission of Risk Prevention and Emmergency Attendance, Costa Rica]

CODECHOCO – Corporación Autónoma Regional para el Desarrollo Sostenible del Chocó, Colombia [Regional Autonomous Corporation for the Sustainable Development of Chocó, Colombia]

COHDEFOR – Corporación Hondureña de Desarrollo Forestal, Honduras [Honduran Corporation of Forest Development, Honduras]

CONABIO – Comisión Nacional para el Conocimiento y Uso de la Biodiversidad, México [National Comission for the Knowledge and Use of Biodiversity, Mexico]

CONAP – Consejo Nacional de Áreas Protegidas, Guatemala [National Council of Protected Areas, Guatemala]

CONIFOR – Comisión Nacional sobre Incendios Forestales, Costa Rica [National Comission on Forest Fires, Costa Rica]

COPECO – Comisión Permanente de Contingencias, Honduras [Permanent Contingencies Comission, Honduras]

CORPOURABA – Corporación Autónoma Regional para el Desarrollo Sostenible del Urabá, Colombia [Regional Autonomous Corporation for the Sustainable Development of Urabá, Colombia]

DWNP – Department of Wildlife and National Parks, Malaysia

ECOSUR – El Colegio de la Frontera Sur, México [The Southern Border School, Mexico]

EAZA – European Association of Zoos and Aquaria

ICADE – Instituto para la Cooperacion y el Auto-Desarrollo, Honduras [Institute for the Cooperation and Self-Development, Honduras]

IDEAM – Instituto de Hidrología, Meteorología y Estudios Ambientales de Colombia [Institute of Hidrology, Meteorology and Environmental Studies of Colombia]

IGAC – Instituto Geográfico Agustín Codazzi, Colombia [Geographic Institute Agustín Codazzi, Colombia]

IHNE – Instituto de Historia Natural y Ecología, México [Institute of Natural History and Ecology, Mexico]

INAB – Instituto Nacional de Bosques, Guatemala [National Institute of Forests, Guatemala]

INEGI – Instituto Nacional de Estadística, Geografía e Informática, México [National Institute of Statistics, Geography and Informatics, Mexico]

INITER – Instituto Nicaragüense de Estudios Territoriales [Nicaraguan Institute of Territorial Studies]

IPÊ – Instituto de Pesquisas Ecológicas, Brasil [Institute of Ecological Researches, Brazil]

IUCN – International Conservation Union

MAGA – Ministerio de Agricultura y Ganadería, Guatemala [Ministry of Agriculture and Cattle Husbandry, Guatemala]

MAGFOR – Ministerio Agropecuario y Forestal, Nicaragua [Minsitry of Agriculture, Cattle Husbandry and Forestry, Nicaragua]

MARENA – Ministerio del Ambiente y los Recursos Naturales de Nicaragua [Ministry of the Environment and Natural Resources of Nicaragua]

MAVDT – Ministerio del Ambiente, Vivienda y Desarrollo Territorial, Colombia [Ministry of Environment, Housing and Land Development, Colombia]

MICIT – Ministerio de Ciencia y Tecnología, Costa Rica [Ministry of Science and Technology, Costa Rica]

MINAE – Ministerio del Ambiente y Energía de Costa Rica [Ministry of the Environment and Energy of Costa Rica]

GO – Governmental Organization

NGO – Non-Governmental Organization

PHVA – Population and Habitat Viability Assessment

PN [NP] – Parque Nacional [National Park]

PNN [NNP] – Parque Nacional Natural (Colombia) [Natural National Park (Colombia)]

PROARCA – Programa Ambiental Regional para Centroamérica [Regional Environmental Program for Central America]

PVA – Population Viability Analysis

PROBIOMA – Proyecto de Biodiversidad de Mamíferos, Panamá [Project of Biodiversity of Mammals, Panama]

RCP – Regional Collection Plan

SEDENA – Secretaria de la Defensa Nacional, México [Secretary of National Defence, Mexico]

SEMARNAT – Secretaria de Medio Ambiente y Recursos Naturales, México [Secretary of the Environment and the Natural Resources, Mexico]

