TAPIR SPECIALIST GROUP

ISSN 1813-2286
Volume 22 • No. 31
December 2013

TAPIR CONSERVATION

The Newsletter of the IUCN/SSC Tapir Specialist Group *www.tapirs.org*

HOUSTON ZOO NATURALLY WILD

Printing and distribution of the Tapir Conservation Newsletter is supported by the Houston Zoo Inc.,
1513 N. Mac Gregor, Houston, Texas 77030, United States, http://www.houstonzoo.org

CONTENTS

Volume 22 ■ No. 31 ■ Dec 2013

TAPIR CONSERVATION

Abbreviation **Tapir Cons.**

ISSN **1813-2286**

Website www.tapirs.org

Production & Distribution This issue is kindly sponsored by Houston Zoo Inc., Kelly Russo, 1513 North Mac Gregor, Houston, Texas 77030, USA.

Cover photo: Lowland tapir at the Vienna Zoo by Daniel Zupanc

FROM THE CHAIR

Here we are with another excellent issue of Tapir Conservation!

As you all know, the IUCN/SSC-affiliated Tapir Specialist Group is a global group of tapir conservationists dedicated to conserving tapirs and their habitat through strategic action-planning in countries where tapirs live, information sharing, and through educational and communication outreach that demonstrates the importance of tapirs to local ecosystems and to the world at large.

Our group continues to grow stronger and more effective each year and I would like to give you a brief update about our most important activities and outcomes in 2013.

The TSG continued to make steady progress on the development of National Action Plans for Tapir Conservation in several tapir range countries in South and Central America and Southeast Asia. TSG Country Coordinators and Regional Committees are working tirelessly towards developing their plans and implementing the priority actions and goals developed for each plan.

Several tapir conservation initiatives around the world made significant progress in 2013. Our TSG Country Coordinator for Nicaragua - Christopher Jordan - is expanding his work in that country and establishing a large, long-term conservation program focused on Baird's tapirs. Christopher is working in several different fronts including research (he is getting ready to capture and radio-collar tapirs), threat mitigation, in particular hunting, education and outreach. Our members in Ecuador - including Armando Castellanos, Andrés Tapia Arias, Fernando Nogales, Juan Pablo Reyes, Carlos Urgilés and many others - continue to work tirelessly to gather information about tapirs in that country, particularly mountain tapirs. Carl Traeholt (Malaysia), Wilson Novarino (Indonesia) and Nay Myo Shwe (Myanmar) continue to work hard on researching and developing strategies for the conservation of Malayan tapirs in Southeast Asia. Here in Brazil, the work of the Lowland Tapir Conservation Initiative (coordinated by me) continues to expand and grow stronger and another project based in the Atlantic Forests of Espírito Santo State (Pró-Tapir) has just captured and radio-collared their first tapir! All very exciting news coming from the field!!!

During 2013, we made significant progress on the review and update of several of our publications, particularly the TSG Field Veterinary Manual. This Manual is the single most important document developed by the TSG, and thousands of people have downloaded the manual from our website and used it widely. The new version of the Manual will be launched and made available online in early February 2014.

The TSG is well on its way on the implementation

Figure 1. Christopher Jordan scratching a baby tapir down for the team veterinarian, Dr. Eduardo Sacasa, to assess her health. This tapir was held illegally as a pet in rural Nicaragua and is now in good health in a rescue center.


Figure 2. Renata Santos, wildlife veterinarian working with the Lowland Tapir Conservation Initiative in Brazil and one of the editors of the new version of the TSG Field Veterinary Manual

of the TSG Strategic Plan 2012-2014, which includes 18 prioritized goals and 53 actions. A new 3-year Strategic Plan will be developed during the Sixth International Tapir Symposium to be held in Brazil in November 2014.

As I mentioned before, the symposium will be held in Campo Grande, capital of Mato Grosso do Sul State, in the central part of Brazil, where I live and work. We have set the dates for the conference: 17-20 November, 2014, with participants arriving on the 16th and departing on the 21st. We are currently working on the local logistics of the conference here in Campo Grande and we have started our fundraising campaign. I have attended all the major zoo association conferences in 2013, including ALPZA, AZA, EAZA and WAZA and through presentations and networking we have managed to approach dozens of tapir holding zoos worldwide which are now excited to support our conference.

I would like to use this opportunity to thank the AZA Tapir Taxon Advisory Group and the EAZA Tapir Taxon Advisory Group, as well as the Copenhagen Zoo in Denmark and the Houston Zoo in the United States, for their continuous support of our TSG activities. We would not be able to do much without the support from these incredible organizations! Thank you so much!

We are all looking forward to meeting you in Brazil next year!!!

Best from Brazil,

Patrícia Medici
Chair, IUCN/SSC Tapir Specialist Group (TSG)

CONSERVATION

Camera-trap Records of Mountain Tapir in Puracé National Park, Colombia

Sebastián Duque López[1,2], **Melissa Abud**[1,3], **Humberto Calero Mejia**[1,4] and **Stephany Valderrama**[1,5]

[1]Universidad del Valle, Fundación Samanea, Cali, Colombia.
[2]Email: gaiacarryon@gmail.com
[3]Email: restauracionpacifico@gmail.com
[4]Email: humcame@gmail.com
[5]Email: svalderrama4@gmail.com

Introduction

Mountain tapir (*Tapirus pinchaque*, Roulin 1829) is one of the four species that represent the Tapiridae family in the world. It is distributed in the Ecuadorian, Peruvian and Colombian Andes (Lizcano *et al*. 2006). It is currently classified as an endangered species by the IUCN Red List (Lizcano *et al*. 2006) and gaps in population ecology and natural history still exist (Lizcano *et al*. 2005). The gathering of information contributing to the local management of mountain tapir populations is essential.

Puracé National Park (PNP) is a protected area located in a massif where the Central and Eastern Andes Mountains of Colombia merge (Lizcano *et al*. 2002). Mountain tapirs have been reported in the PNP by several studies describing footprints, browsing, scats and fortuitous sightings (Sandoval 2004, Sanchez 2005, Abud 2010, Hernández-Guzmán *et al*. 2010). Studies have described vegetation of the mountain tapir habitat and some plants found in its diet (Sanchez 2005, Acosta & Ramirez 2006, Diaz 2008, Abud 2010).

The main threats to the species are habitat loss due to livestock and agriculture (Sandoval 2004, Sanchez 2005). Through camera-trapping approach we have updated the records of the mountain tapir and reported daily activity and capture frequency for the area. Based on our observations, we proposed useful body traits for individual identification. Additional records of other mammals are also reported.

Materials and methods

The study was carried out within the PNP – Cusiyaco Lagoon (1°54'52"N - 76°37'30.90"W) in the southern part of the protected area, at an altitude between 3200 and 3400 meters (Figure 1). Temperature ranges between 3 and 18 °C and rainfall between 1200 and 2500 mm per year. The ecosystem is classified as an ecotone between high-Andean forest and paramo (Amaya *et al*. 2007).

Twelve cameras were deployed in singular-camera stations during September-December 2010 (87 days). Camera traps consisted of heat-in motion digital cameras (Cuddeback Capture model). The distance between each camera was 350 m, which is half of the radius of the mountain tapir's home range estimated by Lizcano & Cavelier (2004). Camera batteries and memory cards were changed between 20-30 days. After the first month, six cameras were moved to enlarge the sampling area (Figure 1).

Camera trap station locations were chosen based on the existence of a tapir path with footprints, scats, evidence of browsing, and the proximity to streams. The photographs were classified with the help of local mammalogists, guides and available geographical distribution for the species. Mountain tapir photographs were classified as independent events following the O'Brien *et al*. (2003) criteria. Capture frequency relative to sampling effort and daily activity were estimated using the independent events.

We selected the right flank of the mountain tapir for individual identification because of the large proportion of photos including this side of the animal.

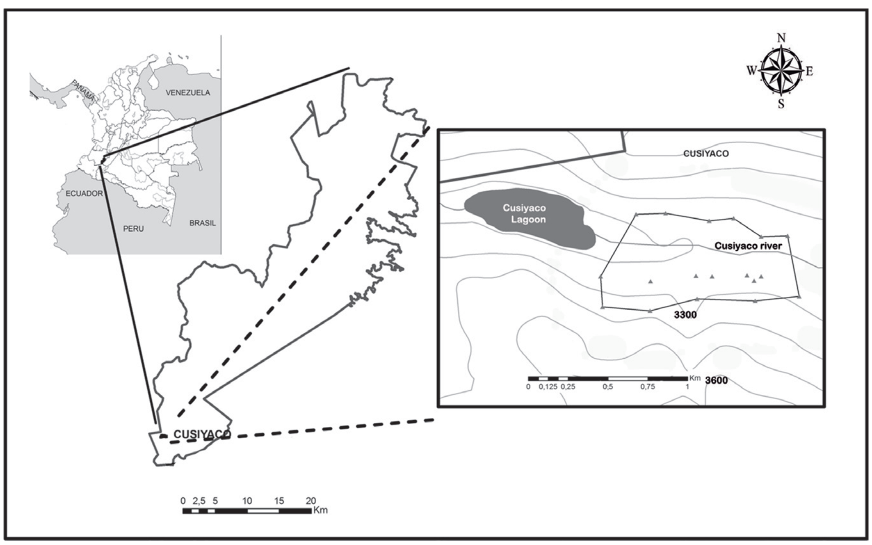

Figure 1. Puracé National Park (PNP) location in Colombia. Close up box shows the sampling area (solid black line) and the camera-trapping stations (triangles).

Figure 2. Mammals photographed by camera-traps in the Cusiyaco Lagoon, Puracé National Park. Mountain tapir (above left), cougar (above right), spectacled bear (below left) and little red brocket deer (below right).

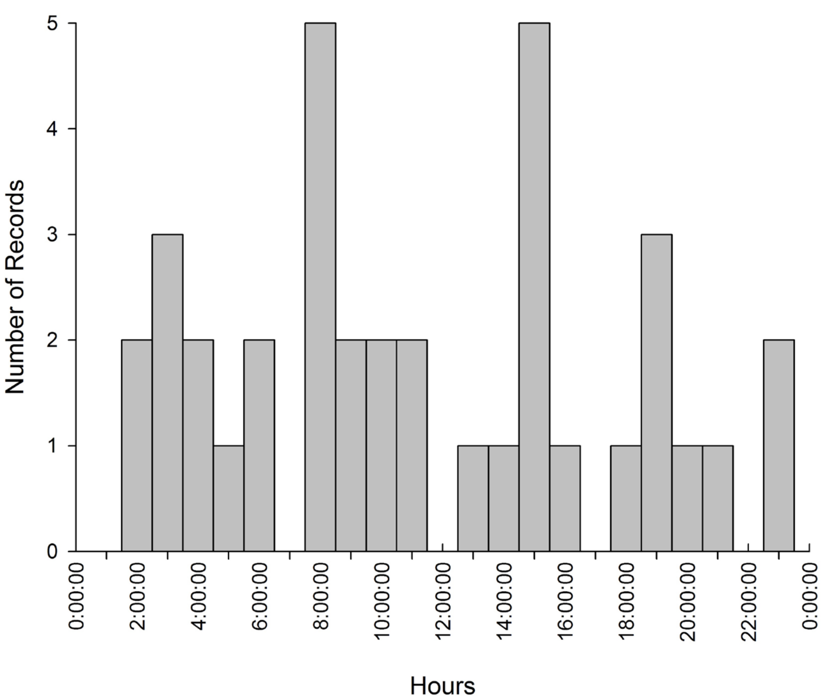

Figure 3. Frequency of mountain tapir records at different times of the day.

We compared body traits such as the swirls of hair on the snout, the presence or absence of white spots on the top of the earlobe, scars and necklines. Photographs were de-saturated and traits were overexposed as proposed by Traeholt & bin Mohamed (2009) to enhance individual identification.

Results and Discussion

A total of 100 photographs were taken from an overall effort of 982 camera nights. We found eight photos (8%) corresponding to human, eight false triggers (8%) and 84 (84%) wildlife recordings belonging to six mammal species and one unidentified species due to the bad quality of the photograph (Table 1). These records suggest an area of relatively high ecological integrity, and thus of high conservation value (Figure 2).

Paramo and Andean forests of Cusiyaco have a complex structure and composition of vegetation, making it suitable habitat for mountain tapirs and other species. The park rangers' monitoring program also reports this site as a foraging point for mountain tapirs (Amaya *et al*. 2010). Furthermore, the Cusiyaco area and its surroundings are able to provide food resources for cougars (Hernandez-Guzmán 2010). Thus, the south of the PNP could be strategic for mountain tapir conservation due to its high connectivity with other forest tracts and national parks where the species still occurs (Lizcano *et al*. 2002).

The most frequent species in our camera-traps was the mountain tapir with 57 photos (68% of the wildlife). Overall, 37 independent records of tapir were recognized, which allowed us to estimate a capture frequency of 3.7 individuals/100 cam-night. This was quite similar to Baird's tapir (*Tapirus bairdii*) in a montane site called "Valle del Silencio" within La Amistad National Park with 3.6 individuals/100 camera-nights (González-Maya *et al*. 2009). The authors of that survey associated the high frequency of tapirs at "Valle del Silencio" with the lower disturbance (poaching and tourist visits) in comparison to other accessible sampling in their study area.

We recorded mountain tapirs throughout the day. The most frequently recorded hours were 08:00 and 15:00, both with five records.

Table 1. Occurrence of wildlife from photo recordings of camera-traps.

Species	Number of Photos	Number of Stations with Photos	IUCN Category
Mountain Tapir (*Tapirus pinchaque*)	57	11	EN
Little Red Brocket Deer (*Mazama rufina*)	10	7	VU
Spectacled Bear (*Tremarctos ornatus*)	8	5	VU
Cougar (*Puma concolor*)	4	4	LC
Mountain Coati (*Nasuella olivacea*)	2	2	DD
Tapeti (*Sylvilagus brasiliensis*)	2	2	LC

At other times, we saw between one to three records per hour (Figure 3). These results were consistent with Downer (1996), who found activity peaks between 15:00 - 21:00 and 06:00 - 09:00. The data is also consistent with Lizcano & Cavelier (2004) who found that the daily activity of a male adult was related to the environmental temperature with a reduction of activity at noon and nightfall.

Identifying individuals was challenging in some pictures because they were dark or were taken under foggy conditions. When there was sufficient light, however, we found a number of useful traits to identify individuals. The tips of the earlobes were helpful because both of them are observable from the right flank. However, light reflection caused by sunbeams on the fur or the camera flash can make it challenging to identify presence/absence of the characteristic white spot.

