



Geographic distribution and population size of the mountain tapir (*Tapirus pinchaque*) in Colombia

D. J. Lizcano, V. Pizarro, J. Cavelier and J. Carmona *Laboratorio de Ecología Vegetal, Departamento de Ciencias Biológicas, Universidad de los Andes, AA 4976 Bogotá, Colombia*

Abstract

Aim We conducted a study to estimate the past and present distribution and population size of *T. pinchaque* in Colombia.

Location The study included all mountain ranges above 2000 m.

Methods The past distribution was obtained by plotting on a map of past distribution of montane rain forests, the geographical locations with the name ‘danta’ or ‘tapir’ above 2000 m obtained from topographic maps, the locations cited in bibliographic references, and the results of interviews in the 530 Andean municipalities. The present distribution was obtained by plotting the present distribution of montane rain forests, the results of interviews and ground control. Population size was estimated by combining measurements of population density with maps of present distribution.

Results In the past, the species occurred in the central and eastern Cordilleras, as well as in the Andean Massive where the three cordilleras merge in the south of the country. Currently, the species occurs in the central Andes south of Nevados National Park, and in the eastern Andes, south of Paramo de Sumapaz, Bogotá. According to our most optimistic estimates, there are about 2500 tapirs in the Andes of Colombia.

Main conclusions These individuals occur in a total of thirty-five forest patches that range from 5 to 3700 km². Only five to six fragments have the minimum necessary size (826 km²) to maintain at least 150 individuals, the estimated number to maintain viable population in the short term. The populations most threatened are those of the central Cordillera between P.N. Las Hermosas and P.N. Nevado del Huila where large tracts of mature montane forests are being converted to opium fields.

Keywords

Mountain tapir, danta, *Tapirus pinchaque*, Tropical montane forest, geographical range, population size.

INTRODUCTION

There are currently four species in the Tapiridae (Gray) family, one in south-east Asia [*Tapirus indicus* (Desmarest)] and three in Central and South America [*Tapirus bairdii* (Gill), *Tapirus terrestris* (Linnaeus) and *Tapirus pinchaque* (Roulin)]. Known as ‘living fossils’ (Janis, 1984), these species are the remnants of a more diverse lineage that first appeared in the fossil record 53 Ma. During the Eocene, the

Tapiridae family underwent a prolific adaptive radiation (Prothero & Schoch, 1989; Holbrook, 1999), subsequent to which was a decline in the diversity and abundance of tapirs. This decline was probably associated with changes in climate and vegetation that favoured the radiation of artiodactyls ruminates (Schoch, 1989). Further extinctions of tapirs and other mammals in North America coincided with the first migrations of humans to that continent (Frison, 1998). Phylogenetic studies of the existing tapirs, suggest that the Central American species (*T. bairdii*) separated from the American lineage about 19–20 Ma, and that the two South American species (*T. terrestris* and *T. pinchaque*) appeared later (Ashley *et al.*, 1996). The appearance of these two

Correspondence: Jaime Cavelier, 2828 Connecticut Avenue, N.W. ap. 608, Washington, DC 20008, USA.
E-mail: jcavelie@earthlink.net

South American species coincided with the formation of the isthmus of Panama and the uplift of the Andes during the late Pliocene (Van der Hammen, 1982).

Tapirus pinchaque, the smallest of the four species of tapirs (Hershkovitz, 1954), is distributed in the Andes of Colombia, Ecuador and northern Peru. Its main habitats are tropical montane forests and paramos between 2000 and 4000 m (Downer, 1996), which have been greatly altered since pre-Columbian times (Etter & Van Wyngaarden, 2000). While montane rain forests have primarily been converted to plantations and grasslands, paramos have been used for low-density cattle ranching and agricultural fields (i.e. potatoes). In addition to declining populations because of habitat destruction, the species has been subject to hunting for use both as food and traditional medicine (the toes of *T. pinchaque* are used to combat epilepsy and heart disease) (Downer, 1997). This species is considered endangered (IUCN, 1996) and it is included in Appendix I of CITES.

Although the general geographical distribution of the species in the northern Andes is well recognized (Downer, 1996), very little information has been gathered in the field on its specific locations, and no systematic calculation of its current population size has yet been carried out. Previous studies have concentrated on taxonomy (Hershkovitz, 1954), behaviour in captivity (Schauenberg, 1969), natural history and home range in Ecuador (Downer, 1996) and density estimates (Lizcano & Cavelier, 2000). Downer (1996) suggested that there are about 2500 individuals in the geographical range of the species, but he provided no methods or descriptions on how this number was obtained.

In the present study, we carried out a nationwide census of the mountain tapir in Colombia with the goal of obtaining estimates of the species past and present geographical distribution (defined below), and of population size. The study of distribution was carried out using interviews, secondary information on topographic maps and data bases, bibliographic references, as well as ground control. The estimate of population size was obtained by combining measurements of population density with maps of present distribution.

