Elevational Distribution and Abundance of Baird's Tapir (*Tapirus bairdii*) at different Protection Areas in Talamanca Region of Costa Rica

*José F. González-Maya[1, 2 *], Jan Schipper[1, 2, 3], Karla Rojas-Jiménez[1]*

1 Proyecto de Conservación de Aguas y Tierras, ProCAT Internacional. Las Alturas, Coto Brus, Puntarenas, Costa Rica.
2 ProCAT Colombia. Calle 127 # 45 – 76, Bogotá, Colombia.
3 IUCN/SSC - CI/CABS Biodiversity Assessment Unit, Center for Applied Biodiversity Science, Conservation International, Arlington, VA 22202, USA
* Corresponding Author, e-mail: jfgonzalez@procat-conservation.org

Abstract

Baird's tapir, *Tapirus bairdii*, is distributed from lowlands to 3600 m from México to Colombia. In Costa Rica the species was distributed across the entire country, but currently its precluded to isolated areas and national parks. Here we present the first elevational abundance estimation for the species in the Talamanca region, one of the most important and key habitats for the species throughout the region. A total of 36 paired camera-trap stations reaching a total of 2,160 trap-nights were deployed in an elevation range from 800 to 3600 m. A disrupted distribution pattern was observed with a high density for the La Amistad National Park at 2600 m. Also, low visitation (low human presence) and highly isolated sites showed a strong preference. Also, night activities were the most frequent with peaks around 1900-2000 hours and 2300-0000 hours. It seems that tapirs have disappeared from both pacific and Caribbean lowland of the Talamanca, precluding the species to mid and high elevation habitats with high degrees of isolation. This study represents an important tool for conservation planning and a key aspect to be considered for regional and species level plans. Other aspects of the species ecology, including diet and feeding habits are necessary to be compared with lowland habitats in order to retain the species on the long term.

Keywords: Central America, Central American Tapir, Ecology, National Parks, Protected Areas.

Introduction

Baird's Tapir (*Tapirus bairdii*) is the largest Neotropical mammal species and is currently listed as Endangered (EN A2abcd+3bce) on the 2008 IUCN Red List of Threatened Species (Castellanos *et al.* 2009). Although the species is distributed from southern Mexico to Colombia and Ecuador (Reid 1997), we know very little about its use of habitat – especially in mountainous areas. Increasingly it is these montane and/or isolated habitats, which retain the majority of the last large blocks of forest and where conservation efforts must focus for the persistence of this and other area-sensitive species.

In Costa Rica, Baird's tapir once occurred throughout the country but today viable populations remain only in a few national parks (Mora, 2000). Extensive surveys in remaining lowland Caribbean forest mosaics of Costa Rica failed to turn up even a single individual over a 3 year study (J. Schipper, pers. comm.). The species requires large areas of intact forests (March & Naranjo, 2005) and is susceptible to hunting (Emmons, 1999) throughout its range, for sport hunting and for food (Gonzalez-Maya *et al.*, 2008). These observations suggest that Baird´s tapir is a conservation dependant species, that is to say – that it will likely not persist without active conservation actions and management. There are already concerns about its genetic viability because population sizes are very low and fragmented.

Baird's tapir is herbivorous and is considered an important disperser and/or predator of seeds, influencing the structure and dynamic of the ecosystems where they remain (March & Naranjo, 2005). Although little is known of the species ecology at higher elevations, it has been observed to be associated with shrubs and especially mountain bamboo (*Chusquea spp.*), which is distributed from 0 to 4,300 m in the

tropics (Londoño, 1996). Much of the available literature describes the distribution of this species as being from sea level to 3,600 m (Reid, 1997); however, there is very little information on habitat use and relative abundance above 1,000 m. Naranjo y Vaughan (2000) reports the presence, by track detection, of the species at up to 3600 m in Chirripó National Park, which is the highest elevation where the species is known to occur.