Hair swirls on the snout were stronger criteria for identification, showing singular patterns in every

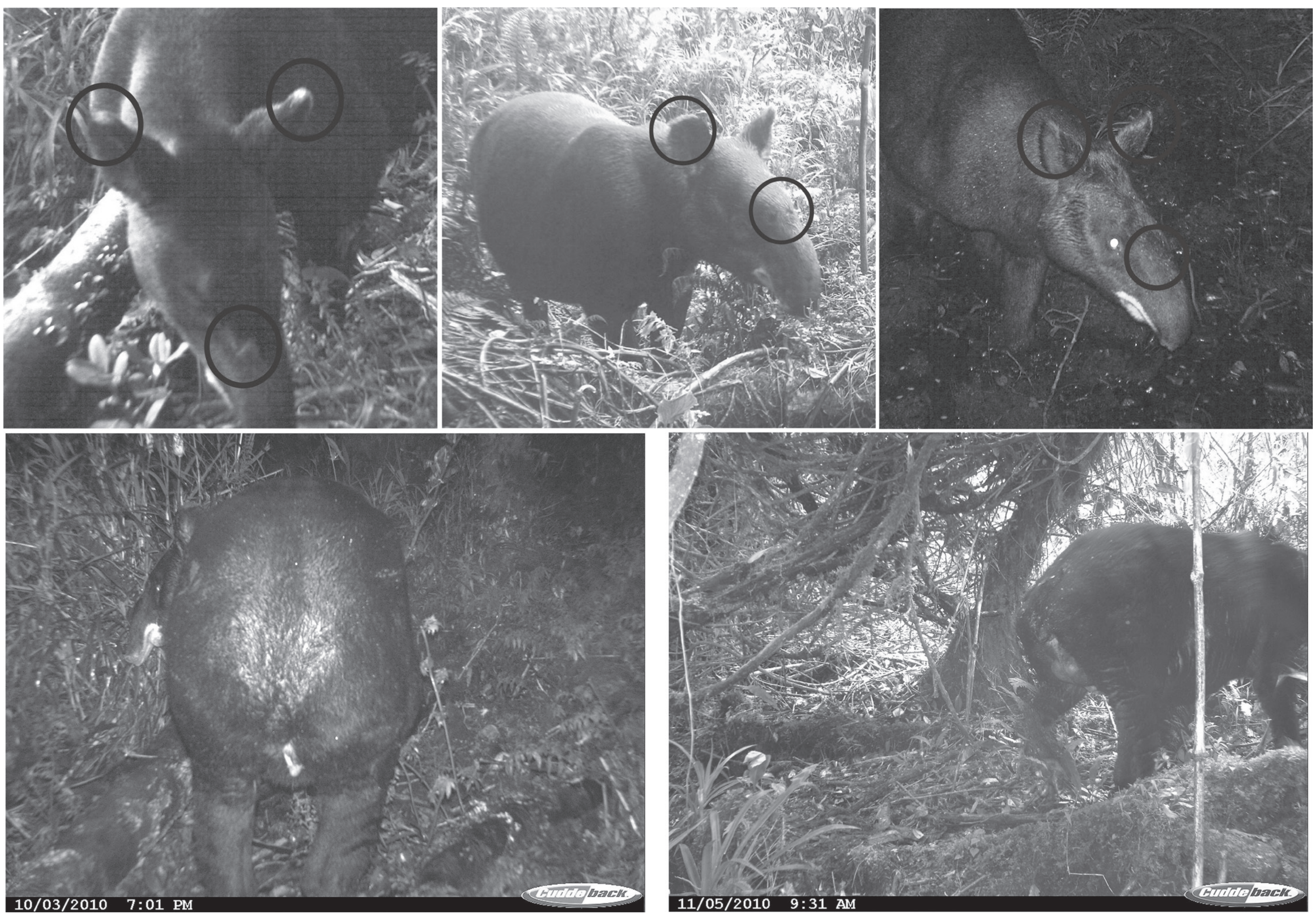

Figure 4. Top images show body traits useful for individual identification of mountain tapir in the Cusiyaco Lagoon. The left one was characterized by white tip ears and a zig-zag mark in the snout. The middle one shows black tip ears and a two circular hair swirls on the snout. The right one shows an individual identified by black tip ears and hair swirl between the eyes. Bottom images show a female (left) and a male (right).

picture, some of them consistent in various records and confirmed by earlobe tips and other marks such as scars (Figure 4). Scars, on the other hand, were difficult to observe due to the species' dense fur, especially when the animals were wet. Necklines were highly variable depending on the camera flashlight, even when the image was over-exposed.

There are no reports in the literature on useful features for recognition of mountain tapir individuals in photographs before this study. Additional characteristics such as spots on the face, stomach and on the tail were useful in the individual identification of lowland tapir (*Tapirus terrestris*) in the Chaco (Noss *et al*. 2003). However we were unable to use the same traits in mountain tapirs. Finally, we were able to identify a male and a female from photographs of the back. But we were unable to assign them back to an individual, as their right flanks were not clearly visible from this angle (Figure 4).

Our results suggest that the PNP in an important region for the conservation of mountain tapir and mammals of the Northern Andes. We strongly encourage continued research and conservation action in this area.

Acknowledgement

We thank the Conservation Leadership Programme (CLP) for the support, training and funding of this research. To Puracé National Park officers and park rangers for their support. To WCS Colombia, PANTHERA Colombia, Fundación Zoológica de Cali and Universidad del Valle, Professors Alba Marina Torres and Germán Corredor for their training and help in carrying out the camera-trapping survey.

References

Abud, M. 2010. Descripción de la vegetación consumida y caracterización del hábitat usado por la danta de montaña (*Tapirus pinchaque*) en un bosque altoandino, Parque Nacional Natural Puracé. B.Sc.Dissertation. Universidad del Valle, Cali, Colombia.

Acosta, S. P. & Ramírez, C. L. 2006. Informe preliminar de la relación entre elementos del hábitat y las actividades de la danta de montaña (*Tapirus pinchaque*) en un sector del PNN Puracé. Unpublished Report, Parque Nacional Natural Puracé, Popayán, Colombia.

Amaya. M.T. & A. L. Mosquera. 2010. Informe del monitoreo de mamíferos en el Parque Nacional Puracé. Manuscrito interno. 80p.

Diaz, L.T. 2008. Estudio de la dieta de *Tapirus pinchaque* en San Agustín – Huila como insumo para la liberación de "Poncho". Trabajo de pregrado para optar al título de Biólogo. Bogotá – Colombia, Pontificia Universidad Javeriana. 89p.

Downer, C. C. 1996. The mountain tapir, endangered "flagship" species of the high Andes. Oryx 30:45-58.

Downer, C. C. 2003. Ámbito hogareño y utilización de hábitat del tapir andino e ingreso de ganado en el parque nacional Sangay, Ecuador. Lyonia 4:31-34.

González-Maya, J., Schipper, J. & Rojas-Jiménez, K. 2009. Elevation distribution and abundance of Baird's tapir (*Tapirus bairdii*) at different protection areas in Talamanca region of Costa Rica. Tapir Conservation 18:29-35.

Hernández-Guzmán A., Payán, E. & Monroy-Vilchis O. 2011. Hábitos alimentarios del Puma concolor (Carnivora: Felidae) en el parque nacional natural Puracé. Revista de Biologia Tropical 59(3): 1285 -1294

Lizcano, D. J. & Cavelier, J.. 2000. Daily and seasonal activity of the mountain tapir (*Tapirus pinchaque*) in the Central Andes of Colombia. Journal of Zoology 252:429-435.

Lizcano, D. J. & Cavelier , J. 2004. Using GPS collars to study Mountain Tapirs (*Tapirus pinchaque*) in the Central Andes of Colombia. Tapir Conservation 13:18-23.

Lizcano, D., Guarnizo, A. Suarez, J. Florez F.K. & Montenegro, O. 2006. Danta de Páramo *Tapirus pinchaque*. In: J. V. Rodríguez-M., , M. Alberico., F. Trujillo & J. Jorgenson. (eds.). Libro rojo de los Mamíferos de Colombia. Conservación Internacional Colombia, Ministerio de Ambiente, Vivienda y Desarrollo Territorial, Bogotá, Colombia.

Lizcano, D. J., E. P. Medici, O. L. Montenegro, L. Carrillo, A. Camacho, & P. Miller. 2005. Mountain Tapir conservation workshop: final report. Tapir Specialist Group & IUCN/SSC Conservation Breeding Specialist Group, Apple Valley, MN, US.

Lizcano, D. J., Pizarro, V. Cavelier, J. & Carmona, J. 2002. Geographic Distribution and Population Size of the Mountain Tapir (*Tapirus pinchaque*) in Colombia. Journal of Biogeography 29:7-15.

Noss, A. J., Cuéllar, R. L., Barrientos, J., Maffei, L. Cuéllar, E., Arispe, R., Rúmiz, D. & K. Rivero. 2003. A camera trapping and radio telemetry study of Lowland Tapir (*Tapirus terrestris*) in Bolivian dry forests. Tapir Conservation 12:24-32.

O'brien, T. G.., Kinnaird, M. F. & Wibisono, H. T.. 2003. Crouching tigers, hidden prey: Sumatran tiger and prey populations in a tropical forest landscape. Animal Conservation 6:131-139.

Sánchez, F. 2005. Estudio preeliminar para la conservación de la danta de montaña (*Tapirus pinchaque*) en el municipio de Puracé, Corregimiento de Paletará, Cauca. Reporte final. Unpublished Report, CRC-CREA, Fundación Zoológica de Cali, Cali - Colombia.

Sandoval, S. 2005. Evaluación preliminar del estado poblacional de la danta de montaña en el sector norte del PNN Puracé, Cauca, Colombia. Proyecto Piloto, Unpublished Report. Fundación Zoológica de Cali, Cali - Colombia.

Traeholt, C. & bin Mohamed, M. S. 2009. Population estimates of Malay Tapir, *Tapirus indicus*, by camera trapping in Krau Wildlife Reserve, Malaysia. Tapir Conservation 18:12-20.

First Report of Positive Serological Response to the Hemoparasite, *Babesia caballi*, in Mountain Tapir

Armando X. Castellanos P.[1,2]

[1]IUCN/SSC Tapir Specialist Group, Ecuador.
[2]Andean Bear Foundation. Pasaje S24B, Oe5-142, La Isla, Quito, Ecuador. email:iznachi@gmail.com

Six mountain tapir (*Tapirus pinchaque*) were captured and fitted with Iridium / GPS collars for ecological research in Cayambe National Park, Ecuador (Castellanos, 2011). One of the wild tapirs captured in this study, named Dante, tested positive results for antibodies specific to the *Babesia caballi*, identified by Laboratorios Livex (Quito, Ecuador). This is the first report of positive serological response to this hemoparasite in the blood of this tapir species. This hemoparasite could have been transmitted by one of a great diversity of tick species identified by Pesquera *et al*. (2013) in the study area. It appears that Dante overcame the piroplasmosis caused by this hemoparasite and apparently has maintained a healthy condition; his movements were monitored for 259 days after taking the blood sample. A rescued semi captive mountain tapir calf, named Leo, in the Antisana Ecological Reserve (Gomez *et al*., 2013) was found to be infected with *Babesia sp*. hemoparasites (Fig 1). A second examination confirmed this infection and also identified the presence of *Anaplasma sp*. (Ortega, 2013). The University of Chiapas veterinarian Dr. Dario Marcelino Güiris (pers comm), however, believes that the diagnosis of anaplasmosis could actually be the presence of Howell-Jolly bodies in the bloodstream, for which he has recommended further analysis for confirmation.

Figure 1. Microscopic image of the blood sample obtained from Leo, the young Andean tapir (below left). On the right, some red blood cells infected with *Babesia sp*. (see yellow arrow).

As both animals in which the parasite was identified are still alive and purportedly doing well, perhaps the tapir serves as an asymptomatic host carrier for *Babesia spp*. and only immunosuppressed animals succumb from infection with these hemoparasites.

Transmission of diseases between tapirs and cattle has been previously documented (Medici *et al*., 2007). Pesquera (2013) identified bacteria of the genus *Anaplasma* and *Rickettsia* in our study area that pose a potential risk of transmission of diseases with important veterinary and public health consequences. Jessica Amanzo (pers comm) reported two episodes of foot and mouth disease in the north of Peru that killed mountain tapirs between 25 and 50 years ago. The likelihood of cross-infection is greatly increased by the encroachment of livestock grazing areas into tapir habitat, which could lead to increased mortality rates in tapirs.

The lack of information about diseases, parasites, vectors and microorganisms affecting the mountain tapir is alarming and requires further research to understand their effect on the tapir's health and population viability and contribute to management strategies.

References

Castellanos, A. (2011). Captura y marcaje de tapires andinos para monitoreo biológico en la cuenca del rio Papallacta, Napo, Ecuador. In Memorias de las XXXV Jornadas Nacionales de Biología y. I Congreso Ecuatoriano de Mastozoología. pp 209-210. Sociedad Ecuatoriana de Biología Núcleo de Pichincha, Pontificia Universidad Católica del Ecuador.

Gomez, L., Urcuango, R., Romero, A., Urgiles, C. & Gallo, F. (2013). Manejo semi-in situ de tapir de montaña (*Tapirus pinchaque*), en la localidad de Cuyuja, Reserva Ecológica Antisana. Primer Congreso Latinoamericano de Tapires- Segundo Congreso Ecuatoriano de Mastozoología, pp 109. Puyo Pastaza, Ecuador.

Medici, E.P., Mangini, P.R. & Sarria-Perea, J.A. (2007). Tapir Field Veterinary Manual (English, Spanish, Portuguese). IUCN/SSC Tapir Specialist Group (TSG). Available online in English, Portuguese and Spanish at www.tapirs.org.

Ortega, A. (2013). Caso Tapir de Montaña (*Tapirus pinchaque*) de Cuyuja. Informe no publicado. Hospital Docente Veterinario Universidad San Francisco, Fondo Tueri. Cumbaya, Ecuador.

Pesquera, C., Palomar, A.M., Portillo, A., Venzal ,J.M. & Oteo, J. A. (2013). Estudio de garrapatas de tapires Andinos, ganado bovino y vegetación, y de las bacterias que vinculan en un área protegida de Ecuador. Primer Congreso Latinoamericano de Tapires- Segundo Congreso Ecuatoriano de Mastozoología, pp 132-133. Puyo Pastaza, Ecuador.

Tapir Conservation Trundles Forward in Belize

Jamal Andrewin-Bohn[1]

[1]The Belize Zoo & Tropical Education Center,
P.O. Box 178, Belmopan, Belize, Central America,
education@belizezoo.org

It is safe to say that 2013 is the "Year of the Tapir" at The Belize Zoo & Tropical Education Center. As the institution enters its 30th year, it continues to strive to remain dynamic and consistent in its wildlife conservation work. Efforts focused on the Central American Tapir (*Tapirus bairdii*) are no exception.

These efforts began with the reimaging for a section of the Zoo, now designated as "Tapir Town." Here, visitors are able to view and interact with several of the resident tapirs at the Zoo, and appreciate new education signage and displays, aimed at building awareness about the natural history and biology of the tapir species, as well as the threats they face in Belize. These displays include an intact skeleton of an adult specimen on exhibit in a glass case, horse and tapir skull displays as a nod to their sister species, and several information boards drawing attention to wildlife-vehicle collisions.