SERNA – Secretaria de Recursos Naturales y Ambiente, Honduras [Secretary of the Natural Resources and the Environment, Honduras]

SIG [GIS] – Sistema de Información Geográfica [Geographic Information System]

SINAC – Sistema Nacional de Áreas de Conservación, Costa Rica [National System of Conservation Areas, Costa rica]

SINAPROC – Sistema Nacional de Protección Civil, Panamá [National System of Civilian Protection, Panama]

SOMASPA – Sociedad Mastozoológica de Panamá [Mastozoological Society of Panama]

SSC – Species Survival Commission

TAG – Taxon Advisory Group

TEC – Tropical Education Center, Belize

TNC – The Nature Conservancy

TPF – Tapir Preservation Fund, United States

TSG – Tapir Specialist Group

TSGCF – Tapir Specialist Group Conservation Fund

UAESPNN – Unidad Administrativa Especial del Sistema de Parques Nacionales Naturales de Colombia [Special Administrative Unit of the System of Natural National Parks of Colombia]

UN.A.CH – Universidad Autónoma de Chiapas, México [Autonomous University of Chiapas, Mexico]

UNAL – Universidad Nacional de Colombia, Colombia [National University of Colombia, Colombia]

UNAMH – Universidad Autónoma de Honduras, Honduras [Autonomous University of Honduras, Honduras]

UNESCO – United National Educational, Scientific and Cultural Organization

USFWS – U.S. Fish & Wildlife Service, United States

WAZA – World Association of Zoos and Aquaria

WCS – Wildlife Conservation Society

WWF – World Wildlife Fund

ZooMAT – Zoológico Miguel Alvarez del Toro, México [Miguel Alvarez del Toro Zoo, Mexico]

Appendix I:

Numerical Results of Simulation Models

Key to column headings

K – Carrying capacity used in each scenario.

F – Presence or absence of inbreeding depression in each scenario.

Hunt – Degree of additional hunting-based mortality used in each scenario. Numbers refer to additional % annual mortality for each adult age class.

Hab. Loss – Degree of reduction in carrying capacity each year. Numbers refer to the annual linear rate of loss in K.

r_s (SD) – The mean rate of stochastic population growth or decline (standard deviation) demonstrated by the simulated populations, averaged across years and iterations, for all simulated populations that are not extinct. This population growth rate is calculated each year of the simulation, prior to any truncation of the population size due to the population exceeding the carrying capacity.

P(E) – Probability of population extinction after 100 years, determined by the proportion of 500 iterations within that given scenario that have gone extinct within the given time frame. "Extinction" is defined in the *VORTEX* model as the absence of either sex.

T(E) – The average time to population extinction, in years.

N_{100} (SD) – Mean (standard deviation) population size at the end of the simulation, averaged across all simulated populations, including those that are extinct.

A) N_0 = 10

K	F	Hunt	Hab. Loss	r_s (SD)	P(E)	T(E)	N_{100} (SD)
10				0.011 (0.161)	0.854	42	8 (2)
10	Yes			-0.009 (0.168)	0.990	37	4 (2)
20				0.018 (0.127)	0.382	50	16 (4)
20	Yes			-0.006 (0.140)	0.778	54	10 (5)
10		0.5		0.006 (0.164)	0.868	40	7 (2)
10		2.0		-0.002 (0.173)	0.952	36	7 (2)
10		4.0		-0.015 (0.182)	0.984	30	7 (3)
20		0.5		0.014 (0.129)	0.388	44	15 (5)
20		2.0		0.002 (0.141)	0.620	47	14 (5)
20		4.0		-0.016 (0.165)	0.876	39	10 (5)
10	Yes	0.5		-0.009 (0.169)	0.990	34	4 (2)
10	Yes	2.0		-0.019 (0.179)	1.000	30	—
10	Yes	4.0		-0.028 (0.186)	1.000	24	—
20	Yes	0.5		-0.010 (0.145)	0.836	53	8 (5)
20	Yes	2.0		-0.019 (0.156)	0.964	46	8 (5)
20	Yes	4.0		-0.031 (0.171)	0.994	33	7 (4)
10			0.5	0.012 (0.168)	0.980	42	5 (0.5)
10			0.75	0.010 (0.171)	1.000	36	—
10		0.5	0.5	0.008 (0.171)	0.976	38	4 (1)
10		0.5	0.75	0.009 (0.174)	0.998	37	2 (0)
10		2.0	0.5	-0.003 (0.177)	0.994	35	3 (1)
10		2.0	0.75	-0.002 (0.182)	1.000	32	—
10		4.0	0.5	-0.016 (0.185)	0.998	27	5 (0)
10		4.0	0.75	-0.013 (0.184)	1.000	29	—
10	Yes		0.5	-0.005 (0.169)	0.998	34	2 (0)
10	Yes		0.75	-0.006 (0.176)	1.000	34	—
10	Yes	0.5	0.5	-0.008 (0.173)	1.000	32	—
10	Yes	0.5	0.75	-0.008 (0.174)	1.000	31	—
10	Yes	2.0	0.5	-0.018 (0.177)	1.000	28	—
10	Yes	2.0	0.75	-0.015 (0.181)	1.000	27	—
10	Yes	4.0	0.5	-0.029 (0.189)	1.000	23	—
10	Yes	4.0	0.75	-0.026 (0.185)	1.000	24	—