The data presented in this study have been obtained from a regional conservation assessment project (ProCAT) in the Cordillera Talamanca, among the largest remaining forest blocks in Central America. Results described herein were part of an ongoing project to evaluate the interaction of jaguars with their principal prey, and the effects of ecological and anthropomorphic variables on the distribution of threatened species.

This report looks to establish a more complete description of the elevation distribution and conservation needs for the species in Mesoamerica and Costa Rica

Materials and Methods

Study Area

The Cordillera Talamanca is located in southern Costa Rica and extends into western Panama. The range protrudes abruptly from the surrounding lowlands and is characterized by steep slopes and variety montane habitats, including cloud forests, elfin forests and páramo. The study site (Figure 1) consists of an elevation transect spanning the Pacific slopes of the Cordillera Talamanca, from 3600 m in Chirripó National Park to 1200 m in Las Alturas de Cotón Farm in the Las Tablas Protected Zone. Very little remaining habitat remains below 1,000 m on the Pacific slopes and thus was not sampled. In 1982 and 1983, this area was designated as a Biosphere Reserve (6,126 km^2) and as a Human Natural Heritage Area by UNESCO (Kapelle, 1996). In addition, the region includes an Endemic Bird Area (Stattersfield *et al.* 1998, Harcourt *et al.,* 1996), is a Center for Plant Diversity (Davis *et al.,* 1997), a Global