Celso Poot, Operations Manager at The Belize Zoo, has been carrying out independent research on roadside ecology, focusing on the rising number of tapir fatalities by vehicular collisions. Following the documented deaths and body recoveries of tapirs between 2009-2012, Celso has been able to mark the collision points along the Burrel Boom road, a highly trafficked highway in the Belize District, and map them via satellite imagery. Through his work, we produced a large display banner mapping on a satellite image the points of tapir fatalities along the highway. The banner is now a part of the displays in "Tapir Town." A total of 13 tapirs are represented on the map, and that number continues to rise in 2013.

'Fuego' the orphaned C.American Tapir with Belize Zoo keeper, George Choc in May 2013.

In response to this alarming occurrence, and with approval and support from the Belizean Ministry of Works, "tapir crossing" road signs were erected at three major collision points, or "hot spots" on the Burrel Boom road. A replica of the "tapir crossing" sign was added to the "Tapir Town" section of the Zoo, accompanied by images of the roadside fatalities, and a message calling for motorists to be more aware of the potential for wildlife encounters on the highways.

Following the opening of "Tapir Town," were celebrations for National Tapir Day, on April 27th. A proposal from The Belize Zoo to establish National Tapir Day in Belize was received and approved by the office of the Belizean Prime Minister in 2012. Official celebrations are now carried out every April 27th at Zoo, to coincide with World Tapir Day. The objective is to involve parents and children in a day of education, awareness, and cultural pride, with the focal point being the National Animal of Belize, the tapir. Over 300 students, teachers and specially invited guests were in attendance for the 2013 celebrations. One key

Bumper sticker exhibiting slogan created by Belizean students to commemorate the 30TH birthday of 'April' the Central American Tapir

Timepiece photo used as centerpiece for 2013 National Tapir Day celebrations at The Belize Zoo.

celebration was that of the 30th birthday of "April" the tapir, who has been recognized as the oldest living female tapir in captivity. Her birthday celebration has been an annual event at the Zoo since 1983, and has proven to be invaluable in instilling understanding, appreciation and respect for her species in the Belizean people.

An important moment in the day's events was the unveiling of an enlarged double image of April as a calf in 1983, befriending Claire Gibson, a long time friend and supporter of the Zoo, next to an image of both April and Claire reuniting for the first time in 2013, several weeks before April's 30th . The image summarized the Zoo's mission for the past 30 years, which is to bring locals and visitors in touch with the native wildlife of Belize, and make the effect long lasting, and applicable to future generations.

Youth groups in attendance were given an opportunity to showcase their talent in honour of National Tapir Day, and added to the festivities with musical and athletic presentations, by a local high school steel band, and tumblers association, respectively. In addition, three young women from a primary school in the Cayo district were honoured for their contributions to a slogan competition that was run countrywide. Their submission was chosen to be added to the commemorative bumper sticker that was created for the event: *"30 Years of **A**ppreciation, **P**rotection, **R**espect, **I**ntegrity, and **L**ove: Happy 30th Birthday, **APRIL** the Tapir!"*

A new tapir conservation poster, funded by a grant awarded by the IUCN/SSC Tapir Specialist Group (TSG), was also issued to everyone in attendance. The Zoo's education department is now distributing the poster, along with the commemorative bumper sticker, and a children's book focused on "Tambo," a rescued tapir now living at the Zoo, to the over 300 registered schools in the country.

All these efforts received nationwide coverage by the three major media stations in the country, as well as through social media, and newspaper articles.

In May, The Belize Zoo saw the acquisition of an orphaned juvenile tapir, approximately 1-2 months in age. The calf was separated from its mother during a forest fire in the Cayo district; one of many that the nation saw throughout the months of March to May. The fires were, in many cases, reported to be intentionally and carelessly set by humans, and were so severe that health advisories were issued by the Belizean Ministry of Health.

The tapir calf was brought to the zoo by a concerned citizen, after he observed the calf alone for a full day, making distress calls by the side of a road. Due to the nature of his origin, the calf was named "Fuego," and will feature prominently in efforts to promote fire ecology education and responsible burning practices for the next dry season (December 2013-May 2014). The working slogan for the upcoming fire ecology efforts is "*No more Fuegos!*," calling for an end to unsustainable burning practices to help prevent other animals, like "Fuego," from becoming orphaned or killed due to wildfires.

One of two main activities for 2013 National Tapir Day at The Belize Zoo that showcased talented Belizean youth, a special performance by the Belize Tumblers Association

CONSERVATION MEDICINE

Identifying an Effective Treatment for Corneal Ulceration in Captive Tapirs

Mari-Ann O. Da Silva[1], Catalina Hermoza[2], Gianmarco Rojas[2], and J. Michelle Freundt[2,3]

[1] Centre for Zoo and Wild Animal Health, Copenhagen Zoo, Denmark
[2] Parque Zoológico Huachipa, Peru
[3] Email: michelle.freundt@gmail.com

Abstract

Captive tapirs often exhibit debilitating eye disease, frequently in the form of corneal ulcerations. Despite the fact that this is a well-known condition, only few treatments have been established for this disease in tapirs. Here we describe a treatment protocol that successfully treated corneal ulcers and prevented loss of eyesight in captive-held South American tapirs. Two female South American tapirs (*Tapirus terrestris*), held at Huachipa Zoological Park, were diagnosed with corneal ulcerations. They were treated with an eye gel containing deproteinized calf serum along with antibiotic eye drops. This is a treatment that has been validated in other animals and in humans. Improvement was visible already within 48 hours. Within one to two weeks, the ulcerations had disappeared.

Keywords: Cornea, eye, tapir, treatment, ulceration

Introduction

Case reports generated by various professionals associated with zoological institutions have described ocular lesions in birds, reptiles and mammals (Schmidt & Toft, 1981; Montiani-Ferreira, 2001). The pathologies most commonly diagnosed include cataracts, panophthalmitis, conjunctivitis, keratitis, retinal degeneration and microphthalmia (Schmidt & Toft, 1981).

Keratitis is frequently reported in captive held tapir species (*Tapiridae*) with ocular problems including the Malayan tapir (*Tapirus indicus*) and the South American tapir (*T. terrestris*) (Montiani-Ferreira, 2001). The affected eyes typically demonstrate corneal opacification and ulceration as well as conjunctival inflammation (Montiani-Ferreira, 2001). The lesions are thought to be most likely caused by trauma and aggravated by relative overexposure to UV light (Ramsay, 1993). This hypothesis is based on the observation that keratitis is found relatively infrequently in free-ranging tapirs that live in dense tropical jungles with little exposure to direct sunlight. On the other hand, virtually every affected captive individual is exposed to an excessive amount of sunlight (Ramsay, 1993). Regardless of cause, management of corneal diseases in captive wild mammals typically follows similar treatment protocols to those used in domesticated animals (Montiani-Ferreira, 2001).

This paper discusses the diagnosis and treatment of corneal ulcers in two captive-held South American tapirs.

Statement of the Problem

A six-year-old female South American tapir kept at the Huachipa Zoological Park was presented with a deep corneal ulceration of the right eye approximately six mm in diameter (Fig. 1A). Seven months later, another female tapir was seen to have a similar, but slightly smaller lesion also of the right eye. This ulcer was measured at four mm in diameter (Fig. 1B). Both animals showed clinical signs of excessive tear production in the affected eye. The first animal also displayed involuntary closing of the eyelids, indicating discomfort of the eye. A positive fluorescein test in both cases led to the diagnosis of a corneal ulcer. Based on the severity of the clinical signs, decisions were made to sedate the animals in order to perform a thorough eye examination. The tapirs were immobilized with ketamine (4mg/kg IM), dexmedetomidine (0.015 mg/kg

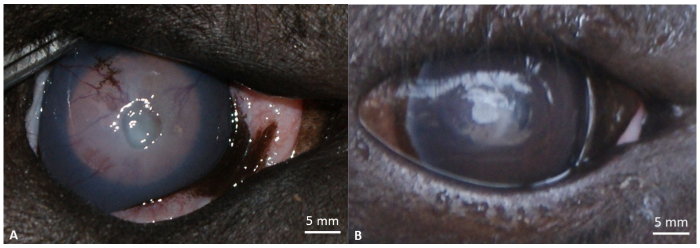

Figure 1. Corneal ulcer of the right eye of two *Tapirus terrestris*. A. Diameter of ulcer is approx. six mm. Note the neovascularization originating from the limbus and proceeding towards the lesion. B. Diameter of ulcer is approx. four mm and neovascularization is less evident.

IM) and midazolam (0.1 mg/kg IM). Once recumbent, the eyes were examined for further evaluation.

In both cases, assessment of the ocular surrounding structures was unremarkable. Slit lamp biomicroscopy demonstrated diffuse corneal edema with a central area of epithelial and stromal loss six mm in diameter in the first tapir and four mm in diameter in the second case. Fundoscopy revealed a retina with normal appearance. Fluorescein staining was positive and corneal stromal loss of approximately 50% in both animals. In the first, more severe case, superficial corneal neovascularization was present, but did not extend to the margins of the corneal defect.

Cytology and bacterial culture data from the first individual revealed the presence of *Pseudomonas aeruginosa*, an opportunistic pathogen of animal skin. This gram negative organism is naturally resistant to a wide range of antibiotics, and topically applied aminoglycosides such as gentamycin and tobramycin are the drugs of choice for treatment of the cornea. The bacterial culture of the second tapir was negative. As part of a standard ocular examination, intraocular structures were examined by the use of high frequency ultrasound (Accutome B-Scan imaging, probe frequency 15 MHz) with a gel stand-off. Anterior and posterior chambers were found to be free of apparent inflammatory or other changes.

Figure 2. A flexible endovenous catheter (Abbocat no. 22) with a tuberculin syringe used as a lavage system to allow easy application of topical eye medications to the surface of the eye.

Description of the Process

Treatment of the first animal consisted of topical ophthalmic solutions of tobramycin sulphate (Trazil Ofteno® 3 mg/ml) 1-2 drops every four hours, diclofenac sodium (3-A Ofteno 1 mg/ml) 1-2 drops every eight hours and deproteinized calf serum (Solcoseryl® Ophthalmic Gel 10%) 1 cm of gel every eight hours. When multiple treatments fell at the same time, five minutes separated the application of the various medications. The second individual was treated similarly with tobramycin sulphate and deproteinized calf serum. As the second animal did not show signs of pain or discomfort, diclofenac sodium was not prescribed.

Due to the difficulty in applying topical eye drops in an very vertically set eye, all solutions were applied through a flexible intravenous catheter (Abbocat no. 22) connected to a tuberculin syringe at the medial canthus (Fig. 2). The protocol was administered for a period of thirty days.

Animal training facilitated management and handling of the animals for application of the topical solutions and fluorescein testing. Furthermore, eye examinations were carried out every seven days. Due to the overall well-being of the animals, systemic treatments were not initiated.

In the first animal, discomfort and tear production decreased considerably after the first 48 hours of therapy. After the first week, the ulcer had diminished to approximately three mm in diameter based on fluorescein staining and slit lamp biomicroscopy. Corneal edema was limited to the area immediately surrounding the ulcer (Fig. 3). Two weeks following initiation of treatment, the fluorescein test was negative (Fig. 4) and the lesion was covered with epithelium. In the second animal, tear production similarly decreased after 48 hours of therapy and the ulcer was reduced by 50% in diameter following the initial week of treatment. After termination of medicinal treatment, the eyes received one drop of hypertonic saline (5%) twice daily for thirty days to eliminate the remaining corneal edema.

Evaluation of the Process

Corneal ulceration is one of the most commonly diagnosed ocular lesions in wild animals held in captivity (Montiani-Ferreira, 2001). The treatment success is highly dependent on establishing a correct protocol at an early stage. Failure to do so may result in corneal perforation and loss of vision or the eye. Ideally, before establishing an antimicrobial treatment protocol, ulcers should be assessed with cytology and/or culture to determine correct antibiotic use (Montiani-Ferreira, 2001).

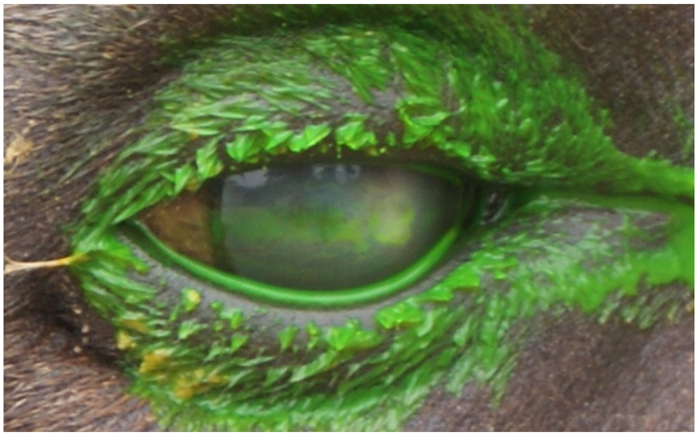

Figure 3. The eye of the first tapir a week after initiating treatment. Blood vessels in the cornea are still present but to a lesser extent. The cornea stains fluorescein positive in a horizontal band.

The use of calf serum is documented in human and domestic animal medicine in order to shorten recovery time and promote healing of the cornea especially when there is no response to conventional treatment (Egger *et al.*, 1999). In equine medicine, the treatment of corneal ulcers often consists of a combination of topical antibiotic and (often oral) analgesic/anti-inflammatory therapy combined with autologous serum (Brooks, 1999, 2002).

Ophthalmic gel containing deproteinized calf blood activates aerobic metabolism and oxidative phosphorylation thus increasing the intake of oxygen and glucose transport in metabolically weakened hypoxic cells (Al-Watban & Andres, 2001). Its use in the management of corneal ulceration is based on the same principles as the use of autologous serum. Serum improves reparation and regeneration of the corneal stroma by facilitating epithelialization: squamous metaplasia is diminished through the action of vitamin A; antiproteases such as alpha2 macroglobulin inhibit collagenase activity and substance P facilitates epithelial migration. The ophthalmic gel was chosen over autologous serum in these cases as it was readily at hand and positive results had been experienced when used as treatment of corneal ulcers in domestic animals. There have never been reports on the use of autologous serum for the treatment of corneal ulcers in tapirs. No irritation or other complications with the topical medications were observed.

These cases demonstrate the satisfactory inclusion in therapy of deproteinized calf blood extract in the management of corneal ulcers in captive wild animals, specifically two South American tapirs. Though it cannot be definitively determined if treatment expedited healing, the calf serum was well tolerated and the ulcerations healed well without complications. Deproteinized calf blood extract is presumed to act in this species similarly to that in humans and domestic animals.

Figure 4. The eye of the first tapir two weeks after diagnosis. The cornea remains clouded but is fluorescein negative, as the ulcer is now covered with epithelium.

Acknowledgements

The authors acknowledge the assistance of Lizette Bermudez of the Parque Zoológico Huachipa.

References

Al-Watban, F.A.H. & Andres, B.L. 2001. The effect of He-Ne laser and Solcoseryl™ in vitro. Lasers in Medical Science 16:267-275.

