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TAPIR CONSERVATION

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TAPIR SPECIALIST GROUP

CONTENTS

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Cover photo: CECON-USAC /CONAP 2015 - Tapirs in "aguada" at Biotopo Protegido Naachtún Dos Lagunas, Reserva de Biosfera Maya, Guatemala. Research & Monitoring Program CECON-USAC.

FROM THE EDITOR

Dear Tapir Conservation readers.

Welcome back. This is our first issue of 2015, and our first since the International Tapir Symposium in Campo Grande at the end of last year. In this issue, we start to introduce some changes that were discussed during the Symposium, aimed at making things easier for our readers and, and to increase the impact of the terrific work we receive for publication in our Newsletter.

The first thing to change is our name. The Newsletter will now be called simply Tapir Conservation. We feel this encapsulates our main mission of publishing work on the natural history, biology, and conservation of tapirs worldwide, making us an instantly recognizable brand and immediately conveying to readers what they can expect. Befitting our new title, this issue is packed with interesting conservation stories, two in particular deserve attention because they deal with the often little spoken issue of tapir-human conflict. However, the main contribution to this issue, alluded to by the cover photo of two Baird's tapirs, is a massive collaborative effort by Baird's tapir range country TSG members to generate new distribution maps for the species. I would like to congratulate Cody Schank and Manolo Garcia for their efforts in coordinating the data collation and producing the maps, and to all the co-authors that contributed data to the enterprise. This will be a most valuable resource for the conservation of Baird's tapir, and a lesson on what we can achieve when we work together.

The second change is designed to position Tapir Conservation not only as a vehicle for disseminating information but also as a clearing house for data relevant to the conservation of tapirs. From this issue forward, we will be instituting a new data sharing policy. The potential benefits of this new policy are already apparent with the new Baird's tapir range maps published in this issue, where we are not only publishing the maps but also the majority of the data used to produce the maps. Such data can now be used for any number of new ventures that will contribute positively to the conservation of tapirs.

The policy, in essence, makes it a condition for publication in Tapir Conservation that the raw data used to generate the results and conclusions of a manuscript be publicly available on an online database. The policy is grounded on the following three principles:

Open Access: Tapir Conservation promotes free and open access to data, information and knowledge for conservation purposes.

Mutual Benefit: Tapir Conservation requires authors to contribute data, information and knowledge in a format accessible electronically. Tapir Conservation encourages both authors and users to use publicly available data in support of tapir conservation.

Rights and Responsibilities: Contributors to Tapir Conservation have full right to attribution for any uses of their data, information, or knowledge, and the right to ensure that the original integrity of their contribution is preserved. Users of data shared through Tapir Conservation are expected to comply, in good faith, with terms of uses specified by contributors and in accordance with these Principles.

We choose this approach because there is abundant evidence that data sharing is considerably beneficial to the advancement of science and conservation. Such a policy has been implemented in many of the top journals, and is recommended by the IUCN. However, as outlined in our principles, we do understand that the authors worked hard to gather their data, and thus we are taking every step to guarantee that authors get full credit whenever someone uses their data. As such, the data is shared under one of two possible Creative Commons license agreements. A full detailed account of the new policy, including information on the licensing model, can be found here: http://tinyurl.com/qdt4gkl.

The third and final change is a move towards a more active online presence for Tapir Conservation. This will be achieved through two different measures: Tapir Conservation is starting its own Facebook page (LINK); and, all published material will have its own independent PDF, which will be deposited online and linked to a permanent DOI (a digital object identifier) number. We hope that through our Facebook page we will be able to reach a wider audience. We will advertise individual papers, and we are moving our Research Spotlight permanently to the Facebook page. Moving to individual PDFs will allow us to publish work online early, reducing the time between acceptance and release, and the individual DOI numbers will give authors a tool to track how their work is being cited.

We hope these new changes to Tapir Conservation will help you, our reader, take more out of the Newsletter. In the meantime, please enjoy our current issue.

With warm regards.

Anders Gonçalves da Silva, PhD
Editor

CONSERVATION

Presencia y primeras fotografías del Tapir de Tierras Bajas (*Tapirus terrestris*) en el Parque Nacional Natural Paramillo, Córdoba, Colombia

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Palabras clave: Área Protegida, Cámaras automáticas, Danta Colombiana.
Keywords: Camera trap, Colombian Tapir, Protected Area

El Tapir de Tierras Bajas *Tapirus terrestris* es una de las tres especies de tapires presentes en el territorio colombiano y es la especie más ampliamente distribuida del género. Esta especie se registra por lo general en bosques de tierras bajas hasta los 1200 o 1500 msnm (Hershkovitz, 1954), aunque se ha reportado en altitudes superiores a los 2000 msnm (Constantino *et al.*, 2006). Actualmente esta especie se encuentra catalogada como Vulnerable (VU) a nivel mundial (Nevada *et al.*, 2008), mientras que en Colombia la subespecie *Tapirus terrestris colombianus* se encuentra catalogada como en Peligro Crítico (CR) (Constantino *et al.*, 2006). En Colombia la especie se encuentra distribuida en la Orinoquia y Amazonia (*Tapirus terrestris terrestris*), y en las tierras bajas del norte el país (Danta Colombiana, *Tapirus terrestris colombianus*) (Hershkovitz, 1954; Padilla & Dowler, 1994; Arias-Alzate *et al.*, 2009). Históricamente Hershkovitz (1954) reportó la presencia de la Danta Colombiana en el noroccidente del país, donde se la consideraba actualmente extinta, aunque en los últimos años se sugirió su posible presencia

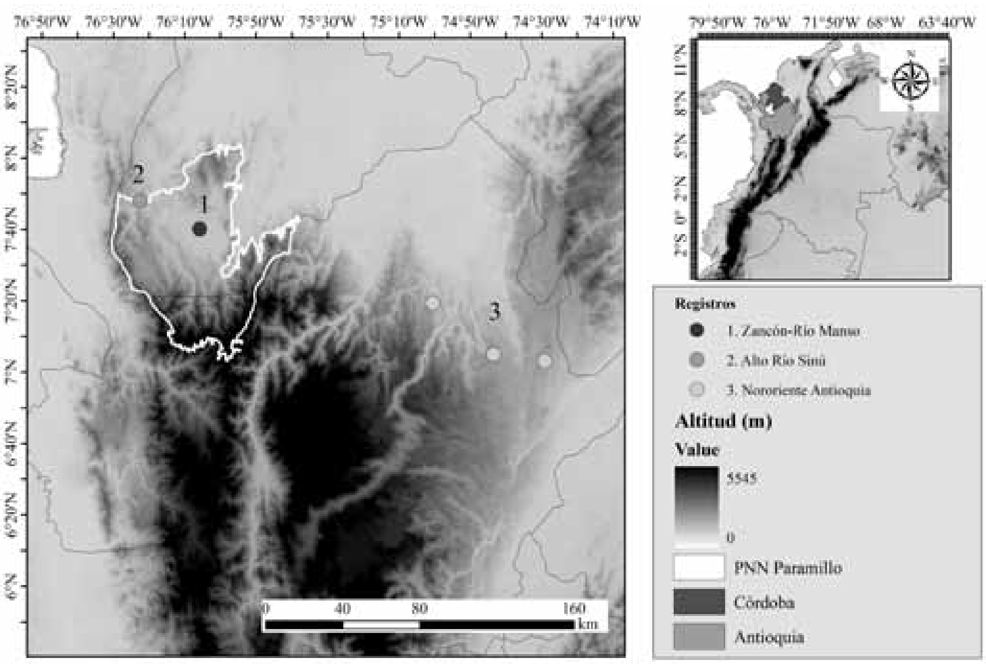

Figura 1. Ubicación geográfica del registro del Tapir de Tierras Bajas (*Tapirus terrestris colombianus*) en la cuenca hidrográfica del Río Manso, PNN Paramillo, Córdoba. Colombia. (Alto Río Sinú, localidad reportada por Hershkovitz (1954); Nororiente Antioquia, algunas localidades reportadas por Arias-Alzate *et al.* (2009).

en el Parque Nacional Natural Paramillo (entre los departamentos de Córdoba y Antioquia) (Arias-Alzate *et al.*, 2009; Racero-Casarrubia & Hernández, 2010). En el departamento de Córdoba, Colombia actualmente se considera como una de las 16 especies de mamíferos amenazados en jurisdicción de la Corporación Autónoma Regional de los Valles del Sinú y San Jorge (Rodríguez-Mahecha, 2006).

Aquí documentamos, luego de más de 60 años sin reportes, el primer registro y las primeras fotografías que confirma la presencia actual del Tapir de Tierras Bajas (correspondiente a la subespecie *Tapirus terrestris colombianus*, única subespecie presente geográficamente en el noroccidente de Colombia sensu Hershkovitz, 1954; Padilla & Dowler, 1994) en el Parque Nacional Natural Paramillo en el departamento de Córdoba, noroccidente de Colombia. Esto representa actualmente un registro notable en un área protegida y contribuye al conocimiento de la especie en su distribución natural en Colombia.