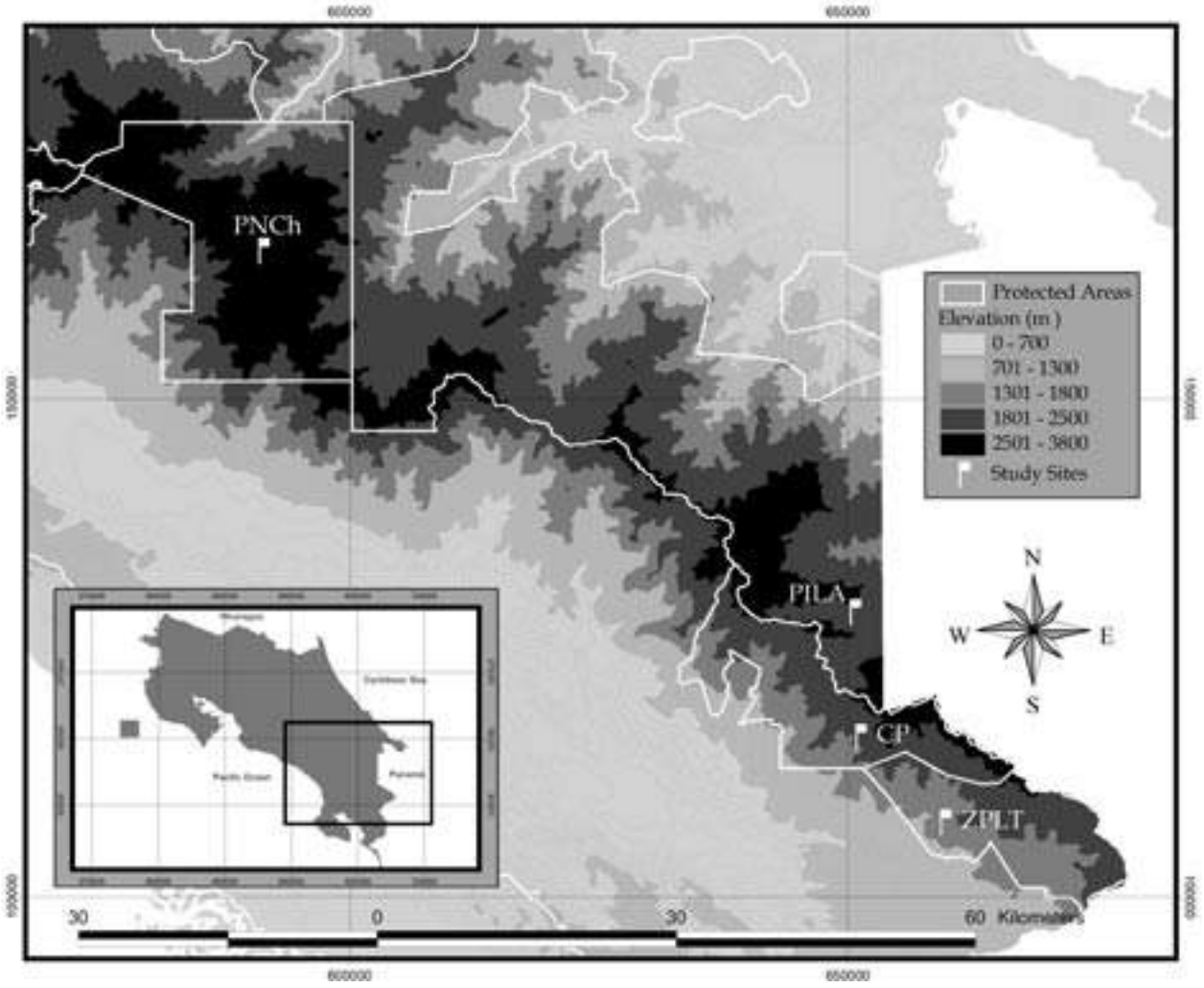

Figure 1. Map of the study area including sampling sites, protected areas and elevation range.

200 Ecoregions (Olson & Dinerstein, 2002) and is considered an important component of the Mesoamerican Hot Spot (Myers *et al.,* 2000, Mittermeier *et al.,* 2005). The region is considered one of the most important protected corridors of forest remaining in Mesoamerica, has more endemic species than any other part of Costa Rica (Gonzalez-Maya *et al.,* 2008) and is considered among the four regions with the highest endemic species concentrations in Central America (Jenkins & Giri, 2008). The region consists of a mosaic of protected areas, indigenous and private reserves and farms, and includes the largest Protected Area in Costa Rica, La Amistad International Park (PILA), which is shared between Costa Rica and Panama (Gonzalez-Maya & Mata-Lorenzen, 2008).

The mean annual precipitation is approximately 5,000 mm, generally with a pronounced rainy season from the end of April to the end of October, and dry season from November to April (Mora-Carpio, 2000) with temperatures ranging from 10º C to 27º C and relative humidity ranging between 80 to 90 % (INBio, 2007). PILA covers 199,147 ha in Costa Rica, and represents about 28.9% of the Costa Rican national park system (Gonzalez-Maya *et al.,* 2008). The region still retains almost 75% of its original forest (DGF, 1989) and approximately 40% is under some kind of formal protection (Powell *et al.,* 2006).

PILA extends approximately from 500 m on Caribbean slope, and 1,500 m on pacific slope to 3,820 masl in Chirripó National Park. It is characterized by steep slopes, small inter-montane valleys and is extremely inaccessible – which is why it has thus far escaped exploitation. However, the pressure for land use change is strong, especially convertion from oak "cloud" forests to pastures and croplands (Kappelle, 1996).Such modifications alter the natural distribution of the species because of habitat loss and fragmentation, thus marginalizing the species to higher, inaccessible parts of the mountain range. These changes also resulted in the loss of middle elevation habitats and in many cases cause species migrations towards higher altitudes, but also caused local extinctions and isolation between lowland forests habitat (as Corcovado National Park) and high elevation forests, affecting altitudinal and seasonal migrations of numerous species (i.e. Resplendent Quetzal – *Pharomachrus mocinno*).

This study focused on three main areas under different management (control, use restrictions) and visitation categories (Human presence for tourism, hunting, harvest, etc.): Valle del Silencio Sector of La Amistad International Park (PILA), Chirripó National Park (PNCh), Cerro Pittier (CP) a privately owned property and Las Tablas Protected Zone (ZPLT) a private farm dedicated to conservation (Table 1).

Methods

Data collection method employed a systematic camera-trap array survey to estimate presence-absence using cameras with heat-in-motion sensors (Gonzalez-Maya *et al.,* 2008). This methodology has been successfully used for the estimate of relative densities and absolute abundances of cryptic species, and it has also been used to estimate relative abundances of other non-cryptic species, and as a useful tool for detecting rare or elusive species (Karanth *et al.* 2004, Maffei *et al.,* 2002, Maffei *et al.,* 2004).