B) N_0 = 25

K	F	Hunt	Hab. Loss	r_s (SD)	P(E)	T(E)	N_{100} (SD)
25				0.022 (0.106)	0.102	65	20 (5)
25	Yes			0.002 (0.116)	0.412	72	15 (7)
50				0.033 (0.080)	0.010	42	47 (6)
50	Yes			0.016 (0.084)	0.042	67	39 (12)
25		0.5		0.021 (0.106)	0.108	65	20 (5)
25		2.0		0.007 (0.117)	0.284	67	18 (6)
25		4.0		-0.010 (0.135)	0.624	58	14 (7)
50		0.5		0.028 (0.083)	0.024	53	46 (7)
50		2.0		0.015 (0.092)	0.088	58	41 (11)
50		4.0		-0.003 (0.111)	0.314	62	29 (15)
25	Yes	0.5		-0.002 (0.121)	0.502	72	14 (7)
25	Yes	2.0		-0.013 (0.131)	0.772	66	10 (7)
25	Yes	4.0		-0.027 (0.412)	0.954	55	5 (3)
50	Yes	0.5		0.014 (0.087)	0.078	66	38 (12)
50	Yes	2.0		-0.004 (0.106)	0.350	68	28 (14)
50	Yes	4.0		-0.022 (0.127)	0.756	63	16 (12)
25			0.5	0.019 (0.119)	0.254	74	10 (3)
25			0.75	0.017 (0.131)	0.528	76	5 (1)
25		0.5	0.5	0.016 (0.122)	0.314	73	10 (3)
25		0.5	0.75	0.012 (0.132)	0.590	78	5 (1)
25		2.0	0.5	0.004 (0.129)	0.496	66	9 (3)
25		2.0	0.75	0.001 (0.139)	0.750	71	5 (1)
25		4.0	0.5	-0.013 (0.142)	0.798	62	9 (3)
25		4.0	0.75	-0.013 (0.147)	0.896	62	5 (1)
25	Yes		0.5	0.000 (0.127)	0.632	74	8 (3)
25	Yes		0.75	-0.002 (0.135)	0.842	72	4 (1)
25	Yes	0.5	0.5	-0.005 (0.131)	0.720	69	7 (3)
25	Yes	0.5	0.75	-0.006 (0.135)	0.868	71	4 (1)
25	Yes	2.0	0.5	-0.015 (0.139)	0.884	64	6 (2)
25	Yes	2.0	0.75	-0.015 (0.143)	0.940	62	5 (2)
25	Yes	4.0	0.5	-0.026 (0.147)	0.978	55	4 (2)
25	Yes	4.0	0.75	-0.028 (0.152)	0.992	53	5 (2)

