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Cover photo: Medardo Tapia, director of the Centro Ecologico Zanja Arajuno, Ecuador, works to reduce hunting of lowland tapirs. Photo by Hugo Santacruz.

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FROM THE CHAIR

I hope this issue of Tapir Conservation finds all of you very well!

Before you go ahead and enjoy the great articles included in this issue, let me keep you here with me for a little while so that I can give you a few exciting updates about the work of the IUCN/SSC Tapir Specialist Group!

Some of us had the opportunity to attend the **First Latin American Tapir Symposium** held in Puyo, Ecuador, from May 8 to 11 (please see Andres Tapia's note about the conference in our Conservation section). This conference was an initiative of our TSG members in Ecuador, with the support from several local organizations including IUCN South America. It was held in conjunction with the annual meeting of the Ecuadorian Mammal Society. It was a great conference, with fantastic presentations and loads of new information about the three tapir species in Latin America. Nevertheless, I have to say that the best part of the conference was the opportunity we had to meet a number of new researchers working on tapirs in countries where we do not have a strong representation, such as Venezuela. The conference in Ecuador brought new blood and energy to the Tapir Specialist Group!

Speaking of meetings, I am currently taking the first steps on the organization of the **Sixth International Tapir Symposium** to be held in Brazil in 2014. The conference will be held in Campo Grande, capital of Mato Grosso do Sul State, in the central part of Brazil, where I live and work. Campo Grande is known as the gateway to the Brazilian Pantanal!

In consultation with the TSG Steering Committee we have set the dates for the conference: 16-20 November, 2014. I will now work on the local logistics here in Campo Grande and we will soon start our fundraising campaign. A group of us will be attending the major zoo association conferences in September and October, including AZA, EAZA and WAZA, and we hope to be able to approach as many tapir holding zoos as possible.

Something very new about the Tapir Symposium in Brazil is that before the conference starts we will be holding two days (15th and 16th of November) of short-training courses (4-hour sessions) on specific topics suggested by members of the group. The topics we have considered so far include: fundraising, red listing, communication tools, camera-trapping, evaluation of hunting impact, mapping of tapir distribution and threats, tapir occupancy and abundance (research design and data analysis using R). We already have instructors for most of these courses, and these people will be responsible for putting the training sessions together.

This time we will not have mid-conference trips as we did for previous conferences. Campo Grande does not really have options for mid-conference trips nearby. We will hold a 4-day symposium without any breaks and then offer packages for pre- and post-conference trips for those interested in exploring the Pantanal.

Last but definitely not least, I would like to report that we have just finalized the 2013 funding cycle of the **TSG Conservation Fund (TSGCF)**. We received 12 proposals and five (5) of those were selected for funding (US$2,000 grants). I would like to thank our TSGCF reviewing committee for their hard work reviewing and selecting proposals. In addition, I would like to congratulate our grantees: **Christopher Jordan** (Increasing Innovation and Efficiency of Regional Government in the Prevention of Tapir Hunting, Nicaragua), **Jaime Andres Suarez Mejia** (Evaluation of the National Program for the Conservation of Tapirs in Colombia), **Juan Pablo Reyes Puig** (Andean Tapir Conservation and Monitoring in Chamanapamba Reserve: A Cloud Forest Refuge for the Species in Central Andes of Ecuador), **Lee McLoughlin** (Integrating the National Animal of Belize, the Baird's Tapir, into the National Curriculum through the Development of Compatible and Innovative Educational Materials), and **Nay Myo Shwe** (Rapid Assessment of Malayan Tapir in Five Potential Townships of Taninthayi Range and Vicinity, Myanmar).