The aim of this project was to estimate the absolute densities of jaguar and their prey (including tapir) along an elevation gradient and to estimate the relative abundance of prey species in the greater Talamanca Region (surrounding PILA). In addition, camera-trap surveys were established along different elevations to estimate the presence of different species for modeling habitat suitability.

Camera traps were used to collect data on tapir both incidentally and targeted towards appropriate habitats and along trails used by the species.

Cameras were active continuously (24 hours) in a two month period at each site. Each photograph includes a date and hour stamp, allowing us to estimate the principal activity patterns, and also to divide the two months in 60 sampling periods (days), to estimate both relative and absolute densities of species.

A relative abundance index was built in order to standardize and compare among sites (Maffei *et al.,* 2002, Karanth & Nichols, 2002), and the index was constructed as the number of captures (individuals) per 1,000 trap nights. Trap nights 24 hour periods calculated as number of days by number of cameras.

In addition, we characterized every camera area by slope, distance to water bodies, forest cover, and vegetation composition using an extrapolation of field data into a Geographical Information System (GIS). Camera surveys were carried out in four places, with systematic arrays of cameras in three of them, and a presence-absence survey in the other (see Figure 1).

Results

A total trap effort of 2,160 trap-nights were completed and timing was distributed equally among the four sites, with arrays of 20 paired cameras in the systematic sites (PILA, CP and ZPLT) and 6 stations for PNCh for a total of 36 stations.

From a total of 628 pictures at 4 sites, 87 were of Baird´s tapir (Table 2), with a notable high capture rate for the PILA site. The greatest number pictures were at PILA at 2,560 m of elevation, on a ridge with

Table 1. Survey sites, elevation and characteristics.

Site	Elevation range (m)	Control	Human presence
PILA	2400 - 2800	Passive	Low
PNCh	3500 - 3800	Active	High
CP	1900 - 2300	Passive	Low
ZPLT	800 - 1200	Active	High

10 degrees of slope dominated by *Chusquea sp.*, with approximately 80% of forest cover. The distribution of relative abundance on the elevation gradient was highly differentiated with a heterogeneous distribution from lowlands to páramo (Figure 2).

The distribution across the elevation gradient showed a pattern with an abrupt change as evidenced by the high abundance in PILA, however, in general terms it shows a greater abundance in the higher elevations. For the entire study tapir was the second most abundant species after the American opossum, *Didelphis virginianus,* and showed an important relationship with elevation and slope (Gonzalez-Maya *et al.,* 2008).

In this study, a total of 13 photographs containing 2 or more individuals were captured at PILA, showing a high number of breeding pairs in the zone, also a low number of young individuals were captured (15.5 %) compared with the total number of photographed individuals.

The distribution showed a marked preference for low visitation (low human presence) sites, even when hunting control was not as active as other areas; also, the site with the highest abundance was the most isolated parts of the park. There was a preference for night activity with peaks around 1900-2000 hours and 2300-0000 hours, and no activity during the day (Figure 3).

Discussion

Conservation planning, site protection and biodiversity assessment are among of the most important issues to consider in order to retain biodiversity in tropical landscapes, however, in many areas even basic information on species occurrence and distributions is lacking. Improving knowledge of species ecology and distribution can contribute greatly to improved priority setting for conservation interventions and in park management.

Tapir appears to have disappeared from both the Caribbean and Pacific lowlands surrounding PILA, thus creating a virtual habitat island (Schipper *et al.,* 2005). This is inferred on the Pacific slope of Cordillera Talamanca by the lack of any major forest fragments below 1,000 m and mainly because of its discontinuity (Cespedes *et al.,* 2007), and observed on the Caribbean slope mainly by hunting, habitat loss/fragmentation and over-exploitation (Schipper, unpub. data.).