C) N_0 = 50

K	F	Hunt	Hab. Loss	r_s (SD)	P(E)	T(E)	N_{100} (SD)
50				0.033 (0.076)	0.002	86	47 (5)
50	Yes			0.020 (0.078)	0.006	70	40 (11)
100				0.036 (0.063)	0.000	—	97 (5)
100	Yes			0.028 (0.063)	0.000	—	95 (8)
50		0.5		0.030 (0.077)	0.000	—	47 (6)
50		2.0		0.017 (0.083)	0.014	57	42 (10)
50		4.0		0.000 (0.096)	0.138	75	32 (14)
100		0.5		0.033 (0.064)	0.000	—	97 (6)
100		2.0		0.022 (0.067)	0.004	85	93 (10)
100		4.0		0.005 (0.079)	0.060	76	73 (26)
50	Yes	0.5		0.016 (0.080)	0.028	80	39 (11)
50	Yes	2.0		0.002 (0.091)	0.130	81	30 (14)
50	Yes	4.0		-0.016 (0.110)	0.468	75	18 (12)
100	Yes	0.5		0.025 (0.063)	0.000	—	93 (10)
100	Yes	2.0		0.012 (0.070)	0.024	72	80 (23)
100	Yes	4.0		-0.009 (0.093)	0.244	76	43 (29)
50			0.5	0.030 (0.086)	0.010	83	23 (3)
50			0.75	0.026 (0.096)	0.050	90	11 (2)
50		0.5	0.5	0.026 (0.087)	0.020	80	22 (4)
50		0.5	0.75	0.022 (0.098)	0.058	91	11 (2)
50		2.0	0.5	0.015 (0.092)	0.026	82	21 (5)
50		2.0	0.75	0.012 (0.102)	0.112	86	10 (3)
50		4.0	0.5	-0.003 (0.106)	0.224	78	17 (7)
50		4.0	0.75	-0.004 (0.112)	0.316	79	9 (3)
50	Yes		0.5	0.015 (0.089)	0.050	80	19 (6)
50	Yes		0.75	0.010 (0.102)	0.144	88	10 (3)
50	Yes	0.5	0.5	0.011 (0.092)	0.074	85	18 (6)
50	Yes	0.5	0.75	0.008 (0.102)	0.174	88	10 (3)
50	Yes	2.0	0.5	-0.002 (0.103)	0.230	82	15 (7)
50	Yes	2.0	0.75	-0.005 (0.111)	0.408	84	9 (3)
50	Yes	4.0	0.5	-0.019 (0.118)	0.588	76	11 (7)
50	Yes	4.0	0.75	-0.019 (0.122)	0.704	79	7 (3)

D) N_0 = 75

K	F	Hunt	Hab. Loss	r_s (SD)	P(E)	T(E)	N_{100} (SD)
75				0.035 (0.066)	0.000	—	72 (5)
75	Yes			0.027 (0.066)	0.000	—	70 (8)
150				0.037 (0.057)	0.000	—	147 (6)
150	Yes			0.032 (0.057)	0.000	—	146 (8)
75		0.5		0.032 (0.067)	0.000	—	72 (5)
75		2.0		0.020 (0.069)	0.000	—	55 (19)
75		4.0		0.006 (0.077)	0.020	82	55 (19)
150		0.5		0.034 (0.057)	0.000	—	147 (6)
150		2.0		0.022 (0.060)	0.002	67	143 (13)
150		4.0		0.007 (0.066)	0.006	80	114 (36)
75	Yes	0.5		0.023 (0.067)	0.002	93	67 (10)
75	Yes	2.0		0.011 (00.072)	0.010	80	57 (17)
75	Yes	4.0		-0.008 (0.088)	0.160	85	35 (20)
150	Yes	0.5		0.028 (0.057)	0.000	—	145 (8)
150	Yes	2.0		0.016 (0.060)	0.000	—	135 (21)
150	Yes	4.0		-0.003 (0.074)	0.066	80	77 (42)
75			0.5	0.033 (0.073)	0.000	—	36 (4)
75			0.75	0.032 (0.081)	0.006	91	18 (2)
75		0.5	0.5	0.030 (0.073)	0.004	96	36 (4)
75		0.5	0.75	0.027 (0.081)	0.008	89	18 (3)
75		2.0	0.5	0.019 (0.078)	0.010	90	34 (5)
75		2.0	0.75	0.017 (0.084)	0.004	98	17 (3)
75		4.0	0.5	0.003 (0.085)	0.056	85	29 (9)
75		4.0	0.75	0.000 (0.093)	0.088	85	15 (4)
75	Yes		0.5	0.024 (0.074)	0.002	90	34 (6)
75	Yes		0.75	0.020 (0.082)	0.014	91	18 (3)
75	Yes	0.5	0.5	0.021 (0.075)	0.004	94	33 (6)
75	Yes	0.5	0.75	0.017 (0.084)	0.020	90	16 (4)
75	Yes	2.0	0.5	0.007 (0.081)	0.034	91	29 (9)
75	Yes	2.0	0.75	0.005 (0.088)	0.058	93	15 (4)
75	Yes	4.0	0.5	-0.010 (0.094)	0.212	83	20 (10)
75	Yes	4.0	0.75	-0.012 (0.100)	0.284	86	12 (5)