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

Best from Brazil,

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

SPOTLIGHT

The purpose of the Research Spotlight is to showcase relevant and important research that is of interest to tapir research. In this volume, we have contributions from Mathias Tobler and Ahimsa Campos-Arceiz, giving their takes on two very interesting papers. Mathias calls attention to an interesting paper exploring the use of camera-trapping to determine the conservation status of the Malay (Asian) tapirs. Ahimsa looks at the possibilities that are opening to us with technological developments in the field of genetics. We are open to suggestions and submissions to the research spotlight. We hope you enjoy our choices.

Camera traps document the status of the Asian tapir across its range

Linkie, M., Guillera-Arroita, G., Smith, *et al*. 2013. Cryptic mammals caught on camera: Assessing the utility of range wide camera trap data for conserving the endangered Asian tapir. Biological Conservation 162, 107-115.

The Asian tapir is one of Southeast Asia's least studied large mammals. Together with other members of the Southeast Asian megafauna such as the Asian elephant, the Javan rhino, the Sumatran rhino, and the gaur its populations have been rapidly declining due to hunting and habitat destruction. Assessing the range-wide status of a species is a difficult task generally requiring workshops with participants from all range countries. This study shows a different approach. Taking advantage of a growing number of camera trap studies being conducted throughout Southeast Asia, the authors compiled data from 19 study areas including 1128 camera trap sites for a large-scale analysis that gives us an insight into how the species is doing in different protected and unprotected areas. By calculating occupancy (the percentage of the sampling area used by tapirs), the researchers were able to not only determine the presence of tapirs for each study area but also to obtain a relative abundance index that shows the status of each population.

The results give some reasons for hope for the future of the Asian Tapir. Tapirs were found in 90% of all the study areas and had high occupancy values in nine areas. The result confirmed the current range estimate and in some cases extended it. A clear difference can be seen between the southern part of the range including the Indonesian island of Sumatra and peninsular Malaysia where tapirs had a high probability of occurrence in almost all areas surveyed and the northern range countries of Thailand and Myanmar were tapirs were less abundant or absent. The authors found a negative relationship between human presence, measured by the human footprint index and tapir occupancy, but mentioned that hunting of tapirs was much less common in countries with a large Muslim population (Indonesia and Malaysia) because tapirs were often considered to be related to pigs.

This study presents a novel approach to a range-wide assessment of a species' status using existing camera trap data. Compared to previous methods this approach relies less on expert knowledge and more on verifiable field data. While spatial coverage of the data is still patchy, the results paint a clear picture of the current situation and show where further data needs to be collected. Many camera trap surveys are being carried out in all tapir range country every year; some with the aim of estimating densities for larger cats such as the tiger, leopard or jaguar, others for inventory purposes, and a few specifically to study tapirs. The data from these surveys contain a wealth of important information that is largely underutilized. This article shows how combining data from many different studies can help answer important conservation questions. I hope we will see many more such collaborative analysis in the future.

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Next Generation Poo Studies

Hibert F, Taberlet P, Chave J, Scotti-Saintagne C, Sabatier D, *et al*. (2013) Unveiling the Diet of Elusive Rainforest Herbivores in Next Generation Sequencing Era? The Tapir as a Case Study. PLoS ONE 8(4): e60799. doi:10.1371/journal.pone.0060799

Let me start with a disclaimer — by writing this spotlight I am exposing my illiteracy in Molecular Ecology. Last year I attended the annual meeting of the ATBC (http://www.atbc2012.org) in Bonito, Brazil. It was an excellent meeting — as

always is — and the session that impressed me the most was one called 'DNA barcodes and beyond', in which the presenters introduced different advances in tropical environmental DNA and metabarcoding. They explained how, using Next Generation Sequencing and sophisticated bioinformatics, environmental geneticists are producing genomic libraries of certain tropical communities, such as the angiosperms of Barro Colorado Island (Panama) and Nouragues Natural Reserve (French Guiana). Once a genetic library is (reasonably) complete, researchers can tell a lot about the ecosystem just by analyzing DNA traces present in small amounts of soil, water, or biological samples. Although the idea is far from new, realizing how advanced the field is, felt revolutionary to a traditional ecologist like myself. Soon I was speculating about the opportunities that metabarcoding will bring for the study of large forest mammals, such as tapirs. But... I didn't need to speculate too much because in a different session of that very same meeting, Fabrice Hibert presented his excellent work applying metabarcoding to describe the diet of lowland tapirs (*Tapirus terrestris*) in Nouragues Natural Reserve (Hibert *et al.* 2013).