Previous studies had reported capture frequencies for tapir; Noss *et al.* (2003) with 11-60 ind/1000 trap-nights in Bolivian dry forests, Wallace *et al.* (2002) with 7 ind/1000 trap-nights for Bolivian lowland moist tropical forest in Madidi, Kelly (under review) with

Table 2. Total number of pictures and tapir pictures and frequency.

Site	Total pictures	Tapir captures	Frequency	Relative abundance (captures/1000 trap-nights)
PILA	99	77	77.78	35.65
PNCh	53	5	9.43	2.31
CP	98	3	3.06	1.39
ZPLT	378	2	0.53	0.93
Total	**628**	**87**	**13.85**	**40.28**

12 ind/1000 trap-nights in the rainforest of Belize for *T. bairdii* and Holden *et al.* (2003) with 4-19 ind/1000 trap-nights for Malayan tapir (*Tapirus indicus)* in lowland rainforest of Sumatra, Indonesia. This study documents a range from 0.93 to 35.65 ind/1000 trap-nights, which represent a high frequency for the species and for the methodology, especially at the elevations sampled.

Continued threats in surrounding lowlands demonstrates the increasing isolation of populations and a continued retreat of the species to more remote montane habitats with less human influence and more continuous habitat or forest. Remaining suitable montane habitats are also spatially limited with much of the Cordillera being extremely steep and broken terrain – likely resulting in a meta-population structure. Even though the species is reported to be associated primarily with lowland forests, the situation in the Cordillera Talamanca region indicates an emerging problem for these and other species, where isolation in upper elevations could represent better suitable habitats for area-dependent species such as tapir.

Based on this analysis, the mountain forests are not only suitable habitat for the species, but seem to be preferred habitats as reflected in the high abundances and density, likely a result of loss of habitat at low and middle elevations combined with a high incidence of hunting. Even in the most isolated portions of La Amistad National Park hunting still takes place, which suggests that there is no place left in Costa Rica where it the tapir can thrive without some degree of persecution. Additionally, due to the continued loss of lowland forests and the increasing exploitation of oak *Quercus* forests the future looks bleak for large mammals in this region unless current and existing laws are enforced. Where corridors exist between habitat blocks hunting activities often increase because the corridors often funnel the animals through a human dominated landscape (Bennet, 2004).

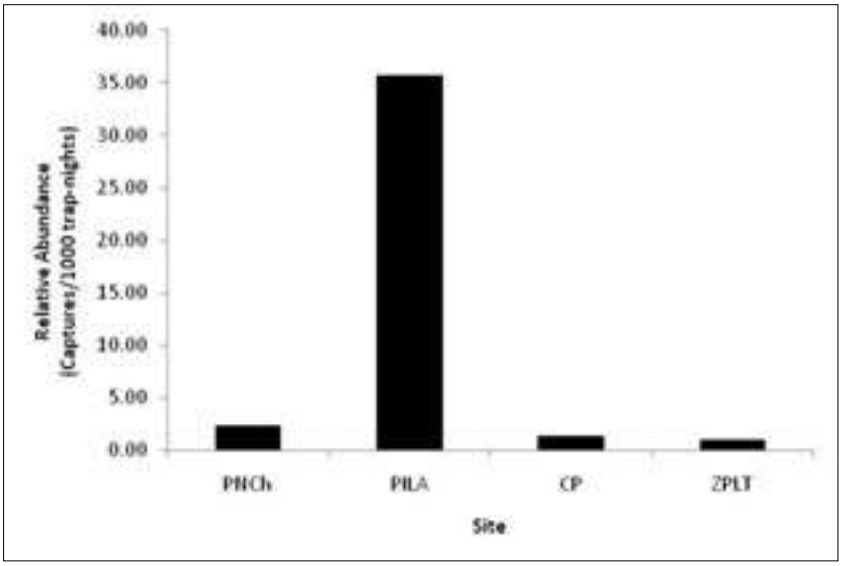

Figure 2. Relative abundance distribution according to elevation.