METHODS

Past geographical distribution

The past geographical distribution of the mountain tapir is defined here as the area of distribution of *T. pinchaque* in the Andes of Colombia during pre-Columbian times. The map of the past distribution of the species was obtained by plotting the geographical locations (i.e. stream, peak, ridge, farm, townships, county) above 2000 m with the name 'danta' or 'tapir', on the map of past distribution of montane rain forests (see below). We are assuming that these locations in the Andes and other mountains were named after the tapir because the species occurred in that locality at one point in time. As these locations are between 2000 and 4000 m, and the only species that occupies these areas is *T. pinchaque*, it is unlikely that the sites were named after a different species. The names of the geographical places were

obtained by manually reviewing 144 topographic maps (scales 1 : 50,000–1 : 100,000) of the Andes of Colombia. Additional locations were obtained from the Diccionario Geográfico de Colombia (IGAC, 1996), and the records and reports in the scientific literature (Hershkovitz, 1954; Schauenberg, 1969; Velasco, 1991; Downer, 1996; Lizcano & Cavelier, 2000). Interviews by mail and ground control, also provided information on past and present distribution of the species (see below). Areas less than 100,000 ha in the map of past distribution of montane rain forests with no geographical locations, records or reports that suggested the past distribution of *T. pinchaque* were considered as not having had tapirs in the past.

The map of the past distribution of montane rain forests of Colombia (1 : 1,500,000) was taken from Cavelier & Etter (1995). From this map, only the montane forests and paramos between 2000 and 4000 m were used, because this is the altitudinal range of the distribution of *T. pinchaque* in Colombia (Downer, 1996; Lizcano & Cavelier, 2000). In the final map, areas included the Andes as well as the Sierra Nevada de Santa Marta, Serranía de la Macarena and Cerro Tacarcuna in the Chocó region.

Present distribution

The present geographical distribution of the mountain tapir is defined here as the area of distribution of *T. pinchaque* in the Andes of Colombia as of today (2001). This map was obtained by combining the map of the present distribution of the montane rain forests and data collected in the field.

The map of the present distribution of montane rain forests of Colombia (1 : 1,500,000) was obtained by combining information from various sources. For the western Cordillera the information was taken from Cavelier & Etter (1995), for the central Cordillera from the map of 'Coberturas vegetales uso y ocupación del espacio' (IDEAM, 1996), and for the eastern Cordillera from the map 'Ecosistemas Naturales de la Cordillera Oriental' (IAvH, 2000). These maps were used because they contain the most detailed and updated information on the forest cover in the three cordilleras. For other mountain ranges, the information was taken from Cavelier & Etter (1995). The maps were digitized using the program ILWIS 3.1 (International Institute for Aerospace Survey & Earth Sciences, Enschede, The Netherlands) and then imported and merged in ArcView GIS 3.2 (Environmental Systems Research Institute, Redlands, CA, USA). The borders of the montane National Parks of Colombia were also digitized. Information was obtained from maps (1 : 50,000–1 : 100,000) from the office of National Parks, Ministry of the Environment, Bogotá (Fig. 1).

The present distribution of the mountain tapir was obtained by interviewing the head of the Office of Technical Assistance for Agriculture and Animal Husbandry (UMATA; Unidad Municipal de Asistencia Técnica Agropecuaria) in each of the 530 municipalities with territories above 2000 m. These offices are in charge of preparing the Zoning Plan for the municipalities, and usually have the best available

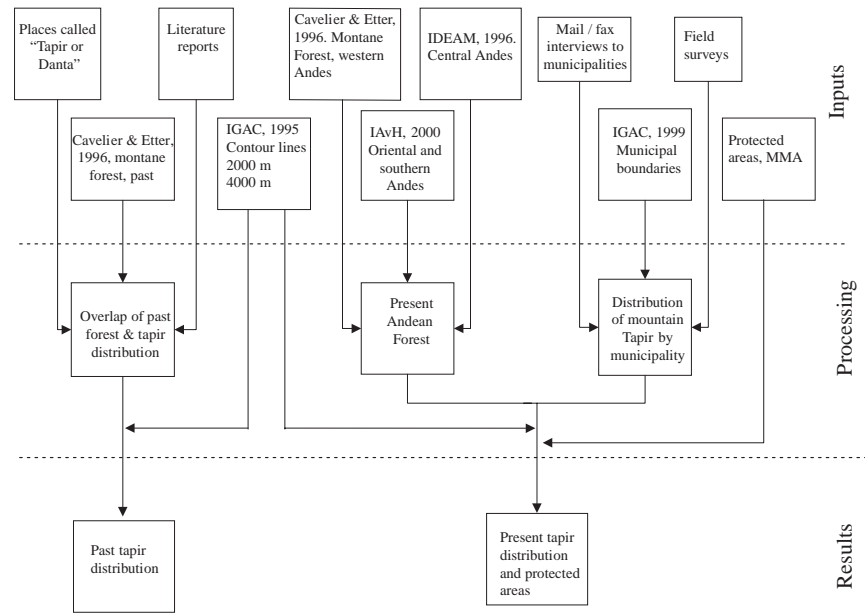


Figure 1 Analytical procedure to obtain the maps of past and present distribution of the mountain tapir in Colombia. IDEAM (Instituto de Hidrología Meteorología y Estudios Ambientales), IGAC (Instituto Geográfico Agustín Codazzi), MMA (Ministerio del Medio Ambiente), IAvH (Instituto Alexander von Humboldt). Flowchart following Etter & Van Wyngaerden (2000).

information on natural resources in the area, including the occurrence of wildlife. The interview consisted of asking if the mountain tapir currently exists or existed in the past in the municipality. A photo of the animal was included to facilitate the identification. The interview was carried out by mail or fax: between January and December 1999. A cover letter addressed to each of the heads of UMATAS was sent along with the interview, explaining the reasons for requesting the information. In that letter a poster of the mountain tapir was offered as a reward for filling out and returning the form to the University of the Andes in Bogotá. A self-addressed, stamped envelope was sent with each letter.