In a nutshell, Hibert and colleagues used metabarcoding techniques to sequence plant DNA extracted from 39 tapir feces found in streams nearby Nouragues station. I will wisely skip the technical details. What matters is that Hibert *et al.* obtained thousands of plant DNA sequences from each sample and as many as more than 2.5 million sequences (!) from the 39 feces altogether. The plant diversity accumulation curves reached an asymptote somewhere around 20 samples, indicating that their sample size was satisfactory to describe the diet of Nouragues. The authors were able to identify 41 plant families, 39 genera, and three different plant species (they also identified eight Sapotaceae species using a different protocol) from these samples. The families Arecaceae, Rubiaceae, Fabaceae, and Cyclanthaceae were present in all the samples, and Arecaceae and Moraceae were the families with the highest number of sequences. The authors were also able to identify seasonal patterns, showing the highest richness of DNA sequences towards the end of the fruiting season. The fact that they were so successful to obtain plant DNA from feces and describe so much about the diet of tapirs is truly impressive.

But working with highly degraded plant DNA (as the one found in feces) poses a trade-off between maximizing the chance of obtaining DNA and the taxonomic resolution. In this case, Hibert *et al.* opted for using a conservative segment of chloroplast DNA (the P6 loop), which resulted in a very low taxonomic resolution, with most of plants identified just at the family or genus level. Hibert *et al.* had previously studied the diet of that tapir population using classic methods (Hibert *et al.* 2011, PLoS ONE 6(10): e25850) and could thus compare the results of both methodologies. Compared with the classic study, metabarcoding failed to identify 49% (18/37) of the families and 76% (41/54) of the genera known to be consumed by tapirs in Nouragues. Part of this discrepancy might be because fruits, an important food resource for lowland tapirs, have little chloroplast DNA and are underrepresented in the metabarcoding study. Indeed, metabarcoding says nothing about the specific plant parts consumed, often a very important information for ecological interpretations. Other problems of the metabarcoding approach is the possibility of species misidentification (due to the use of conservative segments) and sample contamination (e.g. due to dung invertebrates and pollen grains), the cost of analyzing millions of sequences (although this is not mentioned in the study and I am not familiar with the prices, one can imagine that these techniques require heavy investments, even if just initially), and, most importantly, the dependence on a pre-existing comprehensive plant genetic library for the study area. Some of these limitations (e.g. price, need the genetic library) will get better with time. For the other issues, it might be necessary to combine methods — e.g. metabarcoding and the identification of fruit remains in dung — in order to maximize the information in diet studies.

Overall, the study by Hibert *et al.* is a very exciting development that signals the way I expect most diet studies of tropical forest herbivores to be conducted in a not-distant future. The main advantage of metabarcoding is that it brings objective quantification to detection of plant species and that, as our environmental genetic libraries expand, the method becomes increasingly easy and convenient. I, for one, have just signed for a workshop on post-genomics and bioinformatics, to make sure that I don't miss the train of environmental genetics.