E) N_0 = 100

K	F	Hunt	Hab. Loss	r_s (SD)	P(E)	T(E)	N_{100} (SD)
100				0.036 (0.061)	0.000	—	98 (5)
100	Yes			0.030 (0.061)	0.000	—	96 (7)
200				0.038 (0.054)	0.000	—	197 (7)
200	Yes			0.033 (0.053)	0.000	—	195 (9)
100		0.5		0.033 (0.062)	0.000	—	97 (6)
100		2.0		0.022 (0.064)	0.000	—	93 (11)
100		4.0		0.007 (0.069)	0.008	81	80 (22)
200		0.5		0.034 (0.054)	0.000	—	196 (7)
200		2.0		0.023 (0.056)	0.000	—	193 (11)
200		4.0		0.008 (0.061)	0.002	97	161 (46)
100	Yes	0.5		0.026 (0.062)	0.000	—	93 (10)
100	Yes	2.0		0.015 (0.064)	0.000	—	85 (17)
100	Yes	4.0		-0.002 (0.074)	0.040	89	56 (26)
200	Yes	0.5		0.030 (0.054)	0.000	—	195 (9)
200	Yes	2.0		0.019 (0.055)	0.000	—	187 (19)
200	Yes	4.0		0.001 (0.064)	0.008	88	120 (57)
100			0.5	0.035 (0.067)	0.002	95	49 (3)
100			0.75	0.034 (0.072)	0.000	—	25 (2)
100		0.5	0.5	0.032 (0.067)	0.000	—	48 (4)
100		0.5	0.75	0.031 (0.073)	0.000	—	24 (3)
100		2.0	0.5	0.021 (0.069)	0.000	—	47 (6)
100		2.0	0.75	0.019 (0.076)	0.000	—	24 (3)
100		4.0	0.5	0.006 (0.075)	0.010	86	42 (10)
100		4.0	0.75	0.004 (0.082)	0.024	86	22 (5)
100	Yes		0.5	0.028 (0.067)	0.000	—	47 (5)
100	Yes		0.75	0.025 (0.073)	0.000	—	24 (4)
100	Yes	0.5	0.5	0.024 (0.068)	0.000	—	46 (6)
100	Yes	0.5	0.75	0.021 (0.074)	0.002	94	23 (4)
100	Yes	2.0	0.5	0.012 (0.071)	0.004	92	42 (9)
100	Yes	2.0	0.75	0.008 (0.078)	0.016	90	22 (5)
100	Yes	4.0	0.5	-0.005 (0.080)	0.046	90	32 (14)
100	Yes	4.0	0.75	-0.007 (0.087)	0.102	89	18 (6)