Brooks, D.E. 1999. Equine Ophthalmology. In: K.N. Gelatt (ed.) Veterinary Ophthalmology 3rd edition, pp.1053-1116. Lippincott, Williams & Wilkins, Philadelphia, USA.

Brooks, D.E. 2002. Proceedings of the American Association of Equine Practitioners 48:313-315.

Egger S.F., Huber-Spitzy, V., Alzner, E., Scholda, C. & Vecsei, V.P. 1999. Corneal wound healing after superficial foreign body injury: vitamin A and dexpanthenol versus a calf blood extract: a randomized double-blind study. Ophthalmologica 213:246-249.

Montiani-Ferreira, F. 2001. Ophthalmology. In: M.E. Fowler & Z.S. Cubas (eds.) Biology, Medicine and Surgery of South American Wild Animals, pp.437-456. Iowa State University Press, Iowa, USA.

Ramsay, E.C. 1993. Infectious diseases of the rhinoceros and tapir. In: M.E. Fowler (ed.) Zoo and Wild Animal Medicine, pp.459-466. WB Saunders Co, Philadelphia, USA.

Schmidt, R.E. & Toft II, J.D. 1981. Ophthalmic lesions in animals from a zoological collection. Journal of Wildlife Diseases 17:267-275.

Immobilization of Baird's Tapir (*Tapirus bairdii*) Using Thiafenthanil Oxalate (A-3080) in Combination with Xylazine and Ketamine

***Jonathan Pérez Flores*[1,2]**

[1] Africam Safari. km 16.5 Boulevard Capitán Carlos Camacho s/n, Valsequillo, Puebla. C.P. 72960.
E-mail: johnperez@africamsafari.com.mx
[2] El Colegio de la Frontera Sur. Av. Centenario km 5.5, Chetumal, Quintana Roo. C.P. 77014.
E-mail: jperez@ecosur.mx

Abstract

A wide variety of drug combinations have been used to immobilize captive and free ranging tapirs. Most of these anesthetic procedures combine opioids with alpha 2 agonists, cyclohexamines or neuroleptic agents. Thiafentanil oxalate (A3080) is a synthetic opioid that has been used in several species of non-domestic hoofstock. It´s effects have not been previously described on Baird´s Tapir (*Tapirus bairdii*). This study reports the use of a combination of thiafentanil oxalate (1 mg/100 kg), xylazine (1 mg/kg) and ketamine (0.5 mg/kg) (TXK) in two adult tapirs, and a combination of thiafentanil (1 mg/100 kg) and xylazine (0.70 mg/kg) (TX) in another adult tapir. The individuals receiving TXK were reversed with naltrexone (10 mg/mg thiafentanil) and yohimbine (0.125 mg/kg), while those receiving TX was reversed with naltrexone (10 mg/mg thiafentanil) and atipamezole (1 mg/10 mg xylazine). The induction time was 3-5 min, the recovery time was 4-5 min and the total time of anesthesia was 40-120 min. Physiological parameters are similar to those reported in studies that include opioids in the anesthetic protocol. The TX combination produced low oxygen saturation values that recquired suplemmentary oxygen. In conclusion, TXK and TX provided a fast and smooth induction and recovery time. Additionally TXK is an effective and safe option to immobilize wild and captive animals with poor body condition.

Keywords: A-3080, immobilization, opioids, Baird´s tapir, thiafentanil.

Introduction

Since 1960´s opioids have been used for immobilizing large and heavy animals. The three most commonly used in wildlife medicine are fentanyl, etorphine and carfentanil (Kreeger, 1997). These drugs have been combined with alpha-two agonists, butyrophenones, benzodiazepines, phenotiazines and cyclohexamines in order to reduce adverse effects (Caulkett *et al*., 2000; Ramdohr *et al*., 2001; Roffe *et al*., 2001; Miller *et al*., 2003; Lance, 2012). In the last 20 years thiafentanil oxalate (A-3080), a highly potent opioid, has demonstrated its efficacy to immobilize non-domestic hoofed species such as nyala (*Nyala angasii*; Cooper *et al*., 2005), impala (*Aepyceros melampus*; Janssen *et al*.,1991), greater kudu (*Tragelaphus strepsiceros*), African buffalo (*Syncerus caffer*), klipspringer (*Oreotragus oreotragus*), eland (*Taurotragus oryx*), waterbuck (*Kobus ellipsiprymnus*), elk (*Cervus canadiensis*), oribi (*Ourebia ourebi*), reedbuck (*Redunca sp*; Lance and Kenny, 2012), pronghorn (*Antilocapra americana*; Kreeger *et al*., 2001), Uganda kob (*Kobus kob thomasi*; Caulkett *et al*., 2006), mule deer (*Odocoileus hemionus*; Caulkett *et al*., 2006; Wolfe *et al*., 2004), Tibetan yak (*Bos grunniens*; Alcantar *et al*., 2007), Roan antelope (*Hippotragus equinus*; Citino *et al*., 2001), giraffe (*Giraffa camelopardalis*; Citino *et al*., 2006), gemsbok (*Oryx gazella*; Grobler *et al*., 2001), axis deer (*Axis axis*; Smith *et al*., 2005), Rocky Mountain elk (*Cervus elaphus nelsoni*; Stanley *et al*., 1988), rhebok (*Pelea caoreolus*; Howard *et al*., 2004), gaur (*Bos gaurus*; Napier *et al*., 2007) and Lichtenstein's hartebeest (*Sigmoceros lichtensteinii*; Citino *et al*., 2002).

The shortened induction time and the larger safety margin are the principal advantages of thiafentanil compared to other opiods (Lance and Kenny, 2012; Wolfe *et al*., 2004). However, when it is used as the sole agent, thiafentanil can induce muscle rigidity (Grobler *et al*., 2001). The combination of thiafentanil with alpha-two agonists and ketamine induces a good quality anesthesia with minimal disturbance of physiologic parameters, and improves muscle relaxation and analgesia (Grobler *et al*., 2001; Cittino *et al*, 2006). Although Lance (2012) mentioned that Perissodactyla remain refractory to this drug, the immobilization of rhinoceros in the field is becoming more common in Africa. In the case of tapirs, the effects of thiafentanil have not been previously described, and most anesthetic protocols for these species are based on opioids such as etorphine (Parás *et al*., 1996; Kreeger, 1997; Lambethh, 1998) carfentanil (Miller-Edge and Ansel, 1994), and butorphanol (Trim *et al*., 1998; Foerster *et al*., 2000; Velastin, 2004; Hernandez-Divers *et al*., 2005; Tobler *et al*., 2006; Bernal *et al*., 2008). The anesthetic protocol preferred may depend on where the animal is going to be capture, drug availability and the experience of the personnel who perform the immobilization. Here, we report data from four immobilizations of Baird´s tapir in Mexico using thiafentanil.

Figure 1. Intramuscular administration of the antagonists in the second immobilization at Payo Obispo zoo. Photo: Payo Obispo zoo

Materials and methods

The study was conducted at three different sites in Mexico. The first two immobilizations were realized at Payo Obispo Zoo in Chetumal, Quintana Roo (18º 31' 17.72" N and 88º 18' 9.73"W). An adult male (Total Body Weight, TBW= 161 kg) rescued from a fire in the locality of Nuevo Tabasco was brought to the facilities of the zoo for a clinical evaluation. The specimen was anesthetized twice in six months (June-December 2011). The third immobilization was done in the village of Emiliano Zapata, near Calakmul Biosphere Reserve (CBR), Campeche (18º 31' 16.92" N and 89º 40' 32.94" W). An adult male tied by the villagers (estimated weight 150kg) was translocated to the core area of the reserve. The last immobilization was made at Africam Safari zoo in Puebla (18º 56' 8.94" N and 98º 7' 59.69" W). An adult female (TBW= 212 kg) was immobilized for clinical examination.

The first three immobilizations were performed with a combination of thiafentanil A-3080 (1 mg/100 kg; Thianil, Wildlife Pharmaceuticals Inc., Fort Collins, Colorado,USA), xylazine (1 mg/kg; Cervizine, Wildlife Pharmaceuticals Inc., Fort Collins, Colorado,USA) and ketamine (0.5 mg/kg; various sources). This cocktail was delivered intramuscularly (IM) via single use, 3 ml darts shot from a CO2-powered rifle (Dan Inject). In all applications, A-3080 was antagonized with the use of naltrexone HCl (IM; 10 mg to every one mg of thiafentanil delivered; trexonil, Wildlife Pharmaceuticals Inc., Fort Collins, Colorado,USA), and xylazine was antagonized with yohimbine (IM; 0.125mg/kg; various sources).

For the last anesthethic procedure we used a combination of A-3080 (1 mg/100 kg) and xylazine (0.70 mg/kg; Procin Equus, Laboratorios PISA farmaceutica, Mexico). A-3080 was antagonized with the same dose of naltrexone used for the three previous cases, while xylazine was antagonized with atipamezole (1 mg to every 10 mg of xylazine delivered; Antisedan, Pfizer). The drugs were delivered IM, with a 3ml dart shot from a CO2-powered blow pipe (Dan Inject). We recorded induction time (period elapsed between injection and sternal recumbency), recovery

Table 1. Basic anesthetic parameters of four immobilizations of *Tapirus bairdii* with TXK and TX T=Thiafentanil; X=Xylazine; K=Ketamine; M=Male; F=Female

Average values	Payo Obispo (M) 1st Immobilization TXK	Payo Obispo (M) 2nd Immobilization TXK	Zapata (M) TXK	Africam Safari (F) TX
Induction time (min)	4	5	4	3
Total time of anesthesia (min)	106	94	120	40
Recovery time (min)	5	5	5	4
Body temperature (ºC)	36.9-37.9	36.2	33.4-37.8	37- 37.2
Respiration rate (bpm)	13-19	20-24	45536	43374
Heart Rate (bpm)	33-75	51-84	86-128	54-101
Oxygen saturation (%)	80-90	86-94	-	49-89

Table 2. Comparison of anesthetic parameters of different immobilizations using opioids T=Thiafentanil; X=Xylazine; K=Ketamine; C=Carfentanil; E=Etorphine; A=Acetylpromazine; D=Detomidine; AM= Acepromazine maleate; B=Butorphanol.

Average values	This study TXK	Miller *et al.*, 1994 CXK	Parás *et al.*, 1996 EA	Hernandez-Divers *et al.*,1998 BX	Pollock, 2003 DC	Lira *et al.*, 2008 EAM
Number of individuals (n)	3	6	5	16	1	4
Induction time (min)	3-5	5.5	3-6	5-34	3.5-18.35	3
Total time of immobilization (min)	40-120	106.3	40.5	13-60	10-20	60
Recovery time (min)	4-5	4.3	4	0-26	2-5	-
Body temperature (ºC)	36.2-37.9	-	37-37.4	35.5-38.6	36.4-37.2	-
Respiration rate (bpm)	10-24	13	12-27.5	8-50	12-15	-
Heart rate (bpm)	33-101	82.5	-	28-108	40-55	-

time (period elapsed between the administration of the antagonists and stand up), heart rate, respiration rate, rectal temperature and oxygen saturation.

Results

The first two immobilizations were performed in the same animal with the combination of TXK and reverted with naltrexone and yohimbine. The first time the individual was skinny, dehydrated, debilitated and not responsive. A clinical examination was necessary to determine the health status of the tapir. For the second immobilization the animal had gained 20 kg (TBW=170 kg), and the procedure was shorter (first 106 min and second 94 min). The induction time of the two events was 4-5 min, and the recovery time 5 min. Physiologic values were stable and no suplemmentary drugs were needed (Table 1).

Figure 2. Placing the pulse oximeter to monitor oxygen saturation and pulse from an immobilized tapir with TXK at Payo Obispo zoo. Photo: Payo Obispo zoo

The tapir immobilized at Emiliano Zapata presented a poor body condition and had been under a prologend period of stress (tied for 20 hrs), was anesthetised and reverted with the same doses described before. The induction time was 4 min and the recovery time 5 min. In this case the total elapsed time was longer (120 min), due to the translocation of the individual from the village to the core area of the Calakmul Biosphere Reserve (30 km in straight line). During the final minutes the animal began to make slight movements of the head. Once the reversal agents were administered, the individual stood up and walked away through the jungle, after 8 days of the immobilization, the radiocollared tapir was observed a few kilometers from the release point exhibiting normal behaviour.

In all the cases, TXK produced a safe and effective immobilization with minimum alterations of physiological parameters (heart rate, respiration rate and body temperature). For the last anesthethic procedure we used a TX combination. The induction time (3 min) and recovery time (4 min) were shorter than the other anesthetic events. Physiologic values were generally stable, although low oxygen saturation values sometimes occurred (49% to 89%; Table 1). After two hours of observation the individual behaviour was normal, no alterations or health problems were observed in subsequent eight weeks. Both anesthetic protocols allowed morphometric measures to be taken, as well as blood samples, swabs for microbiological analysis, tissue samples, fecal samples, collect ectoparasites and in the case of the translocated tapir, we also placed a radiocollar.

Discussion

One objective of this study was to evaluate the physiologic effects of this cocktail in Baird´s tapir. The combination of TXK shows to be effective for immobilizing captive and free-ranging tapirs. Compared with previous studies the combination of thiafentanil with an alpha 2 agonist and ketamine produced a good quality anesthesia with minimal disturbance of physiologic parameters (Citino *et al*., 2001; Grobler *et al*., 2001). Induction time was similar to those already reported when opioids were used in tapirs (Miller *et al*., 1994; Parás *et al*.,1996; Lira *et al*., 2008)(Table 2). This is one of the principal advantages that narcotics have in comparison to the combination of butorphanol with an alpha-2-adrenergic, and the combination of tiletamina-zolazepam with an alpha-2-adrenergic and atropine in which induction time is of 15 to 20 minutes (Foerster *et al*., 2000; Velastin *et al*., 2004; Hernandez-Divers *et al*., 2007). This characteristic is desirable in the anesthesia of free-ranging animals where habitat conditions are dangerous. In comparison with other protocols that present premature arousals and need the administration of supplementary drugs like ketamine (Foerster *et al*., 2000; Hernandez-Divers *et al*., 2007) this combination could be used for short and long immobilizations (total time of anesthesia 40-120 min) without the addition of supplementary drugs.

Lance and Kenny (2012) reported spontaneous recovery in Elk in 27 to 106 minutes from an initial dose of thiafentanil oxalate without the use of an antagonist. In the case of the tapir immobilized in Zapata, after 100 minutes of being administered the cocktail, the animal started to move its head and be more alert. This is likely due to a low dosage and the rapid absorption and fast metabolism of the components.

Recovery was quick and uneventful in all animals. The shorter recovery time (3 min) was associated with the use of atipamezole which is more potent and more selective than yohimbine (Kreeger *et al*., 1997). This is an important consideration when we are designing the anesthethic protocol for immobilizing tapirs in risky habitats, in our experience the combination of butorphanol and xylazine have a prolonged recovery time (15 min), which increases the risk of drowning, injury or predation. There are few reports on the immobilization of cachectic and underweight tapirs (Hernandez-Divers *et al*., 2005). In this study two animals presented poor physical condition, however immobilization produced by TXK demonstrated to be safe and adequate in these cases.