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CONSERVATION

Primer Congreso Latinoamericano de Tapires, Ecuador

Andrés Tapia[1,3], **Fernando Nogales**[1], **Ruth Arias**[2] y **Diego G. Tirira**[3]

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Como resultado del trabajo conjunto entre el Grupo de Especialistas en Tapires-Ecuador, la Asociación Ecuatoriana de Mastozoología y la Universidad Estatal Amazónica, se realizó en la ciudad de Puyo, Amazonía del Ecuador, el Primer Congreso Latinoamericano de Tapires y II Congreso Ecuatoriano de Mastozoología, del 8 al 12 de mayo de 2013. La decisión de realizar estos eventos de realce internacional en una ciudad pequeña de la Amazonía ecuatoriana, implicó un cambio en la tradición de organización de esta clase de congresos, generalmente realizados en las grandes capitales. La gran acogida recibida, disipó todo tipo de dudas al respecto, como lo prueban los más de 200 participantes (105 ponentes) y 132 trabajos de investigación (52 trabajos sobre tapires) de 15 países de Norte, Centro y Sudamérica y Europa.

Figura 1: Participantes del Primer Congreso Latinoamericano de Tapires y II Congreso Ecuatoriano de Mastozoología.

Figura 2 A: Inauguración del congreso con las palabras de Patricia Medici, Presidenta del TSG. B: Casa abierta durante el Día Nacional del Tapir

Este espacio representó una importante ventana para exponer la riqueza biológica y cultural del Ecuador y especialmente, los avances logrados en la protección de los tapires, insignes mamíferos de los bosques y páramos andinos y de las selvas lluviosas amazónicas del Neotrópico. Los eventos realizados simultáneamente, contemplaron la presentación de 17 conferencias magistrales y 132 ponencias orales del más alto nivel que brindaron pautas para los nuevos retos en los campos de la conservación, manejo e investigación científica. Se contó con la masiva asistencia de conferencistas, docentes, investigadores y estudiantes procedentes de Venezuela, Colombia, Perú, Chile, Argentina, Honduras, Nicaragua, Guatemala, Costa Rica, México, Estados Unidos, Inglaterra, España, Brasil y Ecuador, abarcando temas tan diversos como la Paleontología o la Filogenética, Manejo ex-situ, Ecología, entre otros.

La organización del evento permitió además la realización de reuniones, simposios y mesas de trabajo donde los participantes intercambiaron experiencias en pro de la conservación. Así, se desarrolló el Primer Simposio de micro mamíferos, II Simposio de Primates, III Simposio de Murciélagos y las reuniones de los miembros del Grupo de Especialistas de Tapires, Primates y

Murciélagos. A esto se sumó los cursos pre-congreso sobre "Radio telemetría de tapires", "Ecolocación en murciélagos", "Análisis genéticos poblacionales-moleculares" y "Herramientas para la conservación de mamíferos".

Por otro lado, el 9 de mayo se celebró el Día Nacional del Tapir, una iniciativa impulsada desde el 2010 y que está enmarcada en la Estrategia Nacional de Conservación del género *Tapirus* en el Ecuador, legalmente reconocida por el Ministerio del Ambiente del Ecuador mediante Registro Oficial. El acto contó con una sesión solemne con las palabras de las autoridades presentes y la participación especial de Patricia Medici, Presidenta del TSG a nivel mundial. En una jornada cultural, iniciada desde tempranas horas con la casa abierta "*protegiendo al jardinero del bosque*", hubieron stands de exposición de varios proyectos de conservación del tapir andino y amazónico encaminados en el Ecuador. Cerrando el día, presentaciones artísticas completaron un acto rico en manifestaciones culturales de las 7 nacionalidades indígenas de la provincia de Pastaza, la más diversa culturalmente en el Ecuador. No solo expertos y científicos se hicieron presentes, se contó además con una importante representación de comunidades

Figura 3 A: Presentaciones artísticas de danza amazónica durante el Día Nacional del Tapir. B: La diversidad cultural de las nacionalidades amazónicas durante el evento cultural.