Figura 2. Individuo de Tapir de Tierras Bajas (*Tapirus terrestris colombianus*) registrado en el PNN Paramillo, Córdoba, Colombia. (Fotografía: Parque Nacional Natural Paramillo. Archivo Parques Nacionales Naturales de Colombia).

La localidad del registro está ubicada en la vereda Zancón situada en la cuenca hidrográfica del Río Manso y en la micro cuenca de la quebrada Crisanta (07°40´02.5´´N, 076°05´50.5´´W), a 200 msnm en un área de bosques en las llanuras inundables del Parque Nacional Natural Paramillo (PNN Paramillo) en el departamento de Córdoba, al noroccidente de Colombia (Figura 1). De acuerdo con el sistema de clasificación de Holdridge, esta área corresponde al bosque húmedo tropical (bh-T). Los registros fueron obtenidos a partir de la iniciativa del parque en documentar la biodiversidad presente en la zona y así mejorar las estrategias de conservación de aquellas especies consideradas en su plan de manejo VOC (Valor Objeto de Conservación). Estos registros se obtuvieron por medio del uso de cámaras automáticas o cámaras trampa (Bushnell Trophy Cam) dispuestas en modo fotográfico. En total en el área se instalaron dos cámaras del 5 de marzo al 28 de abril de 2014 a una distancia aproximada de 1.2 Km y ubicadas aproximadamente a 50 cm desde el suelo con la siguiente configuración: fotos con resolución de 5MP, autosensor infrarrojo para día y noche, una foto por evento e intervalo de un minuto entre fotos.

En total se obtuvo un esfuerzo de muestre de 104 cámaras/noche (52 noches efectivas de muestreo), durante el cual se recopilaron 116 fotografías de la especie. Estas fotografías fueron tomadas por una sola cámara los días 12, 14 y 24 de abril de 2014, entre las 01 y 05 hrs, en un sendero al interior de uno de los bosques primarios de la zona, en donde predominan las especies de plantas coronillo (*Bellucia* sp.) y cordoncillo (*Piper* sp.) las cuales son reconocidas localmente como alimento de la especie. Es importante mencionar la identificación de al menos un macho y una hembra a partir del reconocimiento de los órganos reproductivos observados en estas fotografías obtenidas en la localidad.

Este nuevo registro fotográfico de la danta o "burro danto" (Figura 2) como es conocido por las comunidades campesinas locales, es de gran relevancia puesto que luego de 60 años sin registros confirma la presencia de esta especie en la zona, además es interesante por ser las primeras evidencias de la especie al interior de un área protegida en el noroccidente del país (Figura 1), siendo esta subespecie la menos representada en el SINAP (Sistema Nacional de Áreas Protegidas) para Colombia, donde únicamente se registraba para el PNN Sierra Nevada de Santa Marta. En esta zona del noroccidente, Hershkovitz (1954) a nivel histórico reconocía la presencia de la Danta Colombiana (*Tapirus terrestres colombianus*) y su simpatría con el Tapir Centroamericano *Tapirus bairdii* en la región del alto valle del Río San Jorge al occidente de la Serranía de Abibe en la región de Urabá, y en la margen derecha del Río Atrato en los departamentos de Antioquia y Chocó, así como en la zona del alto valle del Río Sinú, en el departamento de Córdoba. Zonas donde actualmente la Danta Colombiana se consideraba extinta localmente (Hershkovitz, 1954; Montenegro, 2005). Es importante mencionar que los reportes actuales de *Tapirus terrestris colombianus* en el PNN Paramillo, provienen de registros secundarios no confirmados (como caminaderos o senderos de la especie, comederos y huellas), y si bien Racero-Casarrubia & Hernández (2010) reportan su presencia así como la de *T. bairdii* para algunos sectores del parque, los registros actuales más cercanos a esta área protegida se encuentran en la zona del nororiente de Antioquia a 162 km de distancia en promedio (Arias-Alzate *et al.* 2009).

Es importante resaltar que la zona del registro en el PNN Paramillo es uno de los sitios de interés para la investigación y conservación de grandes mamíferos en Colombia, ya que se caracteriza por presentar grandes extensiones de selva húmeda tropical en buen estado de conservación, las cuales son reconocidas como hábitats permanentes de otras especies, como el jaguar (*Panthera onca*), el puma (*Puma concolor*), y el oso de anteojos (*Tremarctos ornatus*) (Rodriguez-Mahecha *et al.* 2006; PNN PAR, 2014). Sin embargo, es preocupante la conservación de la Danta Colombiana así como de las demás especies en el futuro inmediato, actualmente la zona presenta inquietantes procesos de fragmentación, desforestación y transformación del bosque nativo, así como también la amenaza que genera el desarrollo de un posible proyecto hidroeléctrico de gran escala, el cual cubriría gran parte del área donde se presentó el registro, lo que pone en peligro la existencia de la especie en la zona. Por ello, esta área protegida junto con los bosque nativos remanentes en el zona representan unos de los pocos ecosistemas naturales importantes para el Departamento de Córdoba, no solamente para la protección de esta especie, sino también porque representan áreas estratégicas para la biodiversidad y su conexión con otros ecosistemas al occidente (ej. Selvas inundables del Urabá y Selvas del Darién en los departamentos de Antioquia y Chocó) y oriente de la región (ej. Bosques de Bajo Cauca-Nechí en Antioquia), y por tanto de la conservación de los servicios ambientales del territorio.

En este sentido, como una de las iniciativas del PNN Paramillo se ha propuesto realizar estudios poblacionales de la especie para el sector Manso-Tigre-Sinú, en un área que abarca 25.000 hectáreas aproximadamente (Racero-Casarrubia, obs. pers.), para así identificar áreas y corredores claves para la protección y conservación de esta especie, además de realizar trabajos de educación ambiental con las comunidades, orientados a dar a conocer la importancia del Tapir de Tierras Bajas en los ecosistemas de selva húmeda presentes en el Departamento de Córdoba y así contribuir con su conservación a largo plazo no solamente en Colombia, sino también en el Neotrópico.

Agradecimientos

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Vampire bats bite lowland tapirs in Yasuni National Park, Ecuador

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In the rainforest, vampire bats (*Desmodus rotundus*) have large mammals such as tapirs, deer, peccaries, cattle, monkeys, birds, and sometimes humans, among their victims (Albuja *et al.*, 2012; Tirira, 2007). Vampire bats have been listed as carriers and reservoir host of rabies (Streicker *et al.*, 2012; Corrêa *et al.*, 2014). Here, we report photographic evidence obtained from camera-traps of vampire bats feeding on lowland tapirs (*Tapirus terrestris*).

Reports of vampire bat attack are generally based only on the scars present on their victims, and photographic evidence or video footage is extremely rare. The photos we present were taken in 2012, at a salt lick close to the Añangu checkpoint in the Yasuni National Park. They clearly display a vampire bat feeding on a lowland tapir individual.

Unfortunately, after the photos were taken the tapir died, but it is difficult to say if the death was caused by rabies. This would require sampling of the vampire bats population to rule out or confirm an outbreak of the disease.

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Figure 1. Lowland tapir predation by a vampire bat at the Añangu salt lick in the Yasuni National Park. Photo credits: Ministerio del Ambiente del Ecuador

Figure 2. Vampire bat feeding on lowland tapir at the Añangu salt lick. Photo credits: Ministerio del Ambiente del Ecuador

Figure 3. Dead lowland tapir found at the Añangu salt lick. Cause unknown. Photo credits: Ministerio del Ambiente del Ecuador

Crop-raiding Baird's Tapir Provoke Diverse Reactions from Subsistence Farmers in Belize

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Keywords: Belize, crop-raiding, farmer-tapir relations

Agricultural areas where people grow crops to feed themselves and their families are often physically enclosed by a fence or represented by a forest edge (Figure 1). The purpose of these physical boundaries is obvious to people but not necessarily recognised by the wild animals they are designed to obstruct (Waters, 2014). Wild animals that cross these boundaries to feed on agricultural crops are commonly referred to by researchers as crop-raiders. A major grievance of subsistence farmers is the damage that crop-raiders do or farmers believe they might do to their crops and thus their livelihoods. Political, social and/or cultural factors as well as livelihood constraints will influence a farmer's reaction to wildlife crop-raiders (Hill, 1997; Riley, 2007; Waters, 2014).

There are anecdotal reports of tapir crop-raiding behaviour in many parts of their range (Waters *et al.*, 2006). Published information includes a record of conflicts between subsistence farmers and crop-raiding mountain tapirs (*Tapirus pinchaque*) in Colombia (Suarez & Lizcano, 2002), and a violent confrontation between a crop-raiding tapir (*T. terrestris*) and a farmer in south-eastern Brazil which resulted in the deaths of both (Haddad *et al.*, 2005). There are also reports of retaliatory killing of Baird's tapir (*T. bairdii*) for crop-raiding from Campeche state in southern Mexico (Reyna-Hurtado & Tanner, 2007) and Nicaragua (Koster, 2006).