The use of opioids to immobilize free-ranging animals is common, they produce rapid induction, are fully reversible and have minimal disturbance of physiologic parameteres. In tapirs it´s use is controversial, Janssen (2003) mentioned that the poor oxygen saturation and the risk to personnel were the principal reasons for the decrease in the use of these narcotics. The combination of thiafentanil with other drugs appears to be an alternative for captive and free ranging tapirs, further studies are necessary to know all the physiologic effects of thiafentanil in all Perissodactyls.

Acknowledgements

This work was a collaboration between El Colegio de la Frontera Sur, University of Sherbrooke, Africam Safari Zoo and Payo Obispo Zoo. The author thanks to Ph D Sophie Calmé and Ph D Rafael Reyna for the early revisions of this work. I am very grateful with the capture team: Mauro Sanvicente, Nicolas Arias, Natalia Carrillo, Antonio Jasso and Marcos Briseño. Special thanks for the authorities of the Calakmul Biosphere Reserve especially Jose Zuñiga and Miguel Alvaro for substantial support in the case of Zapata. Thanks for all the personnel of Africam Safari and the Payo Obispo Zoo. I would also like to thank DVM Ivonne Cassaigne for the help and tips about immobilization.

References

Alcantar, B.E., McClean, M., Chirife, A.D., et al. 2007. Immobilization of Tibetan yak (*Bos gunnies*) using A3080 (Thiafentanil) and xylazine in a wildlife park. In Proceedings of the American Association of Zoo Veterinarians Conference. pp. 47-48.

Bernal, L.A., Orjuela-Acosta, D., Rodriguéz, A. and Lizcano, D.J. 2008. Chemical restraint, hematology and blood parasites of free ranging Mountain Tapirs in the Central Andes of Colombia. Proceedings of the Fourth International Tapir Symposium Xcaret, Quintana Roo, Mexico. Available at: http://www.tapirs.org

Caulkett, N.A., Cribb, P.H., Haigh, J.C. 2000. Comparative cardiopulmonary effects of carfentanil-xylazine and medetomidine-ketamine used for immobilization of mule deer and mule deer/white-tailed deer hybrids. Can J Vet Res. 64:64–68.

Citino, S.B., Bush, M., Grobler, D. and Lance, W. 2001. Anaesthesia of roan antelope (*Hippotragus equinus*) with a combination of A3080, medetomidine and ketamine. J. S. Afr. Vet. Assoc. 72: 29-32.

Citino, S.B., Bush, M., Grobler, D. and Lance, W.R. 2002. Anesthesia of boma-captured Lichtenstein's hartebeest (*Sigmoceros lichtensteinii*) with a combination of thiafentanil, medetomidine, and ketamine. J. Wildl. Dis. 38:457-462.

Cooper, D.V., Grobler, D., Bush, M., Jessup, D. and Lance, W. 2005. Anaesthesia of nyala (*Tragelaphus angasi*) with a combination of thiafentanil (A3080), medetomidine, and ketamine. J. S. Afr. Vet. Assoc. 76:18-21.

Foerster, S.H., Bailey, J.E., Aguilar, R., Loria, D.L. and Foerster, C.R. 2000. Butorphanol/xylazine/ketamine immobilization of free-ranging Baird's tapirs in Costa Rica. Journal of Wildlife Disease. 36:335-341.

Grobler, D., Bush, M., Jessup, D. and Lance, W. 2001. Anaesthesia of gemsbok (Oryx gazelle) with a combination of A3080, medetomidine and ketamine. J. S. Afr. Vet. Assoc. 72:81-83.

Hernández-Divers, S., J., Bailey, R., Aguilar, D., Loria y C., Foerster. 1998. Cardiopulmonary effects and utility of a butorphanol/xylazine/ketamine anesthethic protocol for immobilization of free-ranging Baird´s tapir (*Tapirus bairdii*) in Costa Rica. In Proceedings of the American Association of Zoo Veterinarians Conference. pp. 41-48.

Hernández-Divers, S., J., Bailey, R., Aguilar, D., Loria y C., Foerster. 2005. Health evaluation of a radiocollared population of free-ranging Baird's Tapirs (*Tapirus bairdii*) in Costa Rica. J. Zoo Wildl. Med. 36: 176–187.

Hernandez-Divers, S., Quse, V., de Thoisy, B., Blanco, M. y Lira, I., 2007. Tapir field veterinary manual. IUCN/SSC Tapir Specialist Group (TSG) Veterinary Committee. Available at: http://www.tapirs.org

Howard, L.L., Kearns, K.S., Clippinger, T.L., Larsen, R.S. and Morris, P.J. 2004. Chemical immobilization of rhebok (Pelea capreolus) with carfentanil-xylazine or etorphine-xylazine. J. Zoo Wildl. Med. 35:312-319.

Janssen, D.L., Raath, J.P., Swan, G.E., et al. 1991. Field studies with the narcotic immobilization agent A3080. In Proceedings of the American Association of Zoo Veterinarians Conference. Pp 333–335.

Janssen ,D.L. (2003). Tapiridae. In: Fowler ME, Miller RE, eds. Zoo and Wild Animal Medicine: Current Therapy, 5th ed. Philadelphia: W.B. Saunders. Pp 569–577.

Kreeger, T.J. (1997). Handbook of Wildlife Chemical Immobilization. International Veterinary Services, Inc. Laramie, Wyoming, USA.

Kreeger, T. J., Cook, W.E., Piché, C.A. and Smith, T. 2001. Anesthesia of pronghorns using thiafentanil or thiafentanil plus xylazine. Journal of Wildlife Management 65: 25–28.

Kreeger, T. J and Arnemo, J.M. 2007. Handbook of Wildlife Chemical Immobilization, ed 3, Wheatland, WY.

Lance, W.R. and Kenny, D.E. (2012).Thiafentanil oxalate (A3080) in nondomestic ungulate species. In Miller, R.E. & Fowler, M. (Eds.), Fowler's Zoo and Wild Animal Medicine:Current Therapy, Volume 7. St. Louis, Missouri, USA: Saunders, Elsevier.

Lambeth, R.R., Dart, A.J., Vogelnest, L., et al. 1998. Surgical management of an abdominal abscess in a Malayan tapir. Aust Vet J . 76: 664–666.

Lira, I., Ceballos, G. y Woolrich, D. 2008. Capture, handling and monitoring of Baird's Tapirs in the Zoque Rainforest, Oaxaca, Mexico. Proceedings of the Fourth International Tapir Symposium Xcaret, Quintana Roo, Mexico. Disponible in: http://www.tapirs.org

Mangini, P.R. and Velastin, G.O. 2001. Chemical restraint of two wild *Tapirus pinchaque* (mountain tapir) case report. Arch Vet Sci Curitiba. 6:6.

Miller-Edge, M., Amsel, S. and Junge, R. 1994. Carfentanil, ketamine, xylazine combination (CKX) for immobilization of exotic ungulates: clinical experience in bongo (Tragelaphus euryceros) and mountain tapir (*Tapirus pinchaque*). In Proceedings of the American Association of Zoo Veterinarians Annual Conference.

Miller, B.F., Muller, L.I., Storms, T.N., et al. 2003. A comparison of carfentanil/xylazine and Telazol (R)/ xylazine for immobilization of white-tailed deer. J Wildl Dis. 39:851–858.

Parás, G.A, Forester, C.R., Hernandez, S.M. 1996. Immobilization of free ranging Baird's tapir (*Tapirus bairdii*). In Proceedings of the American Association of Zoo Veterinarians Annual Conference.

Pollock, C., Ramsay, E. 2003 Serial immobilization of a Brazilian Tapir (*Tapirus terrestris*) with oral detomidine and oral carfentanil. J Zoo Wildl Med. 34:408–410

Pye G.W., Citino, S.B., Bush, M., Klein, L. and Lance, W. 2001. Anesthesia of Eastern Giant Eland (Taurotragus derbianus gigas) at White Oak Conservation Center. In Proceedings of the American Association of Zoo Veterinarians Annual Conference. Pp: 226-231.

Ramdohr, S., Bornemann, H., Plotz, J., et al. 2001. Immobilization of free-ranging adult male southern elephant seals with Immobilon (TM) (etorphine/ acepromazine) and ketamine. South Afr J Wildl Res. 31:135–140.

Roffe, T.J., Coffin, K., Berger, J. 2001. Survival and immobilizing moose with carfentanil and xylazine. Wildl Soc Bull . 29: 1140–1146.

Smith, I.L., McJames, S.W., Natte, R., Stanley, T., Kimball, J.F., Becker, T., Hague, B. and Barrus, B. 1993. A-3080 studies in elk: effective immobilizing doses by syringe and dart injection. In Proceedings of the American Association of Zoo Veterinarians Annual Conference. Pp 367-368.

Stanley, T. H., Mcjames, S., Kimball, J., Port, J.D. and Pace, N.L. 1988a. Immobilization of elk with A-3080. Journal of Wildlife Management. 52: 577–581.

Tobler, M., Gimenes, V.M., Ormeño, C.A.C. and Sanchez, C. 2006. Capture and immobilization of *Tapirus terrestris* in Madre de Dios, Peru. Proceedings of the Third International Tapir Symposium, Buenos Aires, Argentina. Available at: http://www.tapirs.org

Trim, C.M., Lamberski, N., Kissel, D.I. and Quandt, J.E. 1998. Anesthesia in a Baird's tapir (*Tapirus bairdii*). Journal of Zoo and Wildlife Medicine. 29:195-198.

Wolfe, L.L., Lance, W.R. and Miller, M.W. 2004. Immobilization of mule deer with thiafentanil (A-3080) or thiafentanil plus xylazine. Journal of Wildlife Disease. 40: 282-7.

CONTRIBUTIONS

Iridium/GPS Telemetry to Study Home Range and Population Density of Mountain Tapirs in the Rio Papallacta Watershed, Ecuador

***Armando X. Castellanos P.*[1,2]**

[1] IUCN/SSC Tapir Specialist Group, Ecuador
[2] Andean Bear Foundation, Pasaje S24B, Oe5-142, La Isla, Quito, Ecuador. Email:iznachi@gmail.com

Abstract

Mountain tapirs are one of the least studied of the large mammals. It wasn't until the 1990's that the first radio telemetry studies were done on the species and huge gaps still exist in the literature regarding mountain tapir population dynamics. In light of recent technological advances in telemetry equipment, it was decided to execute the current study in order to obtain a clearer picture of mountain tapir population ecology. Between June 2012 and February 2013 two female and four male mountain tapirs were captured and equipped with Iridium/GPS collars. The collars recorded between 92 and 278 days of data resulting in 132 to 324 locations. Mean home ranges were estimated using four different methods: minimum convex polygon (MCP), 648 hectares (ha); Kernel 95% and 50%, 397 and 32 ha; nearest-neighbor convex hull (k-NNCH), 310 ha; Brownian bridge movement model (BBMM), 686 ha. Tapir population density was estimated by extrapolating mean tapir home range size (Kernel 95% and k-NNCH) to the size of the study area (25400 ha), both considering and disregarding home range overlap. Using Kernel, a population density of one individual/357 ha and one individual/245 ha was calculated. Using the k-NNCH method densities of one individual/325 ha and one individual/307 ha were calculated.

Keywords: Home range, Iridium/GPS collars, Mountain Tapir, Population Density

Introduction

The mountain tapir (*Tapirus pinchaque*) is one of the least known of any species of large mammal (Thornback & Jenkins, 1982). Its small extant population of no more than three thousand individuals is thinly spread throughout the Andean cordillera between Northern Peru and Central Colombia, and its restricted geographic distribution has led the species to the brink of extinction (Ashley *et al*., 1996; Tapia *et al*., 2011).

It is likely the species is naturally rare. However, the populations have been made even smaller through fragmentation and habitat loss caused by agricultural and livestock expansion. As a result, the International Union for Conservation of Nature (IUCN) has listed this species as endangered (EN) throughout its entire range (2009) and critically endangered (CR) in the Red Book of Mammals of Ecuador (Tapia *et al*., 2011). The species is also included in Appendix I of the Convention on the International Trade of Endangered Species (CITES, 2013).

Between 1966 and 1971, Ecuador went through a peak period of wildlife trafficking. This peak was driven by high demand from European and American zoos for new specimens (Strummer, 1971). During this period, one of the more sought after species was the Mountain Tapir. Groups of Ecuadorians and foreigners alike attempted their capture mainly in the El Placer and Papallacta regions of the Ecuadorian highlands, which are today part of the Sangay and Cayambe Coca National Parks, respectively. Mountain tapir capture and transit are extremely delicate processes, often leading to fatalities due to post-capture myopathy and difficulties in adjusting to captive diets (Wilson & Wilson 1973). Padilla *et al* (2010) reported that between 1967 and 1968 100 mountain tapirs died while being captured by animal traders working for American zoos. Almost certainly more specimens died during transport to the United States.

During this period the most important publication about the mountain tapir was written by Schauenberg (1969), who studied captive specimens and produced a literature review about the species. Downer (1996) described his pioneering work with radio-telemetry in mountain tapirs that began in 1991, outlining some of the first ecological data regarding wild mountain tapirs, and forming the basis for subsequent mountain tapir studies. Castellanos (1994), for instance, used radio telemetry devices to monitor a sub-adult female mountain tapir within the protected cloud forest reserve of Pasochoa.

Mountain tapir ecology studies slowly progressed and between 1998 and 2005, Lizcano & Cavelier (2004) captured and collared two mountain tapirs in Colombia. Both were fitted with GPS collars using the same capture method as Downer (1991) and Castellanos (1994). The study of Lizcano & Cavelier (2004) was the first to use tranquilizer darts for immobilizing wild mountain tapirs in the wild.

In this study, we aimed to quantify tapir home-range size in the Cayambe Coca National Park, and report preliminary estimates of mountain tapir population density. To achieve our goal, we deployed Iridium/GPS satellite telemetry collars on six tapirs within the park. Up until the present day, no Iridium/GPS telemetry studies have been reported on any of the three American tapir species. We document preliminary results using such equipment to monitor mountain tapirs in their natural environment, and discuss the value of GPS technology in studying mountain tapir ecology. The study was part of the Mountain Tapir Conservation Program initiated by EcoCiencia, Fundación Zoológica and IUCN/SSC Tapir Specialist Group/Ecuador, and was financed by the EcoFondo. The study continues to the present day through the Andean Bear and Tapir project and is funded by the Andean Bear Foundation. The entire investigation has been carried out with the full support of the Ecuadorian Ministry of Environment.