A table with the results of the interviews was joined to the map (1 : 1,500,000) of Municipalities of Colombia (IGAC, 1999) using ArcView GIS 3.2. This map, showing the distribution of the mountain tapir by municipality, was merged with the map of present distribution of montane rain forests between 2000 and 4000 m, resulting in the map of present distribution of the species.

In order to assess the quality of the information derived from the interviews, field work was carried out during 1999 in thirty-six municipalities of the Departments of Tolima (Ibague, Cajamarca, Rovira, Roncesvalles, San Antonio, Chaparral, Rio Blanco, Anzoategui, Planadas, and Santa Isabel), Huila (San Agustín), Risaralda (Santuario, Pereira, Santa Rosa, Apia, and Mistrato), Caldas (Villa Maria, Salamina, Marulanda, and Pensilvania), Antioquia (Frontino, Urrao, Nutibara, and Sonson), Norte de Santander (Herran, Ragonvalia, Labateca, Chinacota, Pamplona, and Toledo), Nariño (Pasto, Funes, and Tangua), Cundinamarca (La Calera) and Valle (Calima and Buga). These municipalities were selected more on the basis of logistics and security (Semple, 2000) than on a rigorous statistical design. During each field trip (4–5 days), we looked for signs of the presence of tapirs (foot prints, faeces, hair and browsing signals).

Ideally, ground control should have been maintained in a higher number of municipalities and these should have been selected randomly. Development of a more rigorous sampling design in rural areas of Colombia was impeded because of safety concerns. Additionally, twenty-five former hunters were interviewed on the ground to obtain information of present and past occurrence of the species in the region. The results of the ground control (current presence/absence of the mountain tapir), were compared with the results of the mail interviews.

Total population size

To obtain estimates of past and present population size of the mountain tapir in Colombia, we multiplied estimates of mean density by the area where the species occurs. Estimates of mean density ranged from 1 ind/551 ha (Lizcano & Cavelier, 2000) to 1 ind/587 ha (Downer, 1996). Areas of past and present distribution for the mountain tapir were 74,556 and 14,385 km², respectively (see results).

To evaluate the effectiveness of the system of montane National Parks to protect the populations of mountain tapirs, the map of present distribution was overlapped with the map of protected areas. Additionally, estimates of the population size of the mountain tapir inside protected areas, was calculated by multiplying the area of montane forest within the parks (some areas in Andean National Parks also have areas with other vegetation types, primarily lowland rain forests) by the mean density.

RESULTS

Past distribution

According to the map of past distribution of the mountain tapir in Colombia, the species occurred in the past in the

central- (twenty-nine geographical locations, ten scientific reports and 185 interviews either by mail or on the ground) and eastern-Cordilleras (twenty-one geographical locations, five scientific reports and 162 interviews either by mail or on the ground), as well as in the Andean Massive where the three cordilleras merge in the south of the country (five geographical locations, seven scientific reports and 138 interviews either by mail or on the ground). On the western Cordillera there is only one geographical location with the name 'danta' or 'tapir'. On the eastern Cordillera, the species was distributed from the border with Ecuador to the border

with Venezuela (Paramo de Tamá). The total area of the past distribution was 74,556 km² (Fig. 2).

Present distribution

The present distribution of montane rain forests of Colombia (1 : 1,500,000) shows that there are 33,288 km² of suitable habitat for the mountain tapir. Most of the remaining montane forests occur on the western flank of the western Cordillera, the southern portion of the central Cordillera and the eastern flank of the eastern Cordillera.