In Belize, Baird's tapir was found to use riparian forest fragments and the surrounding agricultural mosaics, inevitably bringing it into close contact with people (Waters & Ulloa, 2007). This species is the national animal of Belize and is protected by national laws; however, any tapir threatening crops or livestock can legally be shot (Anon, 2000). The Wildlife Division of the Belize government expressed an interest in finding out the extent of crop-raiding by Baird's tapir. Here, I report results of a survey focusing on subsistence farmers and their relationship with Baird's tapir in Belize and describe the range of different approaches to tapir crop-raiding behaviour. The quantitative data are based on the results of a questionnaire survey regarding farmer-wildlife coexistence in Belize.

Belize has one of the lowest human populations in Central America with ~240,000 inhabitants (Roberts, 2000) and over a third of its territory is protected in some way by conservation legislation (Anon, 2000). Agricultural practices differ depending on geographical location and, to a lesser extent, on ethnic group. Mayan farmers practice the *milpa* system of agriculture, the small scale slash-and-burn system of alternating cultivation and fallow based on indigenous knowledge of forest regeneration dynamics (Emch, 2003). The Mestizo (Indian/Spanish) population also practices the *milpa* system but allocates more land to pasture for cattle ranching (Carr, 2004).

I used a structured questionnaire to interview subsistence farmers regarding their perceptions about crop-raiding mammals in Belize. The survey took place over 12 weeks during March and May 2006. I surveyed villages outside protected areas which were selected by the wildlife department because the people who inhabit them are predominantly dependent on subsistence agriculture. The target survey population comprised men and boys over 16 years of age permanently residing in the selected village. Men and boys were chosen after my pilot study showed that women in Belize do not generally participate in *milpa* agriculture and were unable to answer many of my questions. I administered the questionnaire to an adult man in every sixth house in the village. If no adult men were at home I continued to the next house.

The survey team consisted of two people, an interviewer and a translator for those respondents who spoke only Spanish. I told the potential respondent that I was undertaking a survey about their agricultural practices. Participants were assured of anonymity and I asked their age and ethnic identity along with socio-economic questions regarding their main occupation, the crops they grew, and what issues positively and negatively affected their harvest. If wildlife was mentioned as a limiting factor on the respondent's harvest, then I asked which species caused the problem, how they caused it, and how farmers reacted to it. Data presented in percentage frequencies may sum to over 100% in questions eliciting multiple responses.

In total, 168 adult men of 23-72 years were interviewed during the survey across 63 villages located in all districts of Belize. We interviewed 2-3 men per village depending on their availability. Agriculture was the occupation for 73.2 % of those interviewed. Overall, corn was the most widely grown crop cultivated by 84.5% of respondents. Four wild mammals > 2kg were reported by more than 20% of respondents

Figure 1. Maize being cultivated adjacent to the forest edge in Belize

as being crop-raiders. White-nosed coatimundis (*Nasua narica*), peccaries (*Tayassu* sp.) and raccoons (*Procyon lotor*) were reported by 64%, 63% and 37% of respondents, respectively. Baird's tapir was reported as a crop-raider by 28% of respondents.

Respondents from 51 villages reported the presence of tapirs and 35 (69%) of those villages reported crop losses due to this species. Respondents reported that crops most frequently consumed by Baird's tapir were young bean shoots (60%), corn (57%) and plantain (11%) with cabbage, pineapple, potatoes, water melon and yam also reported as consumed by the species during crop-raiding events. Of those respondents reporting tapirs as a problem, 6% admitted killing them in retaliation for crop damage. For example, one respondent reported:

> *The tapir eats my corn every night so when I see a tapir I shoot it to eat it so I get to benefit from all that corn of mine it has eaten.*

This statement corroborates reports from other areas of Baird's tapir distribution where subsistence farmers will not forego an opportunity to kill a tapir that may be responsible for consuming and damaging crops (Estrada, 2006; Koster, 2006). In Bosawas reserve, in Nicaragua, a conservation agreement with indigenous people to reduce unsustainable hunting stipulated that crop-raiding tapirs could still be hunted, thus acknowledging the concern felt by local people that their crops are likely to be raided (Koster, 2006).

Other respondents in this survey did not consider lethal retaliation as an option and some compromised by altering their farming practices in response to heavy crop-raiding by tapirs. Seven respondents stated they expected tapirs and other wildlife would visit their fields, so they planted "enough for all". In the Toledo district, six respondents reported giving up cultivating their *milpa* due to the presence of a tapir. For instance:

> *I abandoned my bean field in the forest because the tapir ate all the plants. She had a calf so she was hungry.*

The status of the Baird's tapir as the national animal of Belize is important to some respondents with ten farmers stating they tolerated tapir crop-raiding "*because it is the national animal*".

In Central America, there are differences in people's preference for tapir meat and it is considered unpalatable by some communities in southern Mexico and north eastern Honduras (Jorgenson, 1995; Reyna-Hurtada & Tanner, 2007; Dunn *et al*., 2012). However, whether an animal is good to eat or not is immaterial to an angry farmer retaliating in response to a crop-raiding event. In this study, some individuals admitted they killed and consumed crop-raiding Baird's tapir but this was not a universal response to the problem. Some subsistence farmers attributed greater importance to the tapir's status as the Belizean national animal than any crop losses they sustained due to the species' crop-raiding behaviour. Most of the ethnographic data presented here are the result of informal conversations which took place after the questionnaires had been administered and respondents felt relaxed and more likely to discuss issues they felt important. I would thus recommend that future work employ semi-structured interviews rather than a questionnaire survey. Further data are needed to better understand the interaction between farmers and tapirs. This study suggests a remarkable heterogeneity in subsistence farmer's relations with tapirs. This heterogeneity was observed both within and among villages. It thus important that tapir conservationists working with farming communities outside protected areas work with local villagers to understand their individual perceptions of tapirs and what influences their behaviour towards the animals.

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Reintroduced Andean tapir attacks a person in the Antisana Ecological Reserve, Ecuador

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The mountain tapir (*Tapirus pinchaque*) is often perceived as a peaceful and quiet animal. This view has been re-enforced by domestication accounts that suggest mountain tapirs can be very docile and friendly after a relatively short time (Crandall, 1964; Gale and Sedgwick, 1968). However, wild tapirs are known to occasionally display aggressive behaviour, which when directed towards humans can cause dangerously deep wounds (Schauenberg, 1969). In our own work, we have observed aggressive behavior by females protecting their calves. (Castellanos, 1994; Downer, 1996; Castellanos, 2013). Farmers have also reported observing tapirs displaying similarly aggressive behavior when defending themselves from Andean bear predators (*Tremarctos ornatus*). Finally, it has been also been reported that male mountain tapirs can fight fiercely among themselves inflicting deep bites on ears and hind limbs (Schauenberg, 1969). We do not understand what triggers such behaviour, nor whether such behavior is common in the species, or if it is a trait that varies across individuals.

There are few documented cases of wild releases of captive-bred mountain tapirs. A unique case occurred in the 1990s with a female tapir named Esperanza, released in the Bosque Protector Pasochoa (or Protected Forest 'Pasochoa') in Ecuador. Though she was born in the wild, she was rescued as a calf, reared in captivity and subsequently released at eight months of age. Esperanza was released wearing a radio collar, which allowed her to be tracked for 14 months following her release (Castellanos, 1994). During her eight months in captivity, and the 14 months following her release, we did not register a single display of aggression. In a similar case, a male tapir named Poncho, rescued in 2005 as a calf and kept in captivity on a farm in the Corporacion Autonoma Regional Alto Magdalena, Colombia (Sergio Sandoval, pers. com.). Here, as in the case above, there are no registered displays of aggression towards humans. Contrastingly, a number of fatal attacks inflicted by wild lowland tapirs (*Tapirus terrestris*) (Haddad *et al.*, 2005), and non-fatal attacks inflicted by captive Malayan tapir (*Tapirus indicus*), Baird's tapir (*Tapirs bairdii*) and lowland tapirs have been reported (Naish, 2013). In all cases, attacks were perpetrated by females rearing calves.

In August 2011, a male mountain tapir calf was rescued in Los Cedros, Quijos Alto, Antisana Ecological Reserve, Ecuador. The animal, named *Leo*, was cared for and raised in captivity on a farm (Gómez *et al.*, 2013). In December 2013, the tapir was released approximately four km away from the farm in an area of cloud forest. The tapir was fitted with a leather collar to allow identification. In the months following his release, *Leo* frequently returned to the farm where he had been cared for, to feed on plants in the garden before returning to the surrounding cloud forest. *Leo*, now an adult animal of about 180 kg visited the farm on February 27, 2015 and, attacked, one of his original caretakers for no apparent reason. The man was trampled and bitten, especially around the head and hands. Only the timely intervention of park ranger Leopoldo Gomez saved the victim's life.