Material and Methods

Study Area

The current study was carried out on the eastern slopes of the Ecuadorian Andes, in the Rio Papallacta watershed in the Cayambe Coca National Park, Quijos County, Napo province. Also found in this region is the internationally important Ñucanchi Turubamba Wetland System, classified as a RAMSAR site due to its biological, cultural and hydrological importance. The site is of glacial origin, being formed at the time of the last ice age (around 10,000 years ago), and covers an area of approximately 25.4 km^2 (25,400 hectares) spanning upper montane forest and paramo habitats (Sierra, 1999), ranging from 3,500 to 4,000 masl. The Ñucanchi Turubamba is a unique formation of ecosystems, and is home to a wide diversity of species, many of which are endangered and endemic, including birds such as the Andean Condor (*Vultur gryphus*), the Grey-breasted Mountain Toucan (*Andigena hypoglauca*), and the Torrent Duck (*Mergannetta armata*). Endangered and endemic mammal species include the Andean bear (*Tremarctos ornatus*), pampas cat (*Felis colocolo*), the puma (*Puma concolor*) and the pudu (*Pudu mephistophiles*) amongst others.

Despite a recent increase in abrupt weather patterns leading to more unpredictable climatic conditions, the study area exhibits relatively stable seasonal weather patterns. From June to August there is a very short wet period where rainfall is constant and often torrential. Between February and May there is another wet period with moderate rainfall, and between September and January exists a dry season with little rainfall.

The study area is bisected by the busy Inter Oceanica highway that connects the Ecuadorian Andes to the Amazon region, and a network of minor dirt tracks mainly used by the Municipal Potable Water Company of Quito, sport fishermen and tourists visiting the Papallacta, Baños, Loreto and Mogotes Lagoons, and trails encircling the Sucus and Parca Cocha Lagoons.

Tapir captures

Six adult mountain tapirs were captured (one of the six was recaptured at a later date) using the pursuit techniques successfully implemented by various investigators in Ecuador and Colombia (Downer, 1996; Castellanos, 1994; Lizcano & Cavelier, 2004). However I adapted another approach, incorporating the techniques proposed by Castellanos & Tapia (2010), and implemented a contingency plan designed by Castellanos *et al*. (2011) which consisted of security and safety protocols for the capture and management of tapirs.

Anesthesia of the animals was under the supervision of Ecuadorian veterinarians. Each captured tapir was immobilized using darts launched from a plastic tube, or from an air pistol (Daninject, USA). The tapirs were immobilized using a mixture of xylazine hydrochloride (0.4 mg /kg, AnaSed®, Lloyd, Shenandoah, Iowa,USA) and butorphanol tartrate (0.2 mg/kg, Turbogesic®, Fort Dodge, Iowa, USA). Once the animal was recumbent, ketamine hydrochloride (0.7 mg/kg, Ketamine HCL, Bioniche Teo, Galway, Ireland) was intramuscularly administered to maintain anesthesia as needed. Yohimbine hydrochloride (0.14 mg/kg, Yohimbine Vet, Holliday-Scott S.A., Buenos Aires, Argentina) was intramuscularly administered as a reversing agent.

Morphological measurements of immobilized tapirs were recorded, and specimen weight and age was estimated based on the experience of the local guides. Blood samples were taken for genetic, hematology and serum biochemical analysis, and to inspect for hemoparasites. All samples were immediately placed in a cooler at 10ºC, and were transported to LIVEX laboratories, (Quito, Ecuador) for processing within 24 hrs. Samples that showed signs of hemolysis were

Table 1. Basic data on and tracking duration from six Mountain tapirs captured in the Rio Papallacta watershed, Cayambe Coca National Park.

Animal ID	Sex	Estimated age (years)	Estimated Weight (Kg)	Start Date	End Date
Panchita	Female	8	220	8/22/2011	10/24/2011
Marisol	Female	5	200	8/26/2011	6/18/2011
Melchor	Male	15	180	8/29/2011	12/13/2011
Dante	Male	5	150	9/27/2011	5/18/2012
Juanito	Male	2	130	9/28/2011	1/27/2012
Panchita[2]	Female	10	240	1/28/2013	n/a
Meshi	Male	6	180	2/6/2013	2/23/2013

Start date indicates the capture data.End date indicates the date the collar stopped collecting data.

[2]Recapture of previously collared tapir

not considered for analysis. Captured tapirs were fitted with Iridium/GPS collars (G2110E model, Advanced Telemetry Solutions, AT, USA) and monitored from a safe distance until they recovered.

The satellite collars used in this study weighed 0.825 kg, which is less than 0.5% of the weight of an adult mountain tapir. Each collar had a VHF transmitter, an activity sensor, an environmental temperature sensor, and a drop-off mechanism to be activated once the collar's main battery runs out. Collars were programmed to take eight daily positional readings for a period of 18 months. Data points were sent via an ATS server to my email account.

The quality and quantity of data points were variable, depending on climatic and physical conditions like cloud cover, vegetation density and satellite position and angle. Only GPS points taken from a minimum of 3 satellites and with a margin of error < 30m were considered for analysis. For home range analysis, I only included two daily GPS locations at 12-hour intervals to reduce temporal autocorrelation.

Home-range and population density analysis

Using the GPS localizations, home ranges were calculated using four different estimation models: (1) Minimum convex polygon 100% (MCP), (2) Kernel 95%, 50%, (3) nearest-neighbor convex hull (k-NNCH), (4) Brownian bridge movement model 95% with a 100 m grid cell size (BBMM) (Mohr 1947, Seaman & Powel, 1996; Getz & Wilmers, 2004; Horne *et al*., 2007).

ArcView GIS 3.2 (Environmental Systems Research Institute, ESRI, Redlands, CA, USA) software was used for home range estimations. The Animal Movement Extension (Hooge *et al*., 1999) was used to calculate MCP and Kernel, and the local convex hull extension was used to calculate k-NNCH (Getz & Wilmers, 2004). ArcGis 9 and the ArcGis extension Hawths tool 3.6 (ESRI, 2008) and R program (2008) were used to estimate BBMM.

To estimate mountain tapir population density, I used the analytical methods used by Medici (2010) for *Tapirus terrestris* populations, based on home range size. These methods are described as following:

a.) Tapir population was estimated by extrapolating mean tapir home range size obtained by both Kernel 95% and k-NNCH to the area of 25, 400 ha of Páramo. The density estimates obtained through this method did not consider home range overlap.

b.) Tapir population was estimated by subtracting mean home range overlap (k-NNCH and Kernel 95%) from mean tapir home range size (k-NNCH and Kernel 95%). The value obtained was then extrapolated to the area of 25,400 ha of Páramo in the Papallacta River watershed to obtain a density estimate.

Results

In the current study six mountain tapirs of different ages were captured and fitted with Iridium/GPS collars. During the first capture phase (between June and September 2010), three males (Melchor, Dante and Juanito) and two females (Panchita and Marisol) were captured and collared. One tapir captured in this phase suffered a serious yet not fatal accident during anesthesia (2/6/2010). During the second capture phase (between January and February 2013) we recaptured the female tapir Panchita, and also captured a new male named Meshi (Table 1).

Although the Iridium/ GPS collars were programmed to take data points for a period of 18 months, many had much shorter life times. The collar with the shortest life spans stopped transmitting after just 17 days. The rest of the collars endured significantly longer time periods of 92, 106, 259, and 278 days (Table 1). The collar of the recaptured female, Panchita, continued to send data 369 days after collar deployment.

Home range size varied widely between individuals and estimation method. Using the k-NNCH estimator, home ranges were between 71 and 653 hectares (ha), with a mean area of 310 ha. Using the 95% Kernel method, the home ranges were estimated to be between 62 and 916 ha with a mean of 397 ha. Using the 50% Kernel method, home ranges were estimated to be between 9 and 67 ha with a mean of 32 ha. Using the BBMM method, home ranges were estimated to be between 201 and 1150 ha, reaching a mean of 686; the highest estimate across all the calculation methods. Finally, using the MCP method, home range estimations were greater, being between 125 and 1813 ha with a mean home range of 648 ha (Table 2). Four of the five tapirs monitored in this study showed home range overlap indicating significant intraspecific tolerance. (Fig 1).

Using the k-NNCH to estimate population density in the study area, a density of one individual per 325 ha was estimated without considering range overlap. Taking into account home range overlap a population density of one individual per 307 hectares was calculated.

Using the Kernel method, population density was estimated as one tapir for every 357 ha discarding home range overlap, whilst taking into account home range overlap the population density was estimated as one tapir per 245 ha.

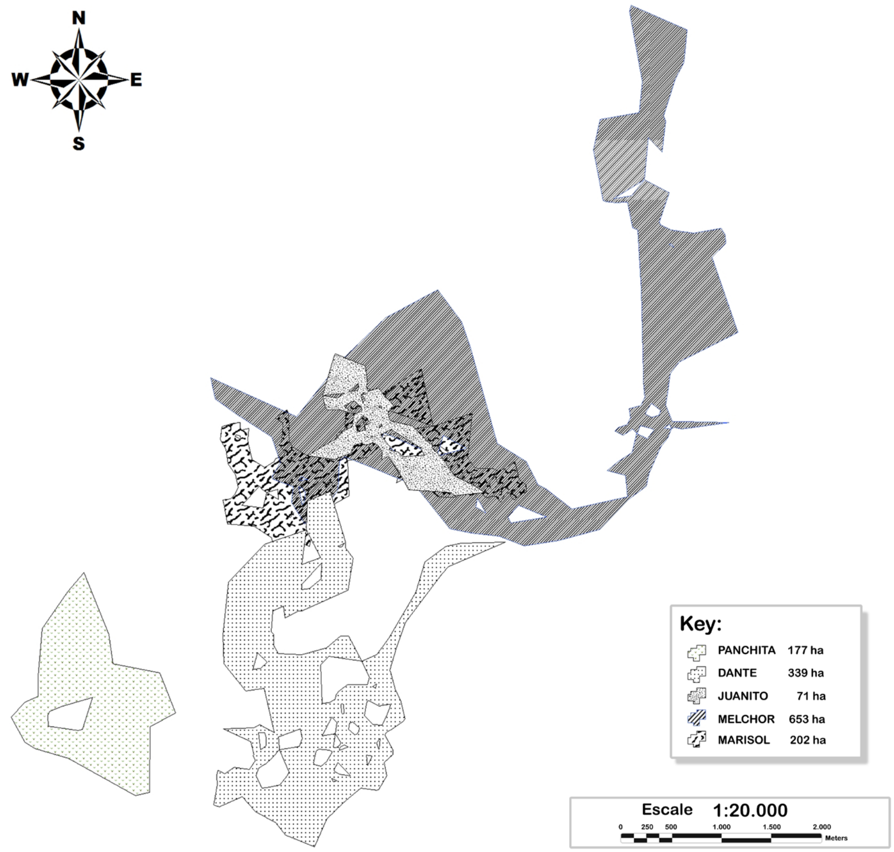

Figure 1. Home range nearest neighbor convex hull (k-NNCH) of five mountain tapir (two female and three male), in the Rio Papallacta watershed, Cayambe Coca National Park, Ecuador. Each different style of polygon represents an individual tapir.

Table 2. Estimates of home range size for five mountain tapirs in the Rio Papallacta watershed, Cayambe Coca National Park, Ecuador.

Animal ID	GPS Locations	Tracking time (days)	Home Range				
			k-NNCH	Kernel 95%	Kernel 50%	BBMM	MCP 100%
Melchor	173	106	653	916	48	1150	1813
Dante	278	259	339	437	67	632	678
Juanito	136	151	71	62	9	395	125
Panchita	132	92	177	173	25	201	225
Marisol	324	278	202	222	11	569	400
Mean			310	397	32	686	648

Discussion

The first tapir trapped in June 2012 suffered an accident whilst recuperating from anesthesia. Still under the influence of the anesthetic she fell into a lagoon and the team acted hastily to rescue her. Showing no vital signs, we initially believed she had drowned, however hours later she regained consciousness. The individual had undergone an acute form of 'diving reflex' exhibited by all mammals during prolonged periods with the head submerged in cold water. After this incident we decided to create a Contingency and Safety Protocol for Animal Management and Capture (Castellanos *et al.*, 2011), which was tested successfully in the following seven tapir capture events that transpired without accidents or problems.

The Iridium/ GPS collars manufactured by Advanced Telemetry Solutions (USA) failed to send GPS localizations as they had been programmed. The intense humidity of the study area caused severe corrosion of the GPS antenna and other electronic components leading to premature malfunctioning of the apparatus. Nonetheless the collars succeeded in sending sufficient information to obtain more accurate data than those reported by Downer (1996) and Lizcano & Cavelier (2004).

Although no sexual dimorphism is exhibited by this species, the body mass estimated for the tapirs in this study correspond to the observations of Barongi (1986) and Medici *et al.* (2007) in that female mountain tapirs are heavier than males.

I considered k-NNCH analysis the best method for delineating areas inhabited and traversed by mountain tapirs in landscapes with deep ravines, lagoons and enormous rock faces such as those across the study area. In contrast to the MCP method it doesn't take into account areas not used by tapirs such as flat plains, large open pastures and villages.

In this study, mean home range estimates using Kernel 95% and 50% were calculated to be 397 and 32 ha. These estimates are slightly larger than the 260 and 60 ha reported by Lizcano & Cavalier (2004) who monitored one male and one female tapir over a period of 6 months using GPS telemetry. Downer (1996) reported a mean home range estimate of 880 ha in his radio telemetry study of mountain tapirs in which he used the MCP estimator to calculate home ranges. Using the same MCP method Lizcano & Cavalier (2004) obtained a home range estimate of just 350 ha. The home range estimate determined from the present study using the MCP estimation tool (686 ha) was within the values reported in those studies. This variation can be explained by the diverse levels of habitat conservation and threats that exist in the different study areas. These factors in turn influence the carrying capacities of such areas and hence account for different home range sizes between tapir populations spanning the species distribution range (Medici, 2010). The current study area, though it is within a national park, is intersected by a series of dirt tracks and trails that may be influencing home range sizes of the native tapir population, possibly even to the extent of defining the areas in which the tapirs inhabit. There are areas where there are lots of evidence of tapir presence, and there are also areas where no evidence of tapir presence is found, as if there were vast stretches unoccupied by tapirs in this type of paramo.

The elderly male tapir, Melchor, exhibited a larger home range size in comparison to those of the females. This may be related to aspects of social organization and mating system. It is predicted that a single male can mate with several females, without any restriction in the number of females per male. As a consequence, home ranges of male tapirs may incorporate larger areas so that they overlap with the home ranges of two or more females (Medici, 2010).

Population density data obtained from this study using the k-NNCH method (One Individual (I) /325 ha, I/307 ha), and the Kernel method (I /357 ha, I / 245 ha) are similar to those observed in mountain tapir studies carried out in Colombia by Acosta *et al* (1996); I / 400 ha, and by Lizcano & Cavelier (2000); I / 551 ha. In the Sangay National Park on south Ecuador, Downer (1996) obtained a population density of I / 587 ha. Contrasting to all other estimates, Urgiles *et al.* (2013) reported a population density of 1.09 individuals/10000 ha in a study using camera traps in the Oyacachi region, which is adjacent to the current study area. There are numerous variables that may explain discrepancies and variation in population density estimations, among these are the differences in environments and habitat types, as well as the different levels of habitat conservation, which in turn reflects different carrying capacities in different habitats found within the species' distribution range. The variation can also be attributed to the different methods used to estimate density, the timeframe of monitoring, and the number of individuals monitored (Medici, 2010).