F) N_0 = 250

K	F	Hunt	Hab. Loss	r_s (SD)	P(E)	T(E)	N_{100} (SD)
250				0.038 (0.051)	0.000	—	246 (8)
250	Yes			0.035 (0.051)	0.000	—	246 (8)
500				0.039 (0.047)	0.000	—	495 (11)
500	Yes			0.037 (0.053)	0.000	—	495 (11)
250		0.5		0.034 (0.051)	0.000	—	247 (7)
250		2.0		0.024 (0.052)	0.000	—	242 (13)
250		4.0		0.009 (0.054)	0.000	—	224 (31)
500		0.5		0.035 (0.048)	0.000	—	494 (12)
500		2.0		0.024 (0.049)	0.000	—	489 (19)
500		4.0		0.010 (0.051)	0.000	—	446 (75)
250	Yes	0.5		0.032 (0.051)	0.000	—	245 (10)
250	Yes	2.0		0.021 (0.052)	0.000	—	239 (17)
250	Yes	4.0		0.006 (0.054)	0.000	—	202 (44)
500	Yes	0.5		0.033 (0.047)	0.000	—	494 (13)
500	Yes	2.0		0.022 (0.048)	0.000	—	487 (20)
500	Yes	4.0		0.007 (0.048)	0.000	—	396 (103)
250			0.5	0.038 (0.054)	0.000	—	124 (4)
250			0.75	0.037 (0.057)	0.000	—	63 (3)
250		0.5	0.5	0.034 (0.054)	0.000	—	124 (5)
250		0.5	0.75	0.034 (0.057)	0.000	—	63 (3)
250		2.0	0.5	0.023 (0.055)	0.000	—	123 (8)
250		2.0	0.75	0.023 (0.058)	0.000	—	63 (4)
250		4.0	0.5	0.009 (0.056)	0.000	—	118 (13)
250		4.0	0.75	0.009 (0.060)	0.000	—	61 (6)
250	Yes		0.5	0.034 (0.054)	0.000	—	124 (5)
250	Yes		0.75	0.033 (0.056)	0.000	—	63 (3)
250	Yes	0.5	0.5	0.030 (0.053)	0.000	—	124 (5)
250	Yes	0.5	0.75	0.030 (0.057)	0.000	—	63 (3)
250	Yes	2.0	0.5	0.020 (0.055)	0.000	—	122 (8)
250	Yes	2.0	0.75	0.019 (0.058)	0.000	—	62 (4)
250	Yes	4.0	0.5	0.005 (0.060)	0.000	—	111 (18)
250	Yes	4.0	0.75	0.004 (0.060)	0.000	—	59 (8)

G) N_0 = 500

K	F	Hunt	Hab. Loss	r_s (SD)	P(E)	T(E)	N_{100} (SD)
500				0.038 (0.047)	0.000	—	496 (10)
1000				0.039 (0.047)	0.000	—	991 (21)
500		0.5		0.035 (0.047)	0.000	—	495 (12)
500		2.0		0.024 (0.048)	0.000	—	489 (19)
500		4.0		0.010 (0.049)	0.000	—	461 (47)
1000		0.5		0.035 (0.045)	0.000	—	991 (22)
1000		2.0		0.025 (0.046)	0.000	—	984 (29)
1000		4.0		0.010 (0.047)	0.000	—	913 (112)
500			0.5	0.039 (0.049)	0.000	—	251 (6)
500			0.75	0.038 (0.050)	0.000	—	128 (4)
500		0.5	0.5	0.035 (0.049)	0.000	—	250 (6)
500		0.5	0.75	0.035 (0.051)	0.000	—	128 (4)
500		2.0	0.5	0.025 (0.050)	0.000	—	249 (8)
500		2.0	0.75	0.024 (0.051)	0.000	—	127 (4)
500		4.0	0.5	0.009 (0.051)	0.000	—	241 (18)
500		4.0	0.75	0.009 (0.053)	0.000	—	125 (7)

H) N_0 = 1000

K	F	Hunt	Hab. Loss	r_s (SD)	P(E)	T(E)	N_{100} (SD)
1000				0.039 (0.045)	0.000	—	993 (17)
2000				0.039 (0.044)	0.000	—	1988 (30)
1000		0.5		0.035 (0.045)	0.000	—	990 (21)
1000		2.0		0.025 (0.046)	0.000	—	980 (32)
1000		4.0		0.010 (0.046)	0.000	—	937 (79)
2000		0.5		0.035 (0.044)	0.000	—	1982 (39)
2000		2.0		0.025 (0.045)	0.000	—	1970 (51)
2000		4.0		0.010 (0.045)	0.000	—	1846 (212)
1000			0.5	0.039 (0.046)	0.000	—	503 (8)
1000			0.75	0.039 (0.047)	0.000	—	257 (5)
1000		0.5	0.5	0.035 (0.046)	0.000	—	501 (11)
1000		0.5	0.75	0.035 (0.047)	0.000	—	256 (5)
1000		2.0	0.5	0.025 (0.047)	0.000	—	499 (13)
1000		2.0	0.75	0.024 (0.048)	0.000	—	255 (6)
1000		4.0	0.5	0.010 (0.047)	0.000	—	489 (23)
1000		4.0	0.75	0.010 (0.048)	0.000	—	254 (8)