It is important to note that the region where *Leo* was originally released is known to be an area of high tapir/human conflict. The family that raised *Leo* reported two previous attacks by wild mountain tapirs on humans. The first occurred when three adult tapirs, possibly in courtship, chased a person forcing him to seek refuge on top of a large rock. The second happened when an adult tapir attempted to bite a lumberjack. Upon investigation, we learned Leo was involved in two additional incidents prior to the near-fatal event. On one occasion, *Leo* chased a neighboring farmer who defended himself using a club. In the other incident, he reportedly lunged towards the park ranger that had rescued him as a calf, biting only his backpack.

Given the seriousness of the case, members of IUCN/SSC Tapir Specialist Group/Ecuador and the authorities of the Ministry of Environment of Ecuador (MEE), decided to relocate *Leo* to a remote cloud forest of Cayambe Coca National Park (CCNP), over 20 km away from region where *Leo* was raised in captivity. The decision was taken to both safeguard the life of the animal and the people of the community. Unfortunately, this action was never carried out. Following a series of additional incidents in late March and early April this year in which *Leo* posed significant threats to humans, the MEE Authorities, local farmers and biologists decided that *Leo* should not be released under any circumstances due to his extraordinarily aggressive behavior towards humans. Consequently, he euthanized on April 3, 2015 by an MEE veterinarian.

The reasons underlying *Leo*'s aggressive behavior are unknown. One hypothesis is that there was a

Figure 1. '*Leo*' homing in the Gómez family farm wearing his leather ID collar. Photo by: Leopoldo Gómez

sexually active female in the region. Due to his very close interactions with humans during early development, he may have confused humans with potential competitors. Perhaps he simply felt threatened and was defending his territory. Another hypothesis is that *Leo* contracted a disorder that has made him aggressive and intolerant towards humans. *Leo* was rescued when only a few weeks old at the bottom of a sheer rock face. It is likely that he suffered an accident in which he fell down the cliff, separating him from his mother, and forcing her to abandon him. He was alone and starving upon rescue, yet it is not known exactly how many days he was without his mother (Gómez *et al.*, 2013). It is possible that *Leo* suffered a traumatic experience caused by the impact of his fall or the starvation he endured at such a crucial period in his development. This could potentially have triggered him to develop a behavioural disorder that has made him particularly vicious towards humans. Such a disorder could also have been caused by a traumatic experience during captivity or since his release. Similar behavioral disruptions have been observed in elephants (Bradshaw *et al*. 2003). Could *Leo* have suffered post-release psychological trauma after being rejected by his 'human family' on his return 'home' that provoked hyperaggressive behaviour?

Given the uncertainty surrounding what might trigger aggressive behavior in tapirs, it is highly recommended that people who come into contact with tapirs either in captivity or in the wild, take every precaution to avoid injury to both human and tapir. Ultimately, this case highlights the lack of knowledge on tapir behavior, and the impact habitat loss, encroachment, and persecution have on individual tapir behavior. Continued monitoring of tapir behavior in areas of diverse conflict is vital to help us understand how tapir/human interactions might be altering and affecting tapir behavior.

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Record and track description of a Baird's tapir juvenile in the north of Oaxaca

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Figure 1. Photograph of Baird's tapir taken with camera-trap in the north of Oaxaca, Mexico.

The presence of Baird's tapir *Tapirus bairdii* in the Sierra Madre de Oaxaca in Southern Mexico has been previously reported by Lira *et al.* (2006), using track records and information obtained through interviews. Seven years later, its presence was confirmed with pictures (Lavariega *et al.*, 2013), bone remains, and tracks (Peña *et al.*, in press). Subsequently, after three surveys with camera traps in the Sierra de Villa Alta (17°29'23"N 96°7'45.6"W; 1499 masl), additional pictures of adult animals have been obtained (personal observation, Mario C. Lavariega; Figure 1)

As part of the routine sampling activities established for recording medium and large mammals through the identification of tracks, well-marked Baird's tapir footprints and the tracks of a juvenile and an adult were found on February 15, 2014 in a muddy area bordering a stream in the mountain cloud forest in the Sierra Madre de Oaxaca (17°29'23"N, 96°7'47"W; 1530 masl). The Baird's tapir footprint has four toes, wide hoofs with round edges and hind footprints similar to the front, but with only three toes. In the tracks, back and front feet line up one over the other, corresponding with a walking or trot trail pattern (Aranda, 2000). The condition of the substrate resulted in good quality track impressions. The tracks were photographed and plaster casts of three tracks were made and were deposited in the Mammal Collection of the CIIDIR-Oaxaca (OAX.MA.026.0497).

The juvenile Baird's tapir footprint in the mud was 13.5 cm long and 15.5 cm wide (Figure 2a) and the adult's was16.0 cm long and 18.0 cm wide (Figure 2b). The adult footprint size lies within the reported footprint range: 15.24 cm to 20 cm long and 12.7 to 20 cm wide (Murie, 1997; Aranda, 2000; Pérez & Matus, 2010). The juvenile's track was composed of five footprints: three of the right hind foot and two of the left hind foot. The track measured 195 cm in length and 31 to 39 cm in width and the distance between the

Figure 2. Tracks of Baird´s tapir in the north of Oaxaca, Mexico: a) juvenile and b) adult.

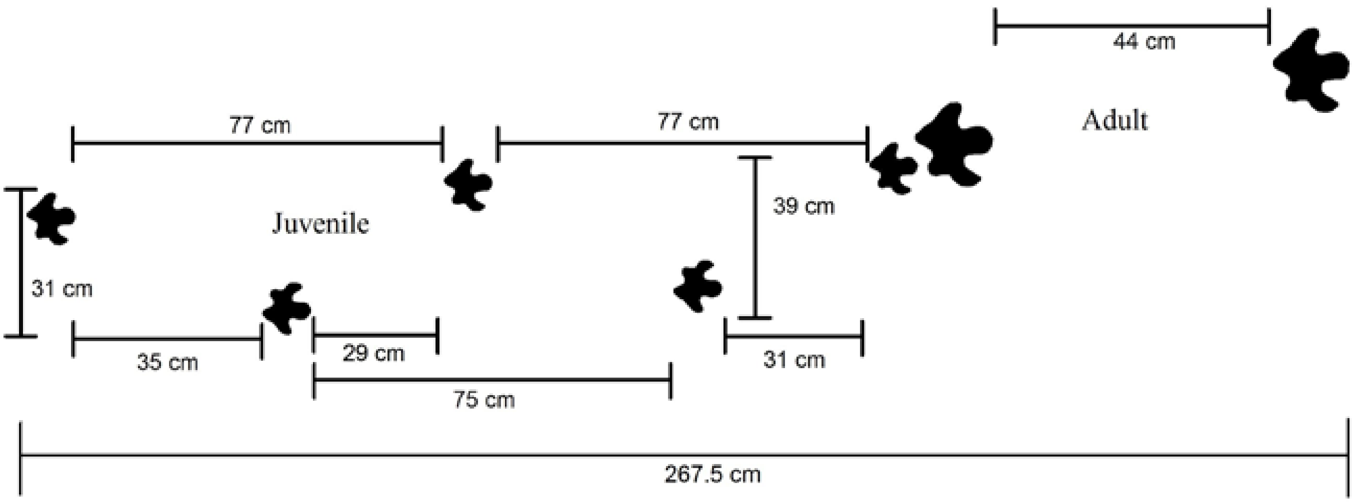

Figure 3. Track of Baird´s tapir in the north of Oaxaca, Mexico. Scheme based on photographs and field data.

juvenile and adult tracks was between 75 to 77 cm. For the adult tapir, three footprints of the right hind foot were found with a separation distance of 44 cm (Figure 3).

This finding, in addition to previous records, allows for the opportunity to further carry out research on the habitat conditions, home range and breeding sites of this species, which has been classified as endangered (IUCN, 2014) due to the threats posed by hunting and deforestation. The presence of a juvenile Baird´s tapir represents strong evidence of reproduction of Baird´s Tapir in the Sierra de Villa Alta, Oaxaca. This is relevant and highlights the value of the mountain cloud forest for the conservation of this species, because it lies within the limit of the species distribution in Mexico and for all the species. As Lira *et al.* (2006) have also noted, it is necessary to develop further studies in adjacent regions with areas of potential tapir habitat (such as Ixtlan, Veinte Cerros, Sierra Mixe) in order to promote conservation strategies in this region.