The MCP home range estimator (Mohr, 1947) was not used to calculate population densities as the study area included sections where the tapirs did not traverse. For example the tapirs in this study completely avoided large open plains where livestock were grazing, where they could potentially have been easy prey for predatory animals. Mountain tapirs predominantly use steep slopes often close to forested areas where they can escape more easily from potential attacks.

Castellanos (2011) encountered similar difficulties using the MCP method to estimate home ranges of the Andean Bear (*Tremarctos ornatus*), where the bears were avoiding populated and agricultural areas in a fragmented cloud forest habitat. To avoid the problem of providing inaccurate home range models in this instance I reverted to use the Kernel and k-NNCH methods to analyses the data. The BBMM method could potentially be a better estimation tool for determining mountain tapir home ranges, however it is relatively new and requires more testing on large Andean mammals.

The use of satellite collars in this study allowed us to establish that mountain tapirs of different ages and sexes in the Cayambe Coca National Park spend most of their time in the Páramo high grassland habitat, occasionally entering *Polylepis* forest patches to browse and seek refuge. Although the study animals moved very close to the upper montane forest, there were no GPS localizations registered in this habitat type. This observation contradicts the hypothesis that mountain tapirs carry out large altitudinal migrations (Stummer, 1971; Acosta *et al.*, 1996; Lizcano & Cavalier, 2000) and supports the observation of Castellanos (1994) of no altitudinal movement of tapirs in the Sangay National Park.

Acknowledgments

I would like to thank the Ecuadorian Ministry of Environment for their support and for granting the necessary permits for this study. I would like to give a special thank you to the park rangers of the upper Cayambe Coca National Park. This study was financed by the Ecofondo and the Andean Bear Foundation, and the institutional support of Ecociencia, the Fundación Zoológica del Ecuador, the Tapir Specialist Group (Ecuador), the Zoo Conservation Outreach Group (ZCOG), the Dino Veterinary Clinic, and the Livex laboratories (Quito). I would like to thank my tapir capture team and tracking companions: Melchor Ascanta, Oscar Ascanta, Felipe Fernández, my friends and collaborators: Leonardo Arias for his high quality, efficient work in tapir immobilizations, Meghan Camp for her help with BBMM analyses, José Luis Carrasco for his help with the maps, and also Mauricio Ortega, José Aguirre, Lucas Achig, Diana Domínguez, Don Wilo Pérez del Hostal Coturpa, Fernando Barragán, Leopoldo Gómez and his family, Patricio y Mario Pillajo, Alandy Torres, Rebecca Hamilton and Fernando Nogales for their support and assistance and lastly Diego Lizcano for his useful comments and edits to this manuscript. I am also indebted to David Jackson for his translation and critical review of this document.

References

Acosta, H., Cavelier, J. & London, S. (1996). Aportes al conocimiento de la biología de la danta de montaña, *Tapirus pinchaque*, en los Andes Centrales de Colombia. Biotropica 28: 258–266.

Ashley, M.V., Norman. J.E. & Stross. L. (1996). Phylogenetic analysis of the Periossodactylan family Tapiridae using mitochondrial Cytochrome C Oxidase (COII) sequences. Journal of Mammalian Evolution 3: 315-326.

Barongi, R.A. (1986). Tapirs in captivity and their management. American Association of Zoological Parks and Aquariums Conference Proceedings 1986:96–108.

Caughley, G. & Sinclair, A.R. (1994). Wildlife ecology and management. Blackwell Science Ltd., Oxford.

Castellanos, A.X. (1994). El tapir andino (*Tapirus pinchaque* Roulin): crianza de un ejemplar en el Bosque Protector Pasochoa y notas ecológicas en el Parque Nacional Sangay, Ecuador. Tesis de Licenciatura. Universidad Central del Ecuador. Quito.

Castellanos, A.X. & Tapia, A. (2010). Metodología unificada para el estudio sobre uso y preferencia del hábitat, abundancia, densidad poblacional, salud y genética del tapir de montaña en la Cuenca del río Papallacta. Reporte no publicado. Fundación EcoCiencia, Fundación Zoológica del Ecuador, Grupo de Especialistas en Tapires-Ecuador/IUCN. Quito, Ecuador.

Castellanos, A.X. (2011). Andean bear home ranges in the Intag region, Ecuador. Ursus, 22:65–73. url: http://www.andeanbear.org/home-ranges-bears.pdf

Castellanos, A., Ortega-Andrade, H.M., Arias, L., Arias, P. & Ortega, A. (2011). Plan de contingencia y protocolo de seguridad para la captura y manejo del tapir de montaña en la cuenca del río Papallacta, Provincia de Napo. Reporte no publicado. Fundación EcoCiencia, Fundación Zoológica del Ecuador, Grupo de Especialistas en Tapires-Ecuador/IUCN. Quito,Ecuador.

Convention on international trade in endangered species of wild fauna and flora. (2013). Appendices I, II, and III. url: www.cites.org/eng/app/appendices.html, accessed 10 August 2013.

Downer, C. (1991). El tapir andino, especie en peligro. Fundación Ecológica Arcoiris. Arcoiris 5:4–5.

Downer, C. (1996). The mountain tapir, endangered “flagship” species of the high Andes. Oryx 30: 45-58.

ESRI. (2008). ArcGis 9.3. Environmental Systems Research Institute: Redlands, CA.

Getz, W. & Wilmers, C. (2004). A local nearest-neighbor convex-hull construction of home ranges and utilization distributions. Ecography 27: 489-505.

Hooge, P.N., Eichenlaub, W. & Solomon, E. (1999). The animal movement program. United States Geological Survey Alaska Biological Science Center, Anchorage.

Horne, J.S., Garton, E.O., Krone, S.M. & Lewis, J.S. (2007). Analyzing animal movements using brownian bridges. Ecology 88(9) 2354–2363.

Lizcano, D.J. & Cavelier, J. (2000). Densidad poblacional y disponibilidad de hábitat de la danta de montaña (*Tapirus pinchaque*) en los Andes Centrales de Colombia. Biotropica 32:165–173.

Lizcano, D.J. & Cavelier, J. (2004). Using GPS collars to study mountain tapirs (*Tapirus pinchaque*) in the Central Andes of Colombia. Tapir Conservation 13:18–23.

Medici, E.P. (2010). Assessing the viability of lowland tapir populations in a fragmented landscape. Ph.D. Dissertation. Durrell Institute of Conservation and Ecology (DICE), University of Kent, UK.

Mohr, C.O. (1947). Table of equivalent populations of North American small mammals. The American Midland Naturalist 37: 223-249.

Padilla, M., Dowler, R.C. & Downer, C.C. (2010). *Tapirus pinchaque*, (Perissodactyla: Tapiridae). Mammalian Species 42(863):166–182.

R Development Core Team (2008). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-07-0, www.Rproject.org

Schauenberg, P. (1969). Contribution a l’étude du *Tapirus pinchaque* Roulin 1829. Revue Suisse de Zoologie. Genéve. 76: 211-255.

Seaman, D.E. & Powell., R.A. (1996). An evaluation of the accuracy of kernel density estimators for home range analysis. Ecology 77:2075–2085.

Sierra, R. (Ed.). (1999). Propuesta preliminar de un Sistema de Clasificación de Vegetación para el Ecuador Continental. Proyecto INEFAN / GEF-BIRF y EcoCiencia. Quito-Ecuador.

Stummer, V.M. (1971). Wolltapire, *Tapirus pinchaque* in Ecuador. Der Zoolog. Garten 40 (3): 148-159.

Tapia, A., Nogales, F., Castellanos, A.X., Tapia, M. & Tirira, D. (2011). Tapir andino (*Tapirus pinchaque*). Pp. 98–100 en: Libro rojo de los mamíferos del Ecuador. D. Tirira, editor, 2da edición. Fundación mamíferos y conservación, Pontifica Universidad Católica del Ecuador y Ministerio del Ambiente del Ecuador . Publicación Especial sobre los Mamíferos del Ecuador 8. Quito.

Thornback, J. & Jenkins, M. (1982). Mountain, woolly or Andean tapir. Pp. 443–445 in The IUCN mammal red data book. Part 1.International Union for Conservation of Nature and Natural Resources, Gland, Switzerland.

Urgiles, C., Gallo, F., Borman, R. & Zapata, G. (2013). Densidad poblacional y patrones de actividad del tapir de montaña (*Tapirus pinchaque*), en cuatro localidades del Parque Nacional Cayambe-Coca y Reserva Ecológica Antisana, Ecuador. Primer Congreso Latinoamericano de Tapires- Segundo Congreso Ecuatoriano de Mastozoología, pp 117. Puyo, Pastaza, Ecuador.

Wilson, R. A. & Wilson, S. (1973). Diet of captive tapirs, *Tapirus spp*. International Zoo Yearbook 13:213–217.

TSG MEMBERSHIP DIRECTORY

TAPIR SPECIALIST GROUP

Currently, the TSG has 122 members, including field researchers, educators, veterinarians, governmental agencies and NGO representatives, zoo personnel, university professors and students, from 28 different countries worldwide (Argentina, Australia, Belize, Bolivia, Brazil, Canada, Colombia, Costa Rica, Denmark, Ecuador, France, French Guiana, Germany, Guatemala, Honduras, Indonesia, Malaysia, Mexico, Myanmar, Nicaragua, Republic of Panama, Paraguay, Peru, Thailand, The Netherlands, United Kingdom, United States, and Venezuela).

AMANZO, JESSICA
Universidad Peruana Cayetano Heredia
Peru

AMORIM MORAES JR., EDSEL
Instituto Biotrópicos
Brazil

AÑEZ GALBAN, LUIS
Fundación Parque Zoológico Metropolitano del Zulia
Venezuela

ANGELL, GILIA
Amazon.com
United States

ARIAS ALZATE, ANDRÉS
Grupo de Mastozoología - CTUA, Universidad de Antioquia
Colombia

AYALA C., GUIDO
Wildlife Conservation Society (WCS) - Bolivia
Bolivia

BARONGI, RICK
Houston Zoo Inc. / AZA Tapir TAG
United States

BECK, HARALD
Towson University
United States

BERMUDEZ LARRAZABAL, LIZETTE
Parque Zoologico Recreacional Huachipa
Peru

BERNAL RINCÓN, AGUEDA LUZ
Zoológico Centro Vacacional CAFAM - MELGAR
Colombia

BODMER, RICHARD
University of Kent
United Kingdom

BOSHOFF, LAUTJIE
Rafiki Safari Lodge
Costa Rica

BUMPUS, RENEE
Houston Zoo Inc.
United States

CALMÉ, SOPHIE
Université de Sherbrooke, Canada / El Colegio de la Frontera Sur (ECOSUR), Mexico
Canada

CALVO DOMINGO, JOSÉ JOAQUÍN
Sistema Nacional de Áreas de Conservación, Ministerio del Ambiente, Energía y Telecomunicaciones
Costa Rica

CAMACHO, JAIME
EcoCiencia - Fundación Zoológica del Ecuador
Ecuador

CAMPOS ARCEIZ, AHIMSA
University of Nottingham Malaysia Campus Jalan Broga
Malaysia

CARTES, JOSÉ
Asociación Guyra Paraguay
Paraguay

CASTELLANOS PEÑAFIEL, ARMANDO XAVIER
Fundación Espíritu del Bosque
Ecuador

CASTILLO, FERNANDO
Guatemala

CHALUKIAN, SILVIA C.
Consultant
Argentina

COLBERT, MATTHEW
University of Texas at Austin
United States

CORDEIRO, JOSÉ LUIS
Fundação Oswaldo Cruz (Fiocruz), Ministério da Saúde
Brazil

CRUZ ALDÁN, EPIGMENIO
Instituto de Historia Natural / Zoologico Regional Miguel Alvarez Del Toro
Mexico

CUARÓN, ALFREDO D.
SACBÉ - Servicios Ambientales, Conservación Biológica y Educación
Mexico

de THOISY, BENOIT
Association Kwata
French Guiana

DEE, MICHAEL
United States

DESMOULINS, AUDE
ZooParc de Beauval / EAZA Tapir TAG
France

DINATA, YOAN
Fauna & Flora International - Indonesia Program
Indonesia

DOWNER, CRAIG
Andean Tapir Fund
United States

ESTRADA ANDINO, NEREYDA
Panthera Foundation
Honduras

FINNEGAN, MITCH
Oregon Zoo
United States

FLESHER, KEVIN
Michelin Brasil
Brazil

FLOCKEN, JEFFREY
International Fund for Animal Welfare (IFAW)
United States

FLÓREZ, FRANZ KASTON
Fundación Nativa & Nativa France
Colombia

FRAGOSO, JOSÉ MANUEL VIEIRA
Stanford University
United States

GALEANO, MIGUEL
Fundación para la Autonomía y el Desarrollo de la Costa Atlántica de Nicaragua, FADCANIC
Nicaragua

GARCÍA VETTORAZZI, MANOLO JOSÉ
Centro de Estudios Conservacionistas / Universidad de San Carlos de Guatemala
Guatemala

GARELLE, DELLA
Cheyenne Mountain Zoological Park
United States

GASPARINI, GERMÁN
División Paleontología Vertebrados, Museo de La Plata, CONICET
Argentina

GATTI, ANDRESSA
Universidade Federal do Espírito Santo (UFES) / Instituto Marcos Daniel (IMD)
Brazil

GLATSTON, ANGELA
Rotterdam Zoo / EAZA Tapir TAG
The Netherlands

GOFF, DON
Beardsley Zoological Gardens / AZA Tapir TAG
United States

GONÇALVES DA SILVA, ANDERS
Monash University
Australia

GREENE, LEWIS
Columbus Zoo / AZA Tapir TAG
United States

GÜIRIS ANDRADE, DARIO MARCELINO
UN.A.CH. / Policlinica y Diagnóstico Veterinario
Mexico

HERNANDEZ, SONIA
University of Georgia
United States

HOLDEN, JEREMY
Flora and Fauna International - Indonesia
Indonesia

HOLST, BENGT
Copenhagen Zoo / EAZA Tapir TAG
Denmark

HOYER, MARK
Artis Royal Zoo
The Netherlands

ISASI-CATALÁ, EMILIANA
Universidad Simón Bolívar
Venezuela

JANSSEN, DONALD
San Diego Wild Animal Park
United States

JORDAN, CHRISTOPHER
Michigan State University
United States

JULIÁ, JUAN PABLO
Facultad de Ciencias Naturales, Universidad Nacional de Tucumán
Argentina