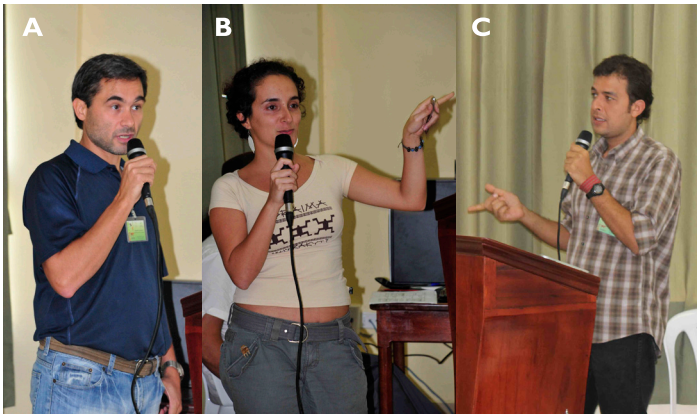

Figura 4: Expositores del congreso A: Germán Gasparini (Argentina); B: Gabriela Pinho (Brasil), C: Manolo García (Guatemala)

indígenas y campesinas, gobiernos locales y funcionarios públicos, vinculados a la conservación del tapir y la fauna silvestre en general.

Con respecto al accionar del TSG, se desarrolló una reunión de trabajo abierta al público donde se discutió tareas y compromisos para continuar fortaleciendo al grupo, resultados que se evaluarán en el marco del próximo Simposio Internacional de Tapires a celebrarse en Brasil en el 2014. Los especialistas vieron la necesidad de incrementar oportunidades de capacitación para sus miembros en captación de recursos financieros, comunicación, monitoreo no invasivo (trampas cámara), validación de impactos de caza, distribución y amenazas, entre otros temas de interés. Este espacio permitió intercambiar además visiones y experiencias de trabajo con el público interesado en la labor que viene desarrollando el Grupo de Especialistas de Tapires en los países de distribución de las tres especies latinoamericanas.

Agradecimientos

El Primer Congreso Latinoamericano de Tapires fue posible gracias al esfuerzo comprometido del Dr. Julio César Vargas Burgos, Rector de la Universidad Estatal Amazónica, Puyo-Ecuador y la planta de docentes asignados para las distintas actividades del evento. El Ministerio del Ambiente aportó significativamente dando una cobertura a este evento en el marco de sus planes de conservación. Agradecemos el invaluable apoyo económico de Ecociencia, Fundación Zoológica del Ecuador, Ecofondo, Fundación Mamíferos y Conservación, GIZ, Museo de Zoología de la Universidad Católica del Ecuador, Editorial Murciélago Blanco, GAD Municipal Puyo, GAD Provincial Pastaza y el Ministerio de Agricultura, Ganadería, Acuacultura y Pesca.

Tapirs in Mexico: researchers working together towards a common goal

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On March 20th 2013, several members of the IUCN/SSC Tapir Specialist Group of Mexico got together to present the most recent updates in terms of research on the Baird's tapir in Mexico. The meeting was organized by Eduardo Mendoza and was carried out at the Universidad Juárez Autónoma de Tabasco during the IV Congreso Mexicano de Ecología. The presentations covered themes from the species' distribution, movements, abundance, and new records, to a couple of studies on the Baird's tapir ecological function and various aspects of tapirs in captivity in Mexico. The main threats to tapir populations in the country were identified as habitat loss and fragmentation, hunting, fire and road-kill.

The participants set short and long-term goals to expand the knowledge of tapirs in Mexico and improve conservation practices. Among the goals, we identified the need to carry out more studies in Oaxaca, Veracruz, Tabasco and Yucatan to identify isolated populations. In particular in Oaxaca, more studies are necessary to evaluate the limits of tapir's distribution in this region of Mexico. Other goals included the development of an awareness program for communities living in close contact with the species, identification of movement patterns and dependency of tapirs on waterholes, assessment of the health status of tapirs in captivity and in the wild, and identification of potential disease transmission between domestic animals and tapirs. In addition, we identified the need to build stronger collaborations and increase communication among members and to organize future meetings to discuss advances and information gaps. This meeting served as the perfect venue to re-consolidate the group of tapir experts in Mexico and to further achieve some of the goals of the Baird's Tapir Action Plan (2005) at a country level. This re-organization of the group might set the basis to develop the Baird's Tapir Action Plan in Mexico, to identify main gaps of knowledge, goals and initiatives to further promote research and conservation of tapirs in Mexico.