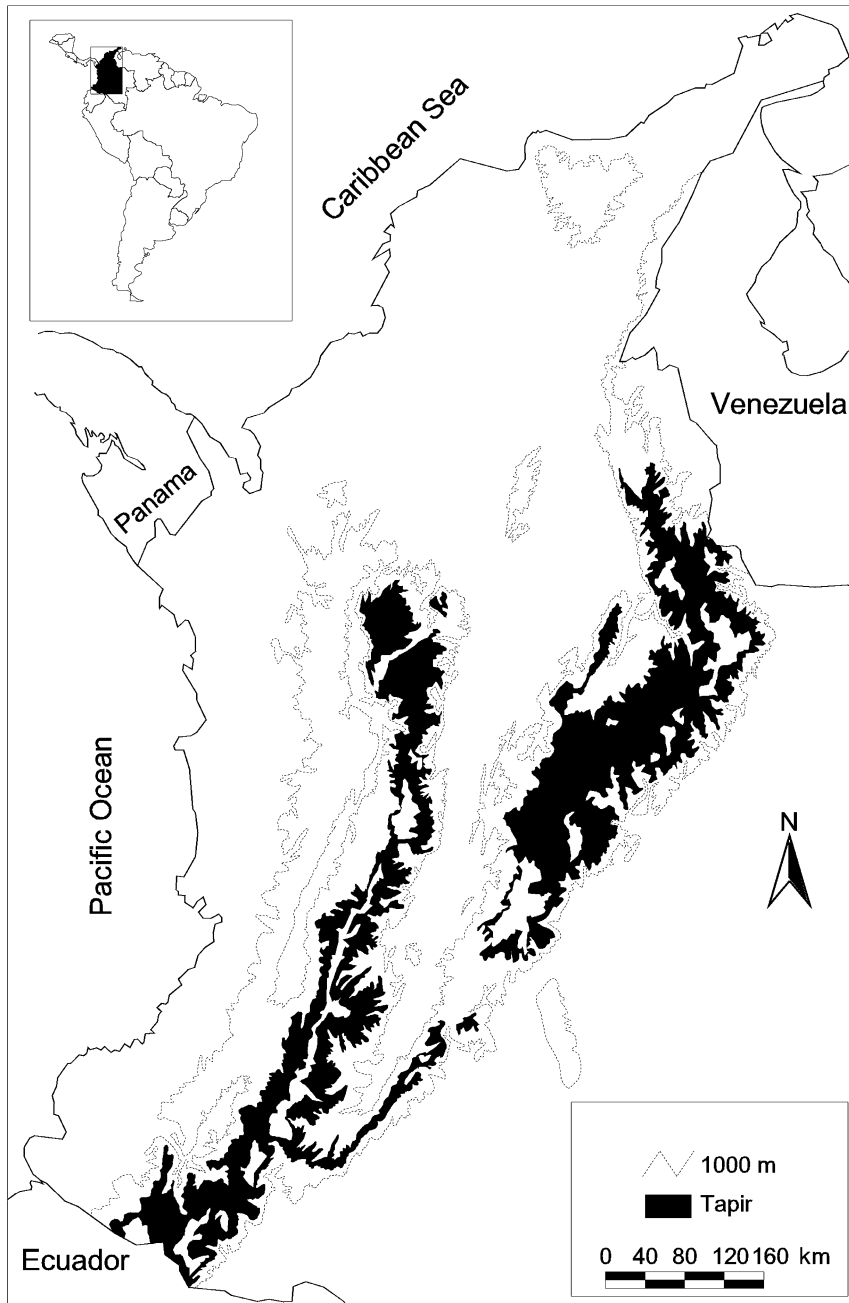


Figure 2 Past distribution of the mountain tapir in Colombia. The dark areas represent tapir habitat between 2000 and 4000 m and includes montane forests and paramos. The dotted line represents the 1000 m counter line.

Of the 530 interviews sent by mail to the municipalities with territories above 2000 m (Fig. 3), 485 (92%) were answered and returned to Bogotá (Fig. 3). There was a high concurrence between the results of the mail interviews and the results of the ground control in thirty-six municipalities (Table 1). In three municipalities (Toledo, Frontino, and Marulanda), there were reports of presence of the mountain tapir, but the field work suggested otherwise, and in only one municipality (Rio Blanco) did the interviews show that there were no tapirs while the ground control suggested the opposite. According to the interviews, the mountain tapir occurs in only fifty-seven of the 530 montane municipalities.

These municipalities belong to the Departments of Cauca, Huila, Quindío, Risaralda, Tolima, Valle, Nariño, Putumayo, Cundinamarca, and Huila.

Ground control in thirty-six municipalities showed that the information provided by the interviews was reliable (89%). This is not surprising as the mountain tapir is large and conspicuous, and would not be mistaken for any other species. Even in municipalities that may have two species (*T. terrestris* and *T. pinchaque* on the eastern flank of the Eastern Cordillera and *T. bairdii* and *T. pinchaque* on the western flank of the Western Cordillera), *T. pinchaque*