LAGUNA, ANDRES
Andean Bear Foundation
Ecuador

LEONARDO, RAQUEL
Fundación Defensores de la Naturaleza
Guatemala

LIRA TORRES, IVÁN
Instituto de Ciencias Agropecuarias - UAEH
Mexico

LIZCANO, DIEGO J.
Universidad de Pamplona
Colombia

LYNAM, ANTONY
Wildlife Conservation Society (WSC) - Asia Program
Thailand

MANGINI, PAULO ROGERIO
TRÍADE
Brazil

MARIN WIKANDER, SOFÍA
Universidad Simón Bolívar
Venezuela

MARINEROS, LEONEL
IRBIO Zamorano
Honduras

MARTYR, DEBORAH
Flora and Fauna International - Indonesia
Indonesia

MATOLA, SHARON
Belize Zoo and Tropical Education Center
Belize

McCANN, NIALL
Cardiff University
United Kingdom

MEDICI, PATRÍCIA
IPÊ - Instituto de Pesquisas Ecológicas
Brazil

MENDOZA, ALBERTO
Vet Tech Institute / AZA Tapir TAG Latin America Advisor
United States

MOGOLLON, HUGO
Ecuador

MONTENEGRO, OLGA LUCIA
Universidad Nacional de Colombia (UNAL)
Colombia

MORALES, MIGUEL A.
Conservation International
United States

MUENCH, CARLOS
CIEco-Centro de Investigaciones en Ecosistemas, Universidad Nacional Autónoma de México
Mexico

NARANJO, EDUARDO
El Colegio de la Frontera Sur (ECOSUR)
Mexico

NOGALES, FERNANDO
Universidad Técnica Particular de Loja (UTPL) / Instituto Ecuatoriano de Propiedad Intelectual (IEPI)
Ecuador

NOVARINO, WILSON
Andalas University
Indonesia

NUGROHO, AGUNG
Bogor Agricultural Institute (IPB)
Inodnesia

O'FARRILL, GEORGINA
University of Toronto
Canada

OLOCCO, MARÍA JULIETA
Universidad de Buenos Aires
Argentina

ORDÓÑEZ DELGADO, LEONARDO
Findación Ecológica Arcoiris
Ecuador

ORDONNEAU, DOROTHÉE
Facultad de Ciencias Veterinarias de Esperanza - Universidad Nacional del Litoral
France

PAVIOLO, AGUSTÍN
CONICET-Instituto de Biología Subtropical, Univ. Nac. de Misiones y CelBA
Argentina

PERERA, LUCY
Wildlife Conservation Society (WCS) – Venezuela
Venezuela

PINHO, GABRIELA
Instituto Nacional de Pesquisas da Amazônia
Brazil

POÓT, CELSO
Belize Zoo and Tropical Education Center
Belize

PRASTITI, SHARMY
Taman Safari Indonesia / South East Asia Zoological Association (SEAZA)
Indonesia

PUKAZHENTHI, BUDHAN
Smithsonian Institution's National Zoological Park, Conservation and Research Center
United States

QUSE, VIVIANA BEATRIZ
Argentina

RESTREPO, HECTOR FRANCISCO
Fundación Wii
Colombia

REYES PUIG, JUAN PABLO
Fundación Oscar Efrén Reyes
Ecuador

RICHARD-HANSEN, CÉCILE
Office National de la Chasse et de la Faune Sauvage (ONCFS) / Direction Études et Recherches
French Guiana

ROBERTS, RACHEL
SSC Network Coordination Officer, IUCN Species Survival Commission (SSC)
United Kingdom

RODRÍGUEZ ORTIZ, JULIANA
Universidad Nacional de Colombia (UNAL)
Colombia

ROMAN, JOSEPH
Virginia Zoological Park / AZA Tapir TAG
United States

RUIZ FUAMAGALLI, JOSÉ ROBERTO
Universidad de San Carlos de Guatemala
Guatemala

RUSSO, KELLY J.
The Houston Museum of Natural Science
United States

SACASA, EDUARDO
Fundación Amigos del Zoológico Nicaragüense (FAZOONIC)
Nicaragua

SANCHES, ALEXANDRA
UNESP
Brazil

SANCHEZ, CARLOS
Chicago Zoological Society
United States

SANDOVAL ARENAS, SERGIO
Colombia

SARMIENTO DUEÑAS, ADRIANA MERCEDES
Fundación Gaia Amazonas
Colombia

SCHWARTZ, KARIN R.
ISIS
Unites States

SCHWARTZ, RICHARD
Nashville Zoo at Grassmere / AZA Tapir TAG
United States

SEITZ, STEFAN
Consultant
Germany

SHEWMAN, HELEN
Woodland Park Zoo
United States

SHOEMAKER, ALAN H.
TSG / AZA Tapir TAG
United States

SHWE, NAY MYO
Friends of Wildlife (FoW)
Myanmar

SIMPSON, BOYD
Copenhagen Zoo - Southeast Asia Conservation Programme
Malaysia

SMITH, DIORENE
Summit Zoo
Panama

STAHL, TIM
Stahl PhotoGraphics
United States

STANCER, MICHELE
San Diego Zoo / AZA Tapir TAG
United States

SUÁREZ MEJÍA, JAIME
Pontificia Universidad Javeriana, Facultad de Estudios Ambientales y Rurales
Colombia

TAPIA, ANDRÉS
Centro Ecológico Shanca Arajuno
Ecuador

TOBLER, MATHIAS
San Diego Zoo Global
United States

TORRES, NATALIA
Ecuador

TRAEHOLT, CARL
Copenhagen Zoo - Southeast Asia Conservation Programme
Malaysia

VARELA, DIEGO
Conservación Argentina
Argentina

WALLACE, ROBERT B.
Wildlife Conservation Society (WCS) - Bolivia
Bolivia

WILLIAMS, KEITH
Private Consultant
Australia

WOHLERS, HUMBERTO
The Belize Zoo and Tropical Education Centre
Belize

ZAINUDDIN, ZAINAL ZAHARI
Malaysia

ZAVADA, JEANNE
East Tennessee State University & General Shale Brick Natural History Museum at Gray Fossil Site
United States

ZAVADA, MICHAEL
East Tennessee State University & General Shale Brick Natural History Museum at Gray Fossil Site
United States

TAPIR SPECIALIST GROUP

INSTRUCTIONS FOR AUTHORS

Scope

The Tapir Conservation, the Newsletter of the IUCN/SSC Tapir Specialist Group aims to provide information regarding all aspects of tapir natural history. Items of news, recent events, recent publications, thesis abstracts, workshop proceedings etc concerning tapirs are welcome. Manuscripts should be submitted in MS Word (.doc, at this moment we cannot accept documents in .docx format).

The Newsletter will publish original work by:

- Scientists, wildlife biologists, park managers and other contributors on any aspect of tapir natural history including distribution, ecology, evolution, genetics, habitat, husbandry, management, policy and taxonomy.

Preference is given to material that has the potential to improve conservation management and enhances understanding of tapir conservation in its respective range countries.
The primary languages of the Newsletter are English and Spanish. Abstracts in English are preferred.

Papers and Short Communications

Full Papers (2,000-5,000 words) and Short Communications (200-2,000 words) are invited on topics relevant to the Newsletter's focus, including:

- Research on the status, ecology or behaviour of tapirs.
- Research on the status or ecology of tapir habitats, including soil composition, mineral deposits (e.g., salt licks) and topography.
- Husbandry and captive management.
- Veterinarian and genetic aspects.
- Reviews of conservation plans, policy and legislation.
- Conservation management plans for species, habitats or areas.
- Tapirs and local communities (e.g., hunting, bush meat and cultural aspects).
- Research on the ecological role of tapir, for example, seed dispersers, prey for predators and facilitators of forest re-growth.
- Natural history and taxonomy of tapirs (e.g., evolution, palaeontology and extinction).

How to Submit a Manuscript
Manuscripts should be submitted in ***electronic format*** by e-mail to the contributions editor at the email provided. Hard copies will not be accepted.
Contributions Editor:
Anders Gonçalves da Silva
e-mail: andersgs@gmail.com

In the covering e-mail, the Lead Author must confirm that:
a) the submitted manuscript has not been published elsewhere,
b) all of the authors have read the submitted manuscript and agreed to its submission,
all research was conducted with the necessary approval and permit from the appropriate authorities and adhere to appropriate animal manipulation guides.

Review and Editing

All contributors are strongly advised to ensure that their spelling and grammar is checked by native English or Spanish speaker(s) before the manuscript is submitted to the Contributions Editor. The Editorial Team reserves the right to reject manuscripts that are poorly written.

All manuscripts will be subject to peer review by a minimum of two reviewers. Authors are welcome to suggest appropriate reviewers; however, the Contributions Editor reserves the right to appoint reviewers that seem appropriate and competent for the task.

Proofs will be sent to authors as a portable document format (PDF) file attached to an e-mail note. Corrected proofs should be returned to the Editor within 3 days of receipt. Minor corrections can be communicated by e-mail.

The Editorial Team welcomes contributions to the other sections of the Newsletter:

News
Concise reports (<300 words) on news of general interest to tapir research and conservation. This may include announcements of new initiatives; for example, the launch of new projects, conferences, funding opportunities, new relevant publications and discoveries.

Letters to the Editor
Informative contributions (<650 words) in response to material published in the Newsletter.

Preparation of Manuscripts

Contributions in English should make use of UK English spelling [if in doubt, Microsoft Word and similar software can be set to check spelling and grammar for "English (UK)" language]. The cover page should contain the title and full mailing address, e-mail address and address of the Lead Author and all additional authors. All pages should be numbered consecutively, and the order of the sections of the manuscript should be: cover page, main text, acknowledgement, tables, figures and plates.

Title
This should be a succinct description of the work, in no more than 20 words.

Abstract
Full Papers only. This should describe, in 100-200 words, the aims, methods, major findings and conclusions. It should be informative and

INSTRUCTIONS FOR AUTHORS

intelligible without reference to the text, and should not contain any references or undefined abbreviations.

Keywords
Up to five pertinent words, in alphabetical order.

Format
For ease of layout, please submit all manuscripts with a minimum of formatting (e.g. avoid specific formats for headings etc); however, the following is needed:

- Manuscripts should be double-spaced.
- Submissions can be in 'doc, 'rtf' or 'wpd' format, preferably as one file attached to one covering email.
- **Avoid** writing headlines in CAPITAL letters.
- Font type and size should be Times New Roman # 12
- Font type for tables should be Arial and 0.5 dot lines.
- 1 inch (2.54 cm) margins for all margins
- Number pages consecutively starting with the title page , numbers should be on the bottom right hand corner
- Font type for tables should be Arial and 0.5 dot lines.
- Pictures and illustrations should be in as high resolution as possible to allow for proper downscaling and submitted as separate files in EPS or JPG format.

References
References should be cited in the text as, for example, MacArthur & Wilson (1967) or (Foerster, 1998). For three or more authors use the first author's surname followed by *et al.*; for example, Herrera *et al.* (1999). Multiple references should be in *chronological order*. The reference list should be in *alphabetical order*, and article titles and the titles of serial publications should be given in full. In cases where an author is referenced multiple times the most recent publication should be listed first. Please check that all listed references are used in the text and vice versa. The following are examples of house style:

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

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

Book
MacArthur, R.H. & Wilson, E.O. (1967) *The Theory of Island Biogeography*. Princeton University Press, Princeton, USA.

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

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

Web
IUCN (2007) *2007 IUCN Red List of Threatened Species*. Http://www.redlist.org [accessed 1 May 2009].

Tables, figures and plates
These should be self-explanatory, each on a separate page and with an appropriate caption. Figures should be in black and white. Plates will only be included in an article if they form part of evidence that is integral to the subject studied (e.g., a camera-trap photograph of a rare situation), if they are of good quality, and if they do not need to be printed in colour.

Species names
The first time a species is mentioned, its scientific name should follow without intervening punctuation: e.g., Malay tapir *Tapirus indicus*. English names should be in lower case throughout except where they incorporate a proper name (e.g., Asian elephant, Malay tapir).

Abbreviations
Full expansion should be given at first mention in the text.

Units of measurement
Use metric units only for measurements of area, mass, height, distance etc.

Copyright
The copyright for all published articles will be held by the publisher unless otherwise stated.

Publisher
IUCN Tapir Specialist Group

Website
www.tapirs.org

TAPIR SPECIALIST GROUP STRUCTURE

Chair
Patrícia Medici, Brazil

Steering Committee
Alan Shoemaker, United States
Alberto Mendoza, Mexico/United States
Anders Gonçalves da Silva, Brazil/Australia
Bengt Holst, Denmark
Carl Traeholt, Malaysia
Gilia Angell, United States
Jeffrey Flocken, United States
Kelly Russo, United States
Mathias Tobler, Switzerland/United States
Michael Dee, United States
Michele Stancer, United States
Rick Schwartz, United States
Viviana Quse, Argentina

Baird's Tapir Coordinator
Manolo García, Guatemala

Lowland Tapir Coordinator
Viviana Beatriz Quse, Argentina

Malayan Tapir Coordinator
Carl Traeholt, Malaysia

Mountain Tapir Coordinator
Armando Castellanos, Ecuador

Red List Authority
Red List Focal Point: Alan H. Shoemaker, United States

Tapir Conservation Newsletter Editors
Contributions Editor: Anders Gonçalves da Silva, Brazil/Australia
Layout & Distribution Editors: Danielle Lalonde, Australia, and Kelly J. Russo, United States

Virtual Library Manager
Mathias Tobler, Switzerland/United States

Fundraising Committee Coordinator
Patrícia Medici, Brazil

Action Planning Committee Coordinator
Patrícia Medici, Brazil

Action Plan Implementation Taskforce
TSG Species Coordinators & TSG Country Coordinators

Zoo Committee Coordinator
Viviana Quse, Argentina

Veterinary Committee Coordinator
Viviana Quse, Argentina

Genetics Committee Coordinators
Anders Gonçalves da Silva, Brazil/Australia

Marketing & Education Committee Coordinators
Kelly J. Russo, United States

Webmasters
Kara Masharani, United States

Re-Introduction & Translocation Advisory Committee Coordinators
Patrícia Medici, Brazil and Anders Gonçalves da Silva, Brazil/Australia

Nutrition Consultant
Maria Julieta Olocco, Argentina

Evolution Consultant
Matthew Colbert, United States

Country Coordinators
Argentina: Silvia Chalukian
Belize: In the process of identifying a coordinator
Bolivia: Guido Ayala
Brazil: Patrícia Medici
Colombia: Olga Montenegro
Costa Rica: In the process of identifying a coordinator
Ecuador: Fernando Nogales
Guatemala: Raquel Leonardo
Guiana Shield (French Guiana, Guiana and Suriname): Benoit de Thoisy
Honduras: Nereyda Estrada Andino
Indonesia: Wilson Novarino
Malaysia: Zainal Zahari Zainuddin
Mexico: Georgina O'Farrill
Myanmar: U Nay Myo Shwe
Nicaragua: Christopher Jordan
Panama: In the process of identifying a coordinator
Paraguay: José Luis Cartes
Peru: Jessica Amanzo
Thailand: Antony Lynam
Venezuela: In the process of identifying a coordinator

TAPIR CONSERVATION

The Newsletter of the IUCN/SSC Tapir Specialist Group www.tapirs.org

Volume 22 • No. 31 • December 2013

Contents