As part of the new initiative to promote communication among Mexican scientists, researchers and conservationists interested in tapir populations; the coordinator of the group decided to create a web page to better demonstrate the state of research in Mexico. For this webpage and to identify our group in Mexico, a contest was carried out to find the logo for our group. By the March 1st 2013 deadline we obtained 7 interesting and sophisticated logos and we are pleased to present the new logo for the Tapir Specialist Group Mexico. The winner Maria José Montiel Castañeda presented a logo that features an abstraction of the tapir's figure emphasizing the natural patterns of its fur through motifs that allude to indigenous Mexican art. This logo shows our commitment to the conservation of tapirs in partnership with the people most intimately involved with the species in our country.

GRUPO DE ESPECIALISTAS DE TAPIR MÉXICO

Fostering International Cooperation for Baird's Tapir Conservation in a Northern Portion of the Mesoamerican Biological Corridor

Manolo J. Garcia[1], Nereyda Estrada[2], Christopher Jordan[3]

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In September 2012, TSG Honduras country coordinator Nereyda Estrada, Baird's tapir species coordinator Manolo Garcia, and Nicaragua country coordinator Christopher Jordan met in Tegucigalpa, Honduras to: i) conduct a joint MAXENT analysis to assess the potential of a northern portion of the Mesoamerican Biological Corridor as Baird's tapir *Tapirus bairdii* habitat, and ii) conduct a workshop for Honduran Forestry, Protected Areas and Wildlife Conservation Institute (ICF), university

students, and NGO employees on the use of the MAXENT software. In their MAXENT analysis, the three members of the TSG used presence data from Honduras, Nicaragua and Guatemala to model potential Baird's tapir habitat across the three countries.

The results of the modeling process indicate that several regions within the three study countries appear integral to the long-term conservation of Baird's tapirs. The Selva Maya region of Guatemala and the swath of forest comprised of the Honduran Moskitia and Nicaragua's Bosawas Reserve are particularly large areas of highly suitable habitat. Additionally, the model highlighted Nicaragua's Caribbean coast as a potentially important tapir corridor connecting the Honduran Moskitia and the Nicaragua/Costa Rica border.

The activities opened with presentations on the status of tapirs in Honduras, Guatemala, and Nicaragua. This was followed by an exercise in which the facilitators guided the 20 participants through the process of using MAXENT to model a species' potential distribution. To conclude, the tri-national tapir distribution modeling results were presented to participants, who were then prompted to discuss the important implications that international cooperation has for Baird's tapir conservation and ideas for encouraging international conservation efforts.

The workshop succeeded in capacitating participants in MAXENT, refining the general understanding of the Baird's tapir's potential distribution in northern Central America, increasing international tapir awareness, and underscoring the importance of international collaboration between both researchers and practitioners. The events were graciously funded by the ICF, Proyecto Moskitia, and Proyecto Ecosistemas of the United Nations Development Program Global Environment Facility.

Nereyda, Manolo, and Chris are currently seeking resources to implement research and conservation initiatives based on their MAXENT findings and to conduct a similar workshop in Nicaragua to inspire conservationists in a country in which tapir conservation activities have historically been lacking. In addition, they are preparing a manuscript on the habitat model which they intend to submit for peer review before the end of the year.

Figure 1: Nereyda, Manolo, and Chris take a photo with a number of workshop participants after the final day of activities.