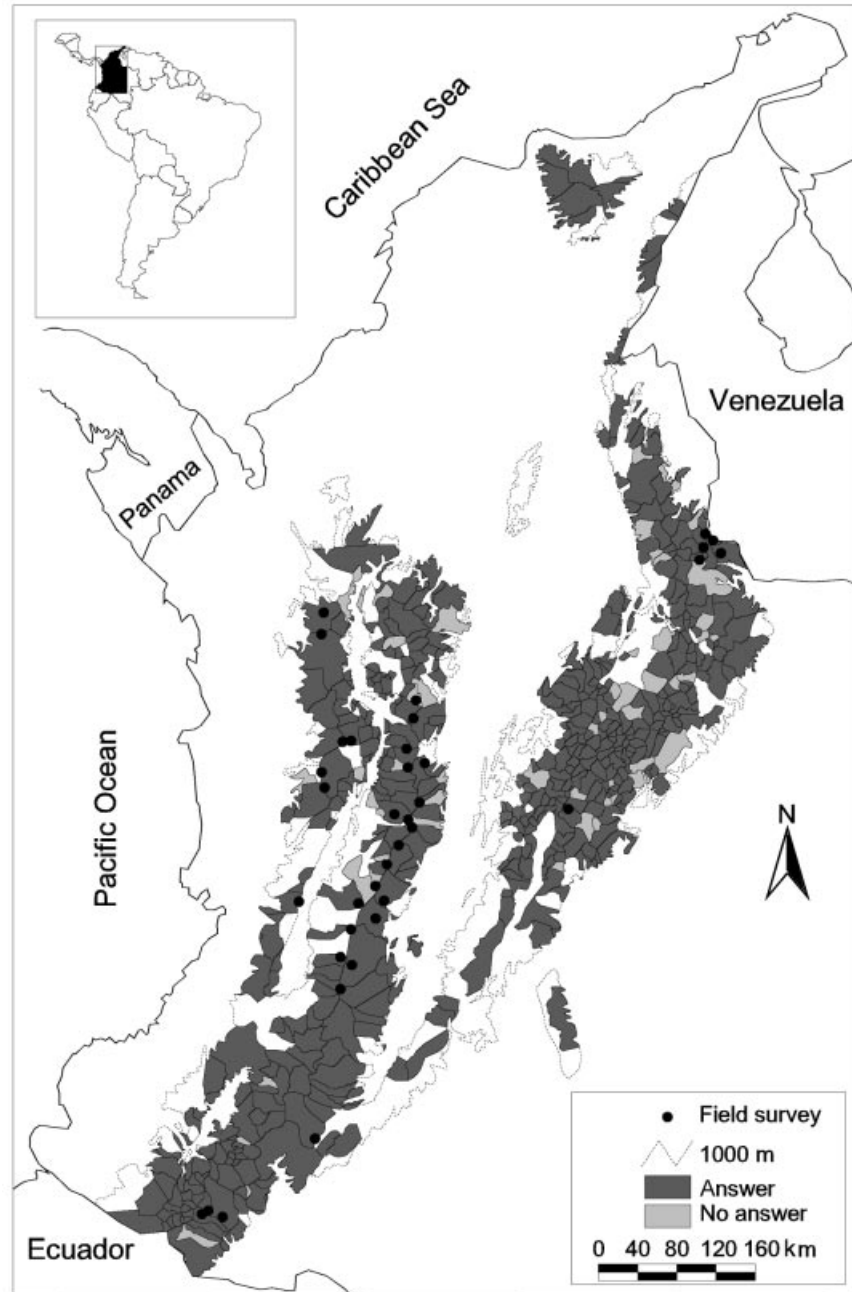


Figure 3 Municipalities with territories above 2000 m where interviews were sent by mail or Fax. Those that responded are in dark grey. The closed circles represent the municipalities where field work was carried out to test the accuracy of the interviews. The dotted line represents the 1000 m contour line.

Table 1 Number of municipalities that answered Yes and No to the question of present existence of the mountain tapir during the mail/fax interviews and ground control

Field survey	Interviews	
	Yes	No
Yes	20	1
No	3	12

would be identified with the upper slopes where the other two species do not occur.

According to the map of present distribution of the mountain tapir (the overlap of the map of present montane rain forests and Andean municipalities with presence of mountain tapir), the species occurs in the Central Andes south of Nevados National Park ($05^{\circ}00' N$) and in the eastern Andes, south of Paramo de Sumapaz ($04^{\circ}30' N$) in Bogotá (Fig. 4). There are no tapirs in the Western Cordillera, northern part of the Central- and Eastern-Cordilleras, Sierra Nevada de Santa Marta, Serrania de la Macarena and