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CONTRIBUTIONS

Integrating current range-wide occurrence data with species distribution models to map the potential distribution of Baird's Tapir

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Abstract

Identifying species distributions is fundamental to understanding their ecology and guiding conservation and management strategies. We compiled 756 unique range-wide Baird's tapir (*Tapirus bairdii*) detections via camera trapping of track/sign surveys in eight countries. We then estimated the distribution of suitable tapir habitat within a Maxent-modeling framework. Though there are some clear areas of over- and under-predicted habitat, the resultant models allowed us to significantly update the potential distribution map of Baird's tapir. We estimate that 39.4% of the available area is suitable for tapirs, but only 27.2% of that habitat occurs in protected areas. We discuss the areas that comprise suitable tapir habitat, and identify global and local threats in each country.

Keywords: Climate, Distribution, Habitat Suitability, Maxent, Model.

Data Availability: Data is shared under a creative commons BY license. Data which are already published or publicly available are listed in Table 1. Data for Honduras is not yet publicly available (contact the authors). The presence data used in these models can be found at https://zenodo.org/record/18557.

Introduction

Species distribution patterns are dynamic traits that reflect the species' relationships with biotic and abiotic variables, their evolutionary histories, and their responses to disturbance (Elith & Leathwick 2009). Therefore, identification of such range-wide

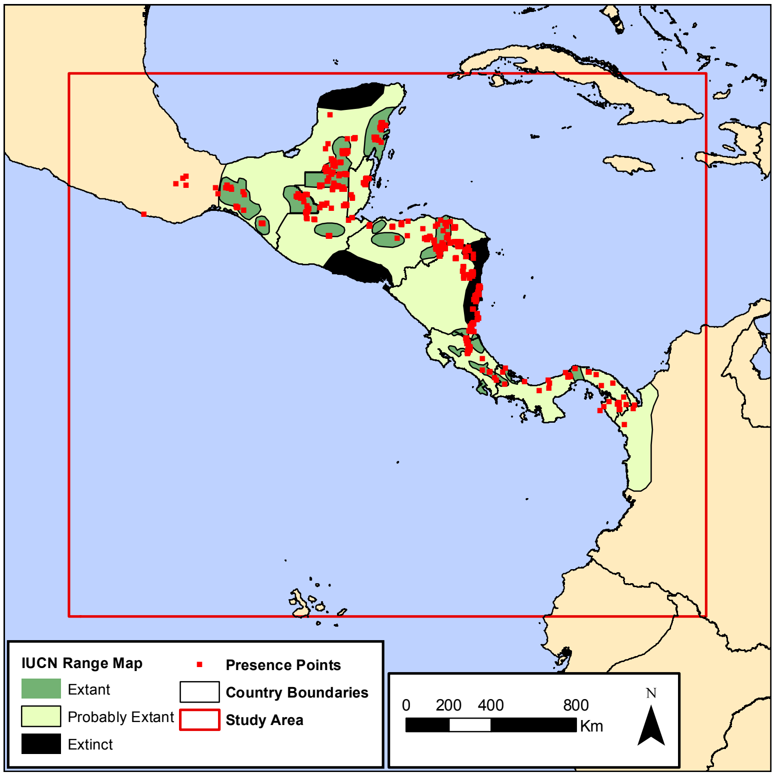

Figure 1: IUCN range map of Baird's Tapir. Locations of presence data used in the SDM, and study area extent are also included on this map.

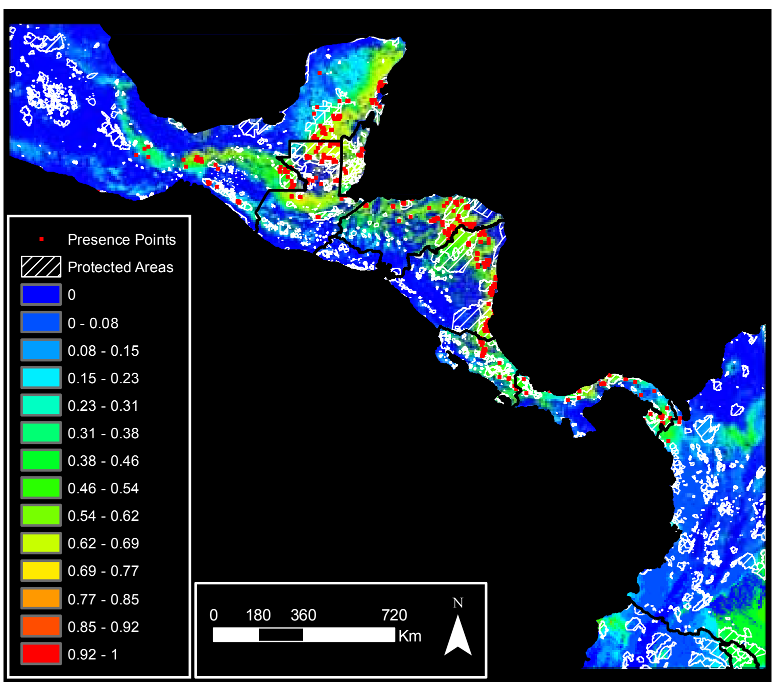

Figure 2: Maxent logistic output (values range from 0 to 1).

patterns is fundamental to the understanding of species ecology and to guide conservation initiatives, assessments and management strategies. The analysis of distribution patterns is particularly critical for species subjected to pressure from human activities (e.g., habitat loss, hunting pressure) that may limit or reduce suitable habitat. Among all mammals, tropical large-bodied herbivores include some of the groups most threatened by human impact (e.g., Perissodactyla: rhinoceros, wild horses and tapirs; Baille *et al.* 2010). Yet, in comparison with large predators (e.g., felids) large herbivores usually draw less attention in terms of the urgency of their conservation despite the fact that the loss of large-bodied herbivore mammals causes a significant impoverishment of local mammal communities, and can lead to the disappearance of entire evolutionary lineages (e.g., Perissodactyla). Furthermore, extirpation of populations of large-bodied herbivores, or even their marked decrease, can cause the interruption of the variate ecological roles these fauna play in their natural habitats (Dirzo *et al.* 2014; Ripple *et al.* 2015). The activities of large-bodied herbivores indirectly and directly affect the occurrence and abundance of coexisting species in their natural ecosystems. For example, by continuously browsing, trampling, defecating and urinating, large-bodied herbivores generate habitat heterogeneity that provides the opportunity for some species to establish (Ripple *et al.* 2015). Likewise, it has been shown that the experimental removal (mimicking defaunation) of large-bodied herbivores (tapirs included) from the tropical rain forest understory significantly affects seedling survival and recruitment patterns, resulting in increased seedling density, but decreased seedling diversity (Camargo-Sanabria *et al.* 2015).

The Baird's tapir (*Tapirus bairdii*) was originally distributed almost continuously from southern Mexico to northern Colombia and Ecuador (Alston, 1882; Matola *et al.*, 1997). However, due to the compounding impacts of habitat alteration and hunting, the original distribution has been reduced by >50% and fragmented over the past three decades (Castellanos *et al.*, 2008). The endangered status of Baird's tapirs, among other threatened large mammals such as jaguars (*Panthera onca*) and white-lipped peccaries (*Tayassu pecari*), has stimulated the establishment of the Mesoamerican Biological Corridor to enhance and ensure suitable habitat for connecting populations among spatially discrete protected areas (Miller *et al.*, 2001). The endangered status of Baird's tapirs has also sparked many recent surveys and demographic studies in multiple countries across the entire range within and outside of protected areas (Gonzalez-Maya *et al.*, 2012; Jordan & Urquhart, 2013; Mendoza *et al.*, 2013; Meyer *et al.*, 2013; Cove *et al.*, 2014). Surveys using new technologies such as camera traps have advanced our current understanding of local tapir distribution and even led to the rediscovery of populations previously believed to be extinct, for example, along the Caribbean coast of Nicaragua

Table 1: Presence data contribution by source and country.

Source	# of presences	Geographic coverage
Garcia *et al.* (2009)	170	Guatemala
Chris Jordan	167	Nicaragua
Mendoza *et al.* (2013)	129	Mexico
National Action Plan for Tapirs in Honduras	125	Honduras
TEAM	47	Costa Rica
Ninon Meyer	32	Panama
Georgina O'Farrill	29	Mexico
Celso Poot	28	Belize
Cove *et al.* (2014)	11	Costa Rica
Jan Schipper/José F. González-Maya	7	Costa Rica
Cody Schank	7	Nicaragua
Diego Lizcano	4	Colombia
	Total = 756	

Table 2: Environmental predictor variables used in the SDM.