CONTRIBUTIONS

Distribution and conservation status of the Baird's tapir in Panama

Ninon Meyer[1], Ricardo Moreno[1,2] and Patrick A. Jansen[1,3]

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The Baird's tapir *Tapirus bairdii*, listed as endangered on the IUCN red list (IUCN, 2013), ranges from South Eastern Mexico to the Gulf of Guayaquil in Ecuador (Reid, 2009). Within this area, the Isthmus of Panama is a key area because it connects populations of Central America and South America with each other (Webb, 2003). Tapirs may persist in some forested areas of Panama, but their presence has not been verified in most of the potential distribution areas. No studies of wild Baird's tapir have been undertaken in Panama outside of Barro Colorado Island, where the species was studied more than 30 years ago (Terwilliger, 1978). Basic information on tapirs' occurrence and distribution is necessary to evaluate the suitability of protected areas for the conservation of viable tapir populations in Panama (Moreno, 2006; Ahumada *et al*. 2011).

Here, we assess the current distribution and conservation status of Baird's tapir in Panama. We compiled occurrence data from 30 sites scattered across the forested areas of Panama, covering nine distinct regions (Table 1). The data combined camera trapping data, field surveys of tracks, dung and direct observation, and interviews with guides and local people. Previous studies have shown that robust tapir data can be obtained from non-tapir specific camera-trap surveys (Noss *et al*. 2003; Rayan *et al*. 2012).

Tapirs were confirmed at just 14 of the 30 sites, and in six of the nine areas (Table1, Fig. 1). The results reveal gaps in the distribution range of Baird's tapirs in Panama (Fig. 1). Tapirs occur mainly on the Atlantic side of Panama in relatively undisturbed forests. Populations appear healthy in the remote intact forests of Donoso, and in the forest block East of the Panama Canal, i.e. Darién and the comarcas de Guna Yala, Wargandi, Mandungandi and Embera-Wounan. These areas have low human population densities and are mainly inhabited and managed by indigenous people – the Gunas, Emberas and Wounaan – who maintain forested areas, practice subsistence hunting and only occasionally kill tapirs (Ventocilla *et al*. 1995; MICI, 2013). With the exception of Donoso, all the above mentioned forests are connected to each other forming a large continuous area where animals can move freely without major anthropomorphic barriers such as highways or cities.

Our assessment suggests that there are three parts of Panama where tapir numbers are critically low. The first is Central Panama that has been intensively monitored for decades due to the presence of the Panama Canal. In this area signs of tapir are rare or nonexistent. The Panama Canal area is the bottleneck of the Mesoamerican Biological Corridor and may present a barrier for the movements of species, due to increasing human population, habitat fragmentation, forest disturbance and high level of poaching (Wright *et al*. 2000). Although tapir is not a preferred game species in Panama, they are often killed opportunistically, because of the large quantity of meat it provides.

An intensive camera trapping survey (120 km2) took place as part of the Tropical Ecology Assessment and Monitoring program (TEAM; Ahumada *et al*. 2011) in the 3-year period from 2010-2012 in Soberania National Park (SNP), a potentially suitable area for tapirs with 225 km2 of mature secondary forest. Yet not a single tapir photo was taken (Meyer *et al*. 2013). Nevertheless, we did see tracks in 2011 and 2013 on

Table 1: Sites in Panama with information on tapir presence, with the survey method. For each site, we italicized the method that did not result in any tapir sign.