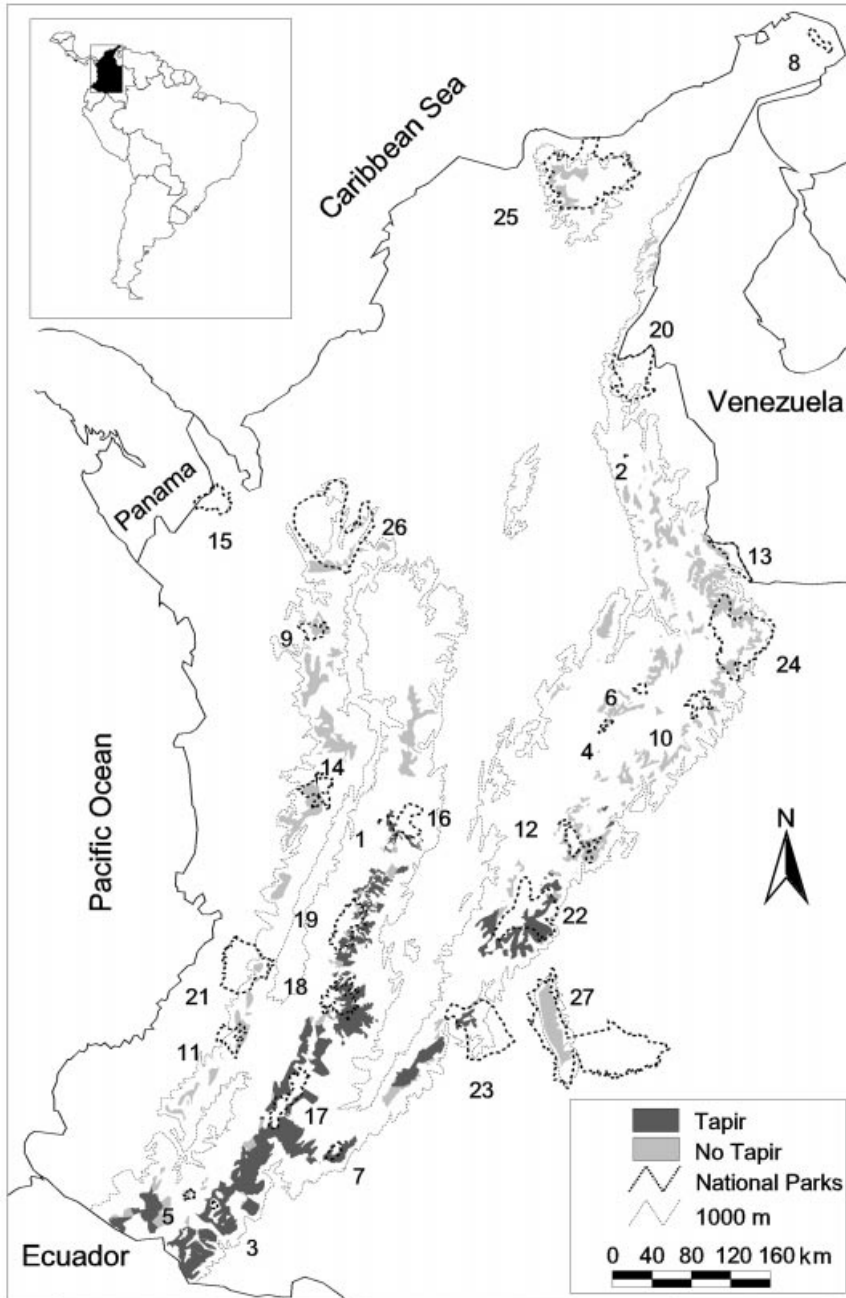


Figure 4 Present distribution of the mountain tapir in Colombia (dark grey) and existing montane forests and paramos between 2000 and 4000 m where there are no tapirs (light grey). The numbers refer to the mountain National Parks (see Table 2). The dotted line represents the 1000 m contour line.

Cerro Tacarcuna. The total area where the species occurs is 14,385 km². This value corresponds to 19% of the past distribution. The area where the species occur is actually a collection of forest patches ($n = 35$) that range from 5.0 to 3700 km² (Fig. 4). Most of the fragments are small and only four are larger than 1000 km².

In the Andes of Colombia there are twenty-three National Parks, of which tapirs are found in only seven (Cordillera los Picachos, Cueva de los Guacharos, Las Hermosas, Los Nevados, Nevado del Huila, Purace, and Sumapaz) (Fig. 4). The area of suitable habitat for the tapir inside the National Parks is 1874 km², or 13% of the total area where tapirs are still found.

Total population size

The present total population size of the mountain tapir in Colombia is estimated between 2451 and 2611 individuals. These numbers represent only 19% of the past population size if all montane forests where the species could occur. Of the present population size, only 13% occur within National Parks (Table 2).

DISCUSION

Past vs. present distribution

The habitat of the mountain tapir (montane rain forests and paramos between 2000 and 4000 m) has reduced by 81%.

This reduction was mostly due to the conversion of native forests to plantations (i.e. coffee) between 1750 and 1850, and to open grasslands (i.e. *Penisetum clandestinum*) for high altitude cattle ranching during the twentieth century (Etter & Van Wyngaerden, 2000).

Besides destruction of the natural habitat of the tapirs, other factors seem to have played a role in the reduction of sites where the species could occur. First, many of the isolated forest patches that remain in the central and eastern Cordillera are probably too small to sustain a viable population (Boyce, 1992). Second, it is well known that hunting can cause local extinction of large mammals (Bodmer *et al.*, 1997). Hunting was the cause of the local extinctions of the populations in Antioquia in the northern part of the Central Andes (D. Lizcano field interviews), and could have been the cause of the tapir disappearance at 2500 m in Santander reported by Allen at the beginning of the twentieth century. (Hershkovitz, 1954). Hunting also could have eradicated tapir populations in forest patches in the central Cordillera north of Parque Nacional los Nevados, and in the eastern Cordillera north of Bogota (grey areas in Fig. 4). It is interesting to observe that although all geographical locations and towns in the high planes of Cundinamarca and Boyacá (north of Bogotá) have indigenous names (i.e. Zipaquirá, Choachí), there are no geographical locations with the name ‘tapir’ or ‘danta’, no bibliographic references on the species, and no recollection of the existence of tapirs in the past. This is probably because

Table 2 Protected areas in the Andes of Colombia with the total area and the area that has mountain tapirs

Number	Protected area (National Parks)	Total area (km ²)	Tapir area (km ²)
1	Otun Quimbaya	5	0
2	Estoraques	6	0
3	Isla Corota	0.08	0
4	Iguaque	67	0
5	Galeras	76	0
6	Guaneta alto rio Fonce	104	0
7	Cueva de los Guacharos	90	87
8	Macuira	250	0
9	Orquídeas	320	0
10	Pisba	450	0
11	Munchique	440	0
12	Chingaza	533	0
13	Tama	519	0
14	Tatama	519	0
16	Los Nevados	583	59
17	Purace	1580	249
18	Nevado del Huila	830	460
19	Las Hermosas	1250	236
20	Catatumbo Bari	1582	0
21	Farallones de Cali	1500	0
22	Sumapaz	830	599
22	Sumapaz	1540	0
23	Cordillera de los Picachos	4390	184
24	Cocuy	3060	0
25	Sierra Nevada de Santa Marta	3830	0
26	Paramillo	4600	0
27	Macarena	6292	0
Total		35246	1874

of the long-term occurrence of pre-Columbian indigenous tribes (Muiscas and Chibchas) in this part of the country.

The mountain tapir is apparently not present in the western Cordillera. With one exception in the northern most part of the Cordillera (a stream that was named in the lowlands and begins above 2000 m), there are no geographical locations with the name 'tapir' or 'danta', no bibliographic references on the species, nor any recollection of the occurrence of the species in this branch of the Andes. Our best explanation as to the absence of the species in areas where there is otherwise suitable habitat, is geographical isolation. The montane rain forests and paramos (2000–4000 m) are surrounded by dry forests and the Rio Cauca on the east, moist and wet lowland forests on the north and west, and the low and dry valley of the Rio Patia canyon. It is possible that the Central American species of tapir (*T. bairdii*), present in the moist and wet forest of the Chocó region (Hershkovitz, 1954), penetrates into the Cordillera through some of the numerous streams and rivers that drain the western flank of the western Cordillera.