Variable Code	Variable Description
ALT	Elevation
BIO1	Annual Mean Temperature
BIO4	Temperature Seasonality (standard deviation *100)
BIO5	Max Temperature of Warmest Month
BIO6	Min Temperature of Coldest Month
BIO12	Annual Precipitation
BIO15	Precipitation Seasonality (Coefficient of Variation)
BIO16	Precipitation of Wettest Quarter
BIO17	Precipitation of Driest Quarter
BIO18	Precipitation of Warmest Quarter
BIO19	Precipitation of Coldest Quarter

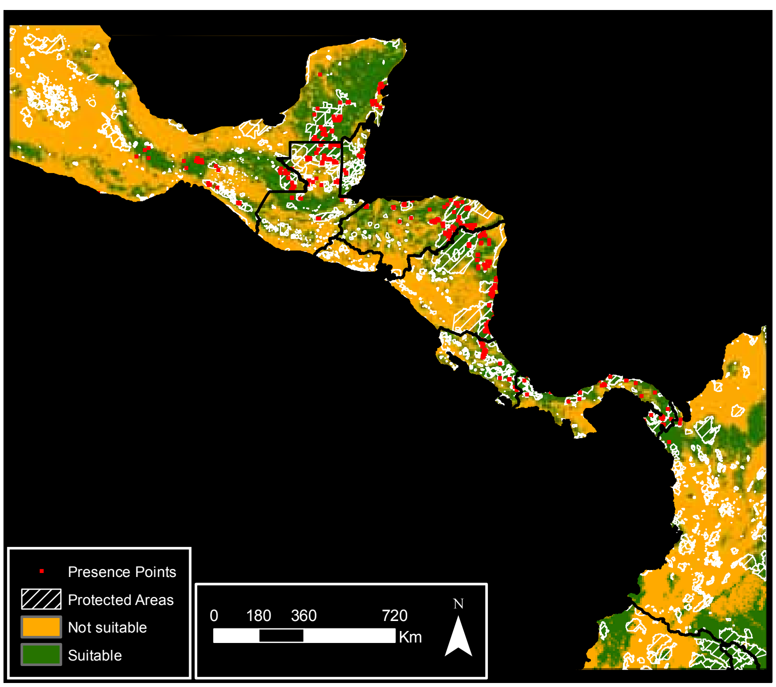

Figure 3: Threshold applied to Maxent output to produce a binary presence-absence map.

(Jordan & Urquhart, 2013). Yet, these new important datasets have not been compiled and analyzed on a range-wide scale, meaning that many of the previous distribution maps are either outdated or limited to only a portion of the original extent (e.g. regionally restricted, Mendoza *et al.*, 2013). Here, we compiled data across all of the Mesoamerican countries (except El Salvador, where the species is reported as extinct) to estimate the current distribution of *T. bairdii* using the most recent range-wide occurrence data within a species distribution modeling framework.

Materials and Methods

The emergence of modeling algorithms based on occurrence data have greatly improved our ability to describe distribution patterns of tropical species, for which accurate information on its presence (i.e., georeferenced records) can often be particularly limited (Cayuela et al. 2009). These modeling approaches use geo-referenced presence data and GIS layers describing spatial variation in environmental variables (usually climatic) to identify the corresponding space in which the probability of species occurrence is heightened. Freely available software, such as Maxent, are used in these modeling procedures and achieve high predictive accuracy in creating maps of suitable habitat (Phillips & Dudik, 2008).

Our study area consists of a rectangular grid covering the entirety of the known distribution of Baird's tapir (101° to 74° W and 1° S to 22° N, at a resolution of 1 km2; ; Figure 1). The presence data used in this modeling exercise were compiled by IUCN/SSC Tapir Specialist Group (TSG) Country Coordinators and additional collaborators and sources (Table 1). The data set includes a total of 756 unique locations of tapir detections (camera trap and track/sign) across all range countries. Most observations cover the years 2000 to present, though there are a handful of records from the 1990s. We modeled the distribution of Baird's tapir with Maxent (Phillips & Dudik, 2008) using 10 climatic variables and elevation (Hijmans *et al.*, 2005; Table 2) as predictor layers in the SDM (following Mendoza *et al.*, 2013). The predictor

Table 3: Suitable habitat for Baird's tapir by country, as predicted by the SDM. The second to last column is the percent of suitable habitat in each country that is protected, determined using data downloaded from protectedplanet.net (IUCN & UNEP-WCMC 2014). The last column shows the percent of suitable habitat contributed by each country across the study area, excluding Colombia because of its large area and probably small contribution to actual tapir habitat.

Country	Total Area (km2	Suitable Area (km2)	Suitable Area (%)	Suitable Protected (km2)	Suitable Protected (%)	Contribution (w/o Colombia)
Belize	21,591.68	15,928.29	73.77%	7,092.60	44.53%	3.37%
Colombia*	440,973.30	136,687.85	31.00%	24,253.81	17.74%	
Costa Rica	51,071.16	33,924.31	66.43%	11,895.11	35.06%	7.18%
El Salvador**	20,352.49	2,516.86	12.37%	458.05	18.20%	0.53%
Guatemala	109,151.03	57,070.46	52.29%	24,212.39	42.43%	12.09%
Honduras	111,916.88	60,624.57	54.17%	17,402.60	28.71%	12.84%
Mexico*	588,054.49	200,442.46	34.09%	32,156.10	16.04%	42.45%
Nicaragua	128,124.62	53,096.82	41.44%	29,289.86	55.16%	11.24%
Panama	73,645.89	48,632.14	66.04%	18,659.18	38.37%	10.30%
Total	**1,544,881.55**	**608,923.75**	**39.42%**	**165,419.71**	**27.17%**	
Total (w/o Colombia)		**472,235.90**				

*study area does not include all of country

**tapir are considered extinct in El Salvador

layers were masked so that islands were excluded from the analysis. We used a bias grid (Elith *et al.*, 2010; Clements *et al.*, 2012) to control for the effect of sampling bias in our presence data. We also selected the response curves and jackknife options to examine the effect of individual predictors (Supplement). All other Maxent settings were left at their defaults (including output = logistic). We then used a forest cover layer (Hansen *et al.*, 2013) to mask out all cells with less than 50% forest cover (Figure 2). Finally, we created a binary map (presence/absence) using model prevalence as a threshold (Liu *et al.*, 2005) (Figure 3; Supplement - detailed maps).

Results and Discussion

The resulting model estimated an area under the curve (AUC) of 0.881, predicting suitable habitat for Baird's tapir within all range countries with a discontinuous distribution that includes: the Sierra Madre and Pacific coast of Mexico; the volcanic chain in the Pacific slope of Mexico and Guatemala; the Yucatán Peninsula in Mexico, Guatemala and Belize; Atlantic coasts of Guatemala, Honduras and Nicaragua; and the Atlantic and Pacific coasts of Costa Rica, Panama and Colombia. Main habitat strongholds include forest remnants in the Sierra Sur of Mexico; the Selva Maya region in Mexico, Guatemala, and Belize; the Moskitia region in Honduras and Nicaragua; Atlantic coasts of Nicaragua, Costa Rica, and Panama; the Darien region in Panama and Colombia; and areas in the Pacific coast region of Ecuador..

The resulting binary map predicts 39.4% of the land surface in the study area as suitable habitat for tapirs (Table 3). However, the actual distribution of the species is much smaller, partly because the above estimate includes portions of the study area which fall outside of the known distributional limits of the species (especially true for Colombia and Ecuador - see Discussion). In addition, a relatively low threshold was chosen for the binary map, which could overestimate the amount of suitable habitat, however, this habitat suitability map could be further refined using expert knowledge. Furthermore, some of the habitat fragments classified as suitable are substantially smaller than commonly cited estimates of Baird's tapir home range (i.e., 2.32 square km in Costa Rica; Foerster 1998) or farther from larger connected forests or protected areas than expected tapir dispersal distances (i.e., 1.5 km for *T. terrestris* in Brazil; Medici 2010) questioning the ecological value of these patches for the species survival. Therefore, many suitable patches in our model results are likely too small and/ or too far from larger contiguous forest (e.g., protected areas) to sustain a viable population of tapirs over the long-term. More accessible, fragmented areas classified as suitable may also be less likely to harbor tapir populations due to high hunting rates (Peres 2001). Taking the above factors into consideration, the suitability map produced here can be further refined to represent the true distribution of the species by explicitly integrating expert opinion regarding viable populations, tapir movement ecology, and local on-the-ground knowledge.