I) N_0 = 2500

K	F	Hunt	Hab. Loss	r_s (SD)	P(E)	T(E)	N_{100} (SD)
2500				0.039 (0.044)	0.000	—	2483 (43)
5000				0.039 (0.043)	0.000	—	4974 (72)
2500		0.5		0.035 (0.044)	0.000	—	2481 (47)
2500		2.0		0.025 (0.044)	0.000	—	2459 (68)
2500		4.0		0.010 (0.045)	0.000	—	2366 (155)
5000		0.5		0.035 (0.043)	0.000	—	4968 (81)
5000		2.0		0.025 (0.044)	0.000	—	4934 (121)
5000		4.0		0.010 (0.044)	0.000	—	4628 (528)
2500			0.5	0.039 (0.044)	0.000	—	1256 (19)
2500			0.75	0.039 (0.044)	0.000	—	642 (8)
2500		0.5	0.5	0.036 (0.044)	0.000	—	1254 (22)
2500		0.5	0.75	0.035 (0.045)	0.000	—	642 (10)
2500		2.0	0.5	0.025 (0.044)	0.000	—	1250 (29)
2500		2.0	0.75	0.024 (0.045)	0.000	—	640 (11)
2500		4.0	0.5	0.010 (0.045)	0.000	—	1232 (48)
2500		4.0	0.75	0.010 (0.046)	0.000	—	639 (14)

Appendix II:

Simulation Modeling and Population Viability Analysis

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

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

Models of population dynamics which incorporate causes of fluctuations in population size in order to predict probabilities of extinction, and to help identify the processes which contribute to a population's vulnerability, are used in "Population Viability Analysis" (PVA) (Lacy 1993/4). For the purpose of predicting vulnerability to extinction, any and all population processes that impact population dynamics can be important. Much analysis of conservation issues is conducted by largely intuitive assessments by biologists with experience with the system. Assessments by experts can be quite valuable, and are often contrasted with "models" used to evaluate population vulnerability to extinction. Such a contrast is not valid, however, as *any* synthesis of facts and understanding of processes constitutes a model, even if it is a mental model within the mind of the expert and perhaps only vaguely specified to others (or even to the expert himself or herself).

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

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

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

PVA models also have weaknesses and limitations. A model of the population dynamics does not define the goals for conservation planning. Goals, in terms of population growth, probability of persistence, number of extant populations, genetic diversity, or other measures of population performance must be defined by the management authorities before the results of population modeling can be used. Because the models incorporate many factors, the number of possibilities to test can seem endless, and it can be difficult to determine which of the factors that were analyzed are most important to the population dynamics. PVA models are necessarily incomplete. We can model only those factors which we understand and for which we can specify the parameters. Therefore, it is important to realize that the models probably underestimate the threats facing the population. Finally, the models are used to predict the long-term effects of the processes presently acting on the population. Many aspects of the situation could change radically within the time span that is modeled. Therefore, it is important to reassess the data and model results periodically, with changes made to the conservation programs as needed (see Lacy and Miller (2002), Nyhus *et al.* (2002) and Westley and Miller (2003) for more details).