The mountain tapir is not present in isolated mountain peaks like the Sierra Nevada de Santa Marta, Cerro Tacarcuna (Chocó) or Serranía de la Macarena. In these isolated mountains, the Amazonian tapir (*T. terrestris*), occurs in surrounding lowlands (Bodmer & Brooks, 1997).

Population size

According to our estimates, there are approximately 2500 tapirs in the Andes of Colombia. This number comes from the assumption that wherever the mountain tapir still exists, the density is the same as in the Parque Regional Ucumari and Los Nevados National Park where we obtained density estimates using multivariate analysis of foot prints (1/551 ha; Lizcano & Cavelier, 2000) or in Sangai National Park in Ecuador where C. Downer estimated tapir density using radio-tracking data (1 ind/587 ha; Downer, 1996). The population densities for the mountain tapir are smaller than those of the other species of tapirs (1 ind/166–476 ha for *T. bairdii* and 1 ind/156–250 ha for *T. terrestris*; Lizcano & Cavelier, 2000) and is probably because of the lower productivity of the montane forests compared with forests in the lowlands. Because the populations in areas outside National Parks are likely to be lower due to hunting and variable carrying capacity of various habitats within the montane forest (i.e. areas without salt licks, very steep and long slopes subject to landslides), the estimation of present population size in Colombia should be considered a best case scenario. This number should be used as a working hypothesis and as a clear indicator that the status of the species is indeed 'Endangered' (IUCN, 1996). The distribution and population status in the remaining montane forests of Ecuador and northern Peru, is unknown.

The population size of the mountain tapir in Colombia would have a maximum of approximately 2500 individuals. If we accept that a total population (N) of 1500–5000 individuals is the minimum population size required to maintain long-term genetic variability (Frankham, 1995;

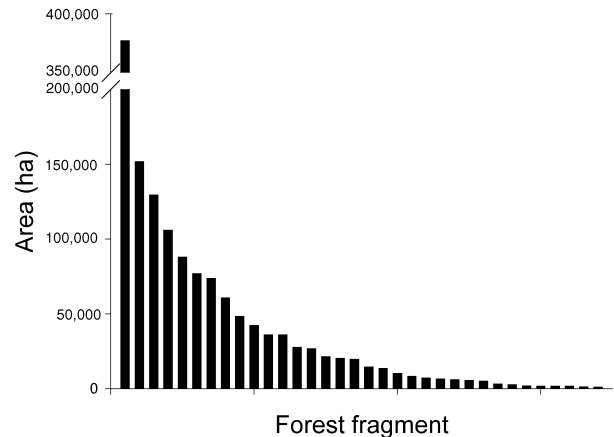


Figure 5 Size of the remaining forest fragments where the tapir currently occurs. Five fragments of < 1000 km² were not included in the graph.

Franklin & Frankham, 1998), then the mountain tapir should have a good chance of survival. Nevertheless, this population is not interconnected, but scattered in isolated populations that range in size from an average of 1 (patches of 5 km²) to 684 individuals (patch of 3700 km²; Fig. 5). Under these circumstances, smaller populations of 150 individuals would be viable on a short-term basis (Frankham, 1995). We found only five to six patches that are the minimum necessary size (826 km²) to maintain 150 individuals. The remaining forest patches are too small to maintain a genetically viable population, even in the short term. These patches could play an important role in the conservation of the species if they are connected (via corridors) to larger patches. Alternatively, individuals in very isolated forest patches could be relocated to larger patches. Currently, none of the National Parks could maintain even a viable populations in the short term.

Although these results may be used by conservation biologists to create a plan of action to conserve *T. pinchaque*, it is unlikely that any plan relying only on increasing patch size would work. Under the current circumstances, demographics and genetics play less of a role in driving the species to extinction than do the combined effect of destruction of natural habitat and hunting. The populations most threatened are those of the Central Cordillera between P.N. Las Hermosas and P.N. Nevado del Huila, where large tracks of mature montane forests are being converted to opium fields (Cavelier & Etter, 1995; Cooper-Ramo, 2001). Future conservation efforts should concentrate on reducing hunting, habitat destruction and the restoration of natural habitat.

ACKNOWLEDGMENTS

This research was carried out with the financial support of the Wildlife Conservation Society, Fundación para la Promoción de la Investigación y la Tecnología, Corporación Autónoma Regional del Tolima and Universidad de los Andes, Bogotá. Thanks to the Heads of UMATAS for

answering the interviews, to Alonso Quevedo and Robinson Lasso for assistance in the field, and to Eric Sanderson for technical support and training with GIS. Sarah LaPlante provided useful editorial comments on the final draft.