Across the study area, only 27.2% of suitable habitat occurs in protected areas (Table 3). However, the "protected" status of these areas does not necessarily indicate that they serve as a refugia for tapirs. Protected areas are all managed differently depending on the country, their protection, or legal status (e.g., national park, forest reserve, indigenous lands, etc.), the local municipality where they are located, and the state of national policies and funding for reserve staff and guards (Hockings, 2003). Nicaragua, for example, has the highest proportion of tapir habitat under protection (55.2%), however the country has recently experienced extensive habitat destruction within protected area boundaries (Watsa, 2014). Hunting is also perceived to be a problem in some notable protected areas (e.g., La Amistad Bi-national Park in Costa Rica and Panama -- Castellanos *et al.*, 2008), yet there remains very limited tapir hunting in some unprotected areas where ecotourism and conservation education have succeeded in transforming local communities' views on tapirs, particularly in Costa Rica (Cove *et al*., 2014). Variables with the greatest percentage contribution to the model were temperature seasonality (33.9%), precipitation seasonality (31.5%), precipitation of the driest quarter (9.7%) and maximum temperature of the warmest month (9.1%), explaining about of 84% of the potential distribution. The response plots suggest that tapirs prefer habitats with both low temperature and precipitation seasonality, and intermediate range of maximum temperature in the warmest month (not too hot, neither too cold). The association of tapir's preferred habitat and low seasonal variation in temperature and precipitation suggests tapir populations could suffer high impact given current climate change scenarios for the region. Some of the most critical regions are those with low precipitation during the driest quarter such as the Selva Maya, where climate change may become a relevant threat to wild populations (Anderson *et al*., 2008; García *et al*., 2012). However, tapirs do occur in some tropical dry forests (see below in Costa Rica section), and studying these populations has the potential to contribute to our understanding of how tapirs mitigate and adapt to dry climates, and thus help in making tapir populations more resilient to the predicted impacts of climate change.

Below, we discuss the individual countries and their contributions to habitat for the Baird's tapir.

Mexico

The suitable tapir habitat identified by this study is mostly in agreement with the suitable habitat described by Mendoza *et al*. (2013) for the Mexican portion of the Mesoamerican biological corridor and its vicinity. Recent fieldwork conducted by Botello *et al*. (2014) and Naranjo *et al*. (2015) confirmed the presence of Baird's tapir in the areas identified by Mendoza *et al*. (2013), which are also included in this model. Modeled suitable habitat is predominantly located in areas where potential vegetation, according to Rzedowski (1998), are: tropical rainforest, semi-evergreen tropical rainforest, montane forest, pine and oak forest. To a lesser extent, suitable tapir habitat is located in areas of deciduous tropical forest and wetland. Scarce coincidence of potential tapir habitat with tropical dry forest areas contrasts with observed presence of Baird's tapir in that type of forest in more southern countries (e.g., Costa Rica). This situation might be related to lower annual precipitation in the dry forests of Mexico, which can reduce abundance of food resources and cause physiological stress.

It is evident that there are some areas for which this study predicts suitable habitat where tapirs certainly do not occur, most strikingly central Mexico. This overprediction results from: (1) including areas for which no historic or contemporary records of tapirs exist to support the species' presence (e.g., western limit of the state of Guerrero and northern limit of Veracruz, Puebla and Hidalgo); and (2) from including areas where tapir originally occurred but are now thought to be locally extinct due to human impact (e.g., Los Tuxtlas, Veracruz). In the first case, overprediction seems to be related to the occurrence of montane forest and pine-oak forest, which is somewhat similar to the forest where the species occurs in more southern locations. Yet, overall, model predictions are in agreement with regional studies indicating that main tapir strongholds occur in the states of Chiapas, Oaxaca, Campeche and Quintana Roo (Naranjo 2009). Despite the likelihood of overprediction, evidence indicates that Mexico supports ~20% of the remaining Baird's tapirs, making the country critical for the long-term survival of the species. A large portion of predicted suitable tapir habitat is within protected area boundaries (~16%, Table 3). However, deforestation in southern Mexico (Mendoza *et al*., 2013) and the decrease in availability of water resources due to climate change (O'Farrill *et al*., 2014) are likely to isolate main tapir strongholds by reducing habitat connectivity.

Belize

Locally known as mountain cow in Belize, *T. bairdii* is the country's national animal. With more than 60% forest cover (Cherrington *et al*., 2010), and a wide network of terrestrial protected areas, tapirs are known to occur in all six districts of Belize. Our model suggests that ~74% of Belize's territory is suitable tapir habitat, including areas in all six districts. These findings support earlier work by Waters and Ulloa (2007) that documented the species' presence widely throughout the country, including outside protected areas. The two largest blocks of contiguous suitable habitat for tapirs are the Rio Bravo Conservation and Management Area in northwestern Belize, which is contiguous to the tri-national Maya Forest; and the Chiquibul/Maya Mountain Massif in southwestern Belize. The model also shows that the Central Belize Corridor, comprised primarily of privately owned unprotected lands, likely provides connectivity between these two larger tracts of forest, highlighting the importance of encouraging conservation on private property in Belize.

Urban expansion is the greatest threat to tapirs in Central Belize (Belize District). Central Belize is comprised primarily of lowland savanna, wetlands, and lowland broadleaf forests. Our model highlights this area as unsuitable habitat for the species; however work by Poot (2014) documented high incidence of tapir vehicle collisions in this human dominated landscape. Current monitoring efforts confirm regular presence of the species throughout this particular region, including wetlands and mangrove habitat (Poot unpublished). Conversion of large tracts of forest for sugar and grain production over the past three years in western Belize (Cayo District) will undoubtedly put additional pressures on the species' available habitat. Future conservation action should include ground-truthing the species presence at the national level, both inside and outside of protected areas, which will assist in future management decisions and policy by providing quantitative empirical data to inform decisions.

Guatemala

The results from this model are consistent with information presented by García *et al.* (2011), who indicated that the most extensive, continuous tract of suitable habitat for tapirs in Guatemala is the northeastern region of the country, primarily within the Maya Biosphere Reserve in the tri-national Maya Forest. The Sierra del Lacandón National Park (the area of connectivity with Mexico) and Sierra de las Minas Biosphere Reserve (the last primary cloud forest area) are two additional important regions for tapirs, given the high percentage of suitable habitat. In the central and eastern region there are numerous small patches of suitable habitat where the species still occurs; despite being isolated remnants, the importance of the genetic variability of those populations must be considered in future action planning. Although the model shows suitable habitat in the Pacific lowlands, the species is considered to be locally extinct (Saunders *et al.*, 1950). Our results reveal suitable habitat for some sites where the species occurred in the 1900s, including the volcanic chain in the Pacific region; however forest fragmentation and reduction, and hunting have almost certainly resulted in the extirpation of the species from these regions.

Honduras

Our model shows that suitable habitat for Baird's tapirs in Honduras is located in lowland tropical forest in the east of the country (mainly the Honduran Moskitia), and cloud forest along the Atlantic coast. Both pine forest and dry forest habitats appear as areas of low suitability. We are unaware of any tapir report from pine forest in Honduras; and the most recent anecdotal records of tapirs in dry forest date back to the 1960's. Unsuitable habitat includes agricultural and urban areas. To a lesser extent the model also indicates suitable habitat in southwestern Honduras, although the occurrence and status of tapir populations in this region is unknown.

Pristine cloud forest remains in southwestern Honduras, but these areas have been historically surrounded by pine forest or pine-oak forest assumed to be poor habitat for tapirs; different from the cloud forest in the Atlantic which transitions into lowland broadleaf tropical forest (Anderson & Bonta, 2002). Nonetheless, few surveys have been carried out in southwestern Honduras cloud forests, thus our model points to this part of the country as an important area to search for tapirs in the future.

The tract of forest shared between eastern Honduras and northern Nicaragua is the second largest area of continuous tapir habitat in the study area. However, this trans-frontier biosphere reserve is being rapidly deforested for pasture lands. The model indicates continuous suitable tapir habitat from the Panama Canal to central Honduras where the Aguan Valley, dominated by agricultural landscape, rises as a barrier; this barrier continues to the south across pine forest, pine-oak forest and human dominated landscapes.

Previous work estimated that 38.5% of all forest in Honduras is inside protected areas (ICF-GIZ, 2014), nonetheless the model shows that only 28.71% of the tapir's suitable habitat is under some protection category. The creation of protected areas has not aligned well with the critical areas for Baird's tapir conservation; a program for tapir and wildlife conservation at a large scale is needed to ensure the conservation of large mammals in Honduras. Among the main threats to tapirs are habitat loss due to the conversion of lowland tropical forest to oil palm plantations in northern and eastern Honduras, and the conversion of cloud forest to coffee farms along the Atlantic mountain ranges. Poaching is also an important threat in the cloud forest of middle Honduras, where these isolated forest remnants are surrounded by high density human settlements (McCann *et al.*, 2012). However, for tapir that occur on indigenous lands, hunting levels are usually relatively sustainable (Dunn *et al.*, 2012; Estrada 2004).

Nicaragua

Our results suggest that there are two areas of suitable habitat that likely serve as strongholds for tapirs in the Caribbean Region of Nicaragua: the Bosawás Biosphere Reserve and the Indio-Maíz Biosphere Reserve. Results also indicate that the remainder of the Caribbean Coast may function as an important corridor of suitable habitat between the Baird's tapir populations in these two strongholds. However, in the past ten years, increasing rates of deforestation both inside and outside of protected areas, the expansion of oil palm plantations and large development projects, widespread unsustainable poaching, and poor to no environmental law enforcement in the Caribbean Coast have probably eliminated connectivity between tapir populations in the far north of the country and those in the far south (Jordan *et al.*, 2014).