The *VORTEX* Population Viability Analysis Model

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

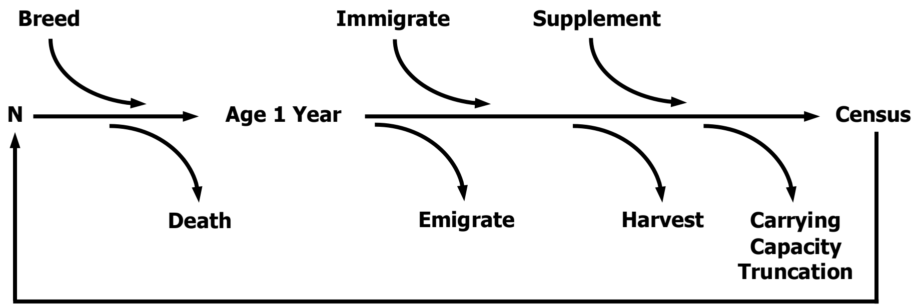
Density dependence in mortality is modeled by specifying a carrying capacity of the habitat. When the population size exceeds the carrying capacity, additional morality is imposed across all age classes to bring the population back down to the carrying capacity. The carrying capacity can be specified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

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

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

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

VORTEX Simulation Model Timeline



Events listed above the timeline increase N, while events listed below the timeline decrease N.

Further information on *VORTEX* is available in Lacy (2000) and Miller and Lacy (2003).

Dealing with Uncertainty

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

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

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

Results

Results reported for each scenario include:

Deterministic r -- The deterministic population growth rate, a projection of the mean rate of growth of the population expected from the average birth and death rates. Impacts of harvest, inbreeding, and density dependence are not considered in the calculation. When r = 0, a population with no growth is expected; r < 0 indicates population decline; r > 0 indicates long-term population growth. The value of r is approximately the rate of growth or decline per year.

The deterministic growth rate is the average population growth expected if the population is so large as to be unaffected by stochastic, random processes. The deterministic growth rate will correctly predict future population growth if: the population is presently at a stable age distribution; birth and death rates remain constant over time and space (i.e., not only do the probabilities remain constant, but the actual number of births and deaths each year match the expected values); there is no inbreeding depression; there is never a limitation of mates preventing some females from breeding; and there is no density dependence in birth or death rates, such as a Allee effects or a habitat "carrying capacity" limiting population growth. Because some or all of these assumptions are usually violated, the average population growth of real populations (and stochastically simulated ones) will usually be less than the deterministic growth rate.

Stochastic r -- The mean rate of stochastic population growth or decline demonstrated by the simulated populations, averaged across years and iterations, for all those simulated populations that are not extinct. This population growth rate is calculated each year of the simulation, prior to any truncation of the population size due to the population exceeding the carrying capacity. Usually, this stochastic r will be less than the deterministic r predicted from birth and death rates. The stochastic r from the simulations will be close to the deterministic r if the population growth is steady and robust. The stochastic r will be notably less than the deterministic r if the population is subjected to large fluctuations due to environmental variation, catastrophes, or the genetic and demographic instabilities inherent in small populations.

P(E) -- the probability of population extinction, determined by the proportion of, for example, 500 iterations within that given scenario that have gone extinct in the simulations. "Extinction" is defined in the VORTEX model as the lack of either sex.

N -- mean population size, averaged across those simulated populations which are not extinct.

SD(N) -- variation across simulated populations (expressed as the standard deviation) in the size of the population at each time interval. SDs greater than about half the size of mean N often indicate highly unstable population sizes, with some simulated populations very near extinction. When SD(N) is large relative to N, and especially when SD(N) increases over the years of the simulation, then the population is vulnerable to large random fluctuations and may go extinct even if the mean population growth rate is positive. SD(N) will be small and often declining relative to N when the population is either growing steadily toward the carrying capacity or declining rapidly (and deterministically) toward extinction. SD(N) will also decline considerably when the population size approaches and is limited by the carrying capacity.

H -- the gene diversity or expected heterozygosity of the extant populations, expressed as a percent of the initial gene diversity of the population. Fitness of individuals usually declines proportionately with gene diversity (Lacy 1993b), with a 10% decline in gene diversity typically causing about 15% decline in survival of captive mammals (Ralls *et al.* 1988). Impacts of inbreeding on wild populations are less well known, but may be more severe than those observed in captive populations (Jiménez *et al.* 1994). Adaptive response to natural selection is also expected to be proportional to gene diversity. Long-term conservation programs often set a goal of retaining 90% of initial gene diversity (Soulé *et al.* 1986). Reduction to 75% of gene diversity would be equivalent to one generation of full-sibling or parent-offspring inbreeding.

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