REFERENCES

- Ashley, M.V., Norman, J.E. & Stross, L. (1996) Phylogenetic analysis of the perissodactylan family Tapiridae using mitochondrial cytochrome *c* oxidase (COII) sequences. *Journal of Mammalian Evolution*, **3**, 315–326.
- Bodmer, R.E. & Brooks, D.M. (1997) Status and action plan of the lowland Tapir (*Tapirus terrestris*). *Tapirs, status survey and conservation action plan* (eds D.M. Brooks, R.E. Bodmer and S. Matola), pp. 46–56. IUCN/SSC Tapir specialist group, IUCN, Gland, Switzerland and Cambridge, UK.
- Bodmer, R.E., Eisenberg, J.F. & Redford, K.H. (1997) Hunting and the likelihood of extinction of Amazonian mammals. *Conservation Biology*, **11**, 460–466.
- Boyce, M.S. (1992) Population viability analysis. *Annual Review of Ecology and Systematics*, **23**, 481–506.
- Cooper-Ramo, J. (2001) America's shadow drug war. *TIME*, **157**, 12–18.
- Downer, C.C. (1996) The mountain tapir, endangered 'flagship' species of the high Andes. *Oryx*, **30**, 45–58.
- Downer, C.C. (1997) Status and action plan of the mountain Tapir (*Tapirus pinchaque*). *Tapirs, status survey and conservation action plan* (eds D.M. Brooks, R.E. Bodmer and S. Matola), pp. 10–22. IUCN/SSC Tapir specialist group, IUCN, Gland, Switzerland and Cambridge, UK.
- Etter, A. & Van Wyngaarden, W. (2000) Patterns of landscape transformation in Colombia, with emphasis in the andean region. *Ambio*, **29**, 432–439.
- Frankham, R. (1995) Effective population size/adult population size ratios in wildlife: a review. *Genetical Research*, **66**, 95–107.
- Franklin, I.R. & Frankham, R. (1998) How large must population be to retain evolutionary potential? *Animal Conservation*, **1**, 69–107.
- Frison, G.C. (1998) Paleoindian large mammal hunters on the plains of North America. *Proceedings of the National Academy of Sciences of the United States of America*, **95**, 14,576–14,583.
- Hershkovitz, P. (1954) Mammals of northern Colombia, preliminary report no. 7: Tapirs (genus *Tapirus*), with a systematic review of American species. *Proceedings of the United States National Museum*, **103**, 465–496.
- Holbrook, L.T. (1999) The Phylogeny and classification of tapiromorph perissodactyls (Mammalia). *Cladistics*, **15**, 331–350.
- IAvH (2000) *Ecosistemas Naturales de la Cordillera Oriental (1:1 000 000 scale, Transverse Mercator Projection)*. Alexander von Humboldt Institute, Bogota.
- IDEAM (1996) *Vegetation cover and land use 'coberturas vegetales uso y ocupación del espacio' (1:100 000 Scale, Transverse Mercator Projection)*. Instituto de Hidrología Meteorología y Estudios Ambientales, Bogota.
- IGAC (1996) *Geographic dictionary of Colombia, CD-ROM edition*. Agustín Codazzi National Geographic Institute, Bogota.
- IGAC (1999) *Digital map of municipalities of Colombia (1:1 500 000 scale, Transverse Mercator Projection)*. Agustín Codazzi National Geographic Institute, Bogota.
- IUCN (1996) *IUCN Red list of threatened animals*. IUCN, Gland, Switzerland and Cambridge, UK.
- Janis, C. (1984) Tapirs as living fossils. *Living fossils* (eds N. Eldrege and S.M. Stanley), pp. 80–86. Springer-Verlag, New York.
- Lizcano, D.J. & Cavelier, J. (2000) Densidad poblacional y disponibilidad de habitat de la danta de montaña (*Tapirus pinchaque*) en los andes centrales de Colombia. *Biotropica*, **31**, 165–173.
- Prothero, D.R. & Schoch, R.M. (1989) Origin and evolution of the perissodactyla: summary and synthesis. *The evolution of perissodactyls* (eds D.R. Prothero and R.M. Schoch), pp. 504–529. Oxford University Press, New York.
- Schauenberg, P. (1969) Contribution à l'étude du Tapir pinchaque, *Tapirus pinchaque* Roulin 1829. *Revue Suisse de Zoologie*, **76**, 211–256.
- Schoch, R.M. (1989) A review of tapiroids. *The evolution of perissodactyls* (eds D.R. Prothero and R.M. Schoch), pp. 298–320. Oxford University Press, New York.
- Semple, K. (2000) A habitat held hostage (FARC guerrillas drive out researchers). *Audubon*, **102**, 82–103.
- Van der Hammen, T. (1982) Paleoeecology of tropical South America. *Biology diversification in the tropics* (ed. G.T. Prance), pp. 60–67. Columbia University Press, New York.
- Velasco, E. (1991) *Distribución y uso de la fauna paramuna en los departamentos del Valle y Cauca, Colombia*. MSc Thesis, Universidad Nacional, Heredia, Costa Rica.

BIOSKETCHES

D. Lizcano, V. Pizarro and J. Carmona were undergraduate students at University of the Andes, Bogotá. After graduation, D. Lizcano continued working on the biology and ecology of the mountain tapir and published a series of papers on the subject. He is currently a Ph.D. student at the University of Kent, UK. V. Pizarro is completing a M.Sc. and J. Carmona moved to the US. J. Cavelier is a Ph.D. from Cambridge University and worked as an associate professor in Colombia for the last ten years. During this time he combined teaching and research on tropical ecology. With 15 years of experience on the ecology of the terrestrial ecosystems of Colombia, particularly on montane rain forests, he recently moved to Washington DC where he currently works for the World Wildlife Fund.