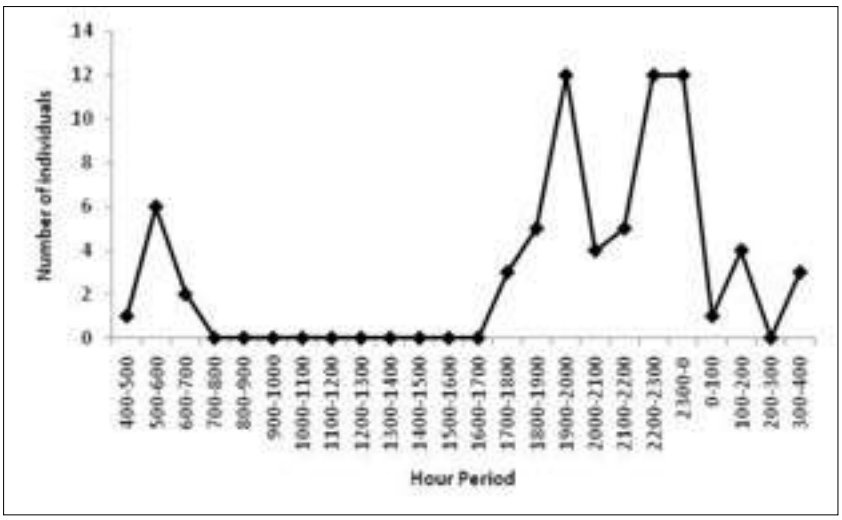

Figure 3. Daily activity patterns accumulative throughout the study.

There is some evidence suggesting that tropical forests species behavior has been shown to change when they occur in human dominated areas; evidence suggests that animals abandon the area or change their activity patterns and habitat use by becoming more nocturnal and adapt movement patterns to suit the conditions (Griffiths & van Schaik, 1993). The present study reveals that tapirs were mainly nocturnal and highly abundant in areas far from human habitation. This confirms the suggestion that areas with less human presence represents better suitable habitat for these and other large mammals (Griffiths & van Schaik, 1993). In fact some changes in the natural history of tapir have been observed as an adaptation to human presence such as shifting activity patterns, use of trails and habitat -density relationships (pers. obs.).

Abundance, elevation distribution and activity patterns can represent important inputs for conservation planning and for the understanding of species population dynamics on different environments and response to hunting, habitat modification and human presence generally. Specifically for montane regions we

feel that this data represents a key information to consider during a conservation planning process because subsequent policies and actions should include ecological information to support management decisions. In addition there is an urgent need for additional support to the park systems, which is the largest but most understaffed in the country, to prevent hunting, illegal logging and mining activities from taking place in the region.

Recommendations

Feeding habits and diet need further investigation for tapir in these montane habitats in order to understand the differences with known lowland habitats (as in Corcovado National Park). Also basic ecology features such as home range, daily movements and habitat use must be investigated at higher elevations as nearly everything that is currently known is derived from data in lowland areas. The future for long term conservation of the species, however, must include these remnant montane habitats which we know next to nothing about. Provide connectivity and ensure habitat continuity from lowlands to highlands, and within them, is also one of the current conservation needs for these conservation-dependant species in the region. We therefore want to encourage scientist to work towards filling the data gaps, habitat restoration and landscape connectivity, so we can effectively plan for their long term survival.

Acknowledgements

Special thanks to Edward Jackson and Moises Romero for their field assistance, Beth Polidoro, Juan Mata and Gustavo Hernandez for their assistance and help in the entire project. We want also thank to La Amistad International Park, MINAE/ACLA-P and Las Alturas staff for all their help, specially Luis Sanchez, Adrian Arias, Aguila and Fernando Castañeda. Financial support was provided by The Nature Conservancy (TNC), Wildlife Conservation Society (WCS), Jaguar Cars/Ford Motor Company (Jaguar Conservation Trust), and CATIE. Also thanks to Diego Zarrate, Sergio Balaguera, Amancay Cepeda and Mauricio Gonzalez for their comments to the manuscript and editors and reviewers for their help.

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