Uncontrolled hunting and deforestation along a cattle ranching frontier that is quickly advancing from west to east across the Caribbean Coast threaten the survival of Nicaragua's tapirs over the long-term (Jordan *et al.*, 2014). Due to these same phenomena, much of the suitable habitat west of our detection data in the Caribbean region, perhaps with the exception of the regions to the far north, are unlikely to harbor tapirs. Indeed, most remaining forests far from the Caribbean Coast are typically hunted unsustainably and isolated within cattle ranches (C. Jordan, unpublished). Other regions, such as volcanic islands in Lake Nicaragua, appear as suitable habitat in our maps but do not harbor tapirs. Despite the overprediction of tapir distribution and the increasing threats to Nicaraguan tapirs, the country remains a significant link in the Baird's tapir's global range, especially given the apparent corridor of suitable habitat connecting Honduras and Costa Rica and the large portion of the remaining suitable habitat that enjoys nationally protected status (55.16%). Our modeling results corroborate the conclusion of Jordan and Urquhart (2013) concerning the greater importance of the Caribbean Region of Nicaragua compared with the Pacific Region, which differs from some prior Baird's tapir range maps (i.e., Figure 1).

Costa Rica

Costa Rica is well known for its reliance on ecotourism as a primary driver in the national economy (Fennel and Eagles, 1990). With nearly 25% of the country protected as national parks, forest reserves, and wildlife refuges, Costa Rica has among some of the highest proportions of the total land mass in protected habitat. However, of the 66% of the country classified as suitable, our models suggest that only 35% of that potential tapir habitat is located in protected areas. Costa Rica's government incentives for landowners to reforest fallow lands has led to an increase in forest cover in some areas with secondary forest and tree plantations (Morse *et al.*, 2009). These private lands can function as suitable corridors between protected areas and many of these areas are represented in our models of suitable habitat. Cove *et al.* (2014) observed tapirs utilizing secondary forest and even exotic tree plantations in the northern zone of Costa Rica, further suggesting tapirs might be resilient to colonize new forest patches if there is enough forage and cover available in the biological corridors between them.

Although the model accurately predicts most of the tapir habitat in Costa Rica, there are several areas that are likely overpredicted and some that are underpredicted which require further examination. For example, Santa Rosa National Park in northwestern Costa Rica is an area that was not identified as suitable habitat, yet the adjacent Guanacaste National Park was identified as suitable tapir habitat within our predicted distribution map. Tapirs occur in both of these national parks (Janzen, 1982; Wainwright, 2007). This exemplifies a case of underprediction due to climatic data because Santa Rosa is largely dry forest. Similarly, Wainwright (2007) suggested that tapirs occur in Palo Verde National Park which was also identified as non-habitat in our models due to the dry climate of that park. Underprediction of tropical dry forests as suitable habitat is most likely an artifact of sampling biases with a lack of data points from these regions. This issue might extend beyond the dry forests of Costa Rica and warrants further study of tapir occurrence and ecology in drier climates to further update the model. Areas of suitable habitat on the Nicoya peninsula are likely not occupied by tapir, since they have been extirpated from protected areas such as Cabo Blanco (Timm *et al.*, 2009) and Wainwright (2007) suggested no tapir occurrence on the entire peninsula. Additionally, there are some areas extending along the Caribbean coast between Limon and Cahuita National Park that have undergone recent development and expansion of plantations that likely represent areas where tapir are no longer present. These areas might, however, warrant further survey to validate our model predictions.

The agricultural expansion of pineapple production has increased dramatically over the past decade, particularly in northeastern Costa Rica, and this land clearing practice is likely the largest threat to available tapir habitat in the country (Cove *et al.*, 2013). Whereas, exotic tree plantations provide cover, pineapple fields prevent movement by tapirs as they function as effective barriers to tapir dispersal in the absence of biological corridors (Gonçalves da Silva 2007; Medici 2010). The increasing economic growth of pineapple production might further increase the infrastructure of these areas, and could potentially lead to more paved roads and multi-lane highways, which have been identified as threats to tapir conservation in other countries (Castellanos *et al.*, 2008). Although there is significant habitat in Costa Rica and hunting pressure is relatively limited, the potential expansion of pineapple plantations, urbanization, and roads could play a role in reducing suitable habitat and increasing the likelihood of human-tapir conflict.

Panama

Panama is particularly important for Baird's tapirs because it constitutes the only link between tapirs in Colombia and those in Central America. Most of the suitable habitat predicted in Panama is along the Atlantic coast, especially farther east where large protected areas are connected by the primary forests of the indigenous territories Embera and Guna. The model overpredicts tapir distribution nationally, especially in the pacific side of the country, which has experienced widespread deforestation. With the exception of the Darién National Park, the few large patches of forest remaining in the Pacific region host endangered species such as the jaguar (Moreno *et al.* in press) and could potentially harbor tapirs, but no evidence of tapir occurrence has been reported for decades (Meyer *et al.* 2013). Even though some of these forests are protected, they are too far from contiguous forests that do support tapir populations to allow their recolonization by the species. Another overprediction of tapir distribution occurs in Central Panama. Outside of Barro Colorado Island, there is probably no resident population of tapirs in the area (Meyer *et al.* in press). Central Panama is heavily fragmented, and although illegal, hunting pressure is high throughout the area including in the numerous protected areas of the Canal watershed that are easily accessible (Wright *et al.* 2000). The rapid economic development that Panama is currently experiencing leads to habitat loss and fragmentation (Heckadon-Moreno 1993) and combined with hunting (killing events are regularly reported), these factors threaten the long term viability of tapir populations in Central Panama. Only 38% of predicted suitable habitat for tapirs is protected, thus conservation strategies should focus on maintaining forests with no protected status between the large protected areas along the Atlantic Coast in order to enable connectivity and ensure the long term persistence of tapirs along the Isthmus of Panama.

Colombia/Ecuador

The model predicts suitable tapir habitat in Colombia across a wide range of climates, including the extremely wet Chocó region, where Baird's tapir was recorded recently by several researchers in Los Katios National Park (Mejia-Correa *et al.* 2014), and also the dry forests and savannas of the upper Sinu River (Caribbean region), where Philip Hershkovitz registered the species in the first half of the 20th century, sympatric to *Tapirus terrestris* colombianus (Hershkovitz 1954). Despite the model predicting suitable habitat there, Baird's tapirs have not been recently recorded in the upper Sinu river (Solari *et al.* 2013), while explorations have recorded *Tapirus terrestris* colombianus in the municipalities of Segovia and Remedios in Antioquia (Arias Alzate *et al.* 2009). It is interesting that no suitable tapir habitat was predicted by the model in the Bahia Solano region, were Baird's tapir was reported as locally extinct in the second half of 20th century due to overhunting (Ulloa *et al.* 2004), even though substantial forest cover still remains.

The southernmost record of Baird's tapir in Colombia is from Departamento de Nariño on the Pacific slopes of the Andes in southern Colombia, where Baird's tapirs were reported as declining in the 1980s due to overhunting (Orejuela 1992). However no records have been recently obtained in southern Colombia. Interestingly, habitat predicted as suitable by our model in Ecuador coincides with the region north of Guayaquil where Hershkovitz (1954) reported an individual of Baird's tapir (though the exact locality is unknown). Baird's tapirs are depicted in the red book of mammals of Ecuador, however it is included as almost extinct (Tirira 2001). There have been no records of Baird's tapirs in Ecuador in the last 50 years despite survey efforts (Urgilés-Verdugo *et al.* 2013).

Conclusion

This study represents a clear improvement of our knowledge on the global distribution of Baird's tapir habitat, particularly when it is compared with previous maps (such as that used in the IUCN Red List - Figure 1). Use of climatic and forest layers produced a more sensitive description of potential tapir distribution, which is particularly clear in its northernmost limit in Mexico. Thus, this study provides a more realistic and updated description of current Baird's tapir habitat distribution that can be used as a baseline for more comprehensive and refined analyses in the future.

The present study resulted from a collaborative effort involving researchers from several countries (including all of the countries in which Baird's tapir is present) and with many different fields of expertise. Our collaboration yielded not just a unified database of tapir presence data and tapir distribution maps, but also allowed us to compile detailed information on current threats in each of the participating range countries. The main threat is habitat loss due to land use change for agriculture, pastures, and infrastructure, causing habitat connectivity loss and isolation of tapir populations. Additionally, poaching and collisions with vehicles are another relevant threat in most range countries. The formal continuation of this partnership between global tapir researchers will ensure that we can efficiently produce the maps and supporting documents needed to design and implement the actions that will be necessary in coming years to ensure the survival of Baird's tapir populations and the conservation of their habitat.

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TAPIR SPECIALIST GROUP

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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).
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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.

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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.

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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.

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

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Contents

TAPIR SPECIALIST GROUP