Province	Site	Method			Tapir occurrence	Source
Chiriquí	[1] Volcán Barú	*CT*	*T*	*PC*	X	ANAM-ANCON, 2004a; J. Willis, pers. com.
	[2] La Amistad NP			PC	X	ANAM-ANCON, 2004a
	[3] Fortuna		*T*	*PC*	X	A. Guevara and N. Fossatti, pers. com.
Bocas del Toro	[4] Palo Seco		T	PC	O	ANAM-ANCON, 2004b
	[5] San San - Pond Sac		T	PC	O	ANAM-ANCON, 2004b; O. Lopez and A. Santos, pers. com.
Veraguas	[6] Santa Fé	CT			O	Donoso, 2010
	[7] Cerro Hoya	*CT*	*T*	*PC*	X	Fort and Nielsen, 2012; ANAM, pers. com.
Herrera	[8] Montuoso		T	PC	X	Mendez and Santamaria, 2004. M. Arosemena, pers. com.
Coclé	[9] Donoso	CT	T	PC	O	MWH, 2013, pers. obs.
	[10] El Copé		T	PC	X	L. Martinez and J-P Rios, pers. com.
Colon	[11] San Lorenzo NP	*CT*			X	Meyer *et al*, 2013
	[12] BCI	CT	T		O	Terwilliger, 1978; Meyer *et al*, 2013; pers. obs. (RM)
	[13] BCNM Peninsulas	*CT*	*T*	*PC*	X	Wright *et al*, 2000; Meyer *et a*l, 2013; H. Esser unpub. data.; S. Valdes, pers. com.
	[14] Soberania NP	*CT*	T		O	Meyer *et al*, 2013; A. Santos, pers. com.
	[15] Agua Salud	*CT*			X	Meyer *et al*, 2013
	[16] Sierra llorona	*CT*	*T*	*PC*	X	Meyer *et al*, 2013
	[17] Santo Domingo	*CT*		*PC*	X	Meyer *et al*, 2013
	[18] Chagres NP	CT	T	PC	O	Moreno and Bustamante, 2007; I. Lopez, unpub. data.
	[19] Portobelo NP	CT	T	PC	O	Moreno and Bustamante, 2007; H. Rissanen, pers. com.
Panama	[20] Cocobolo NR	CT		PC	O	E. Espino, pers. com.; H. Esser, unpub. data.
	[21] Camino de cruces	*CT*	*T*		X	H. Esser, unpub. data; RM
	[22] Howard		*T*	*PC*	X	ANCON, 2005
Guna Yala	[23] Nusagandi	CT	T	PC	O	Brown and Moreno, 2013
	[24] Wargandi			PC	O	MICI, 2013; J. Moreno, pers. com.
	[25] Madugandi		T	PC	O	MICI, 2013; J. Moreno, pers. com.
Darién	[26] Cerro Chucanti			PC	O	G. Berguido, pers. com.
	[27] Cemaco		T	PC	O	Medina, 2013
	[28] Serrania de Bagre		T	PC	O	ANAM-ANCON, 2006
	[29] Paya		T		O	E. Campos, pers. com.
	[30] Cana	CT	T	PC	O	Moreno, 2006

[1] CT = camera trapping, T = tracks, dung and direct observation, PC = interviews and personal communication
[2] X = no tapir sign encountered, O = tapir sign encountered

the west side of Pipeline road, indicating that very few individuals persist in the area. The TEAM survey was also conducted in Barro Colorado Natural Monument (BCNM) located in the middle of the Gatun Lake and consists of Barro Colorado Island (BCI) surrounded by five peninsulas. Tapirs were only detected on BCI, but neither game wardens nor local communities have ever observed signs of tapirs outside of BCI or reported any kills. However, the small population of tapirs on BCI (8-10 individuals, J. Giacalone-Willis, pers. com.), may consist of individual migrants, or transitory individuals through BCI providing renewal of the gene pool. We also found tapir tracks on Isla Maiz, a small island between BCI and the mainland supporting this hypothesis. This suggests that there are migrating tapirs in the mainland around BCI too.

The route tapirs use to cross the canal and migrate through forests east and west of the Canal remains unknown. Several corridors have been proposed including the Filo de Santa Rita Corridor that connects Chagres NP to SNP (USAID, 2009). However, the corridor consists of small patches of forests in a matrix of cattle pastures, with a high human density and with two major roads that make this area difficult and dangerous for the tapirs to cross.

The second region of critical concern involves tapir populations of the Serrania de Maje and the Atlantic coast. These populations are isolated by the Pan-American Highway that runs across the country in East-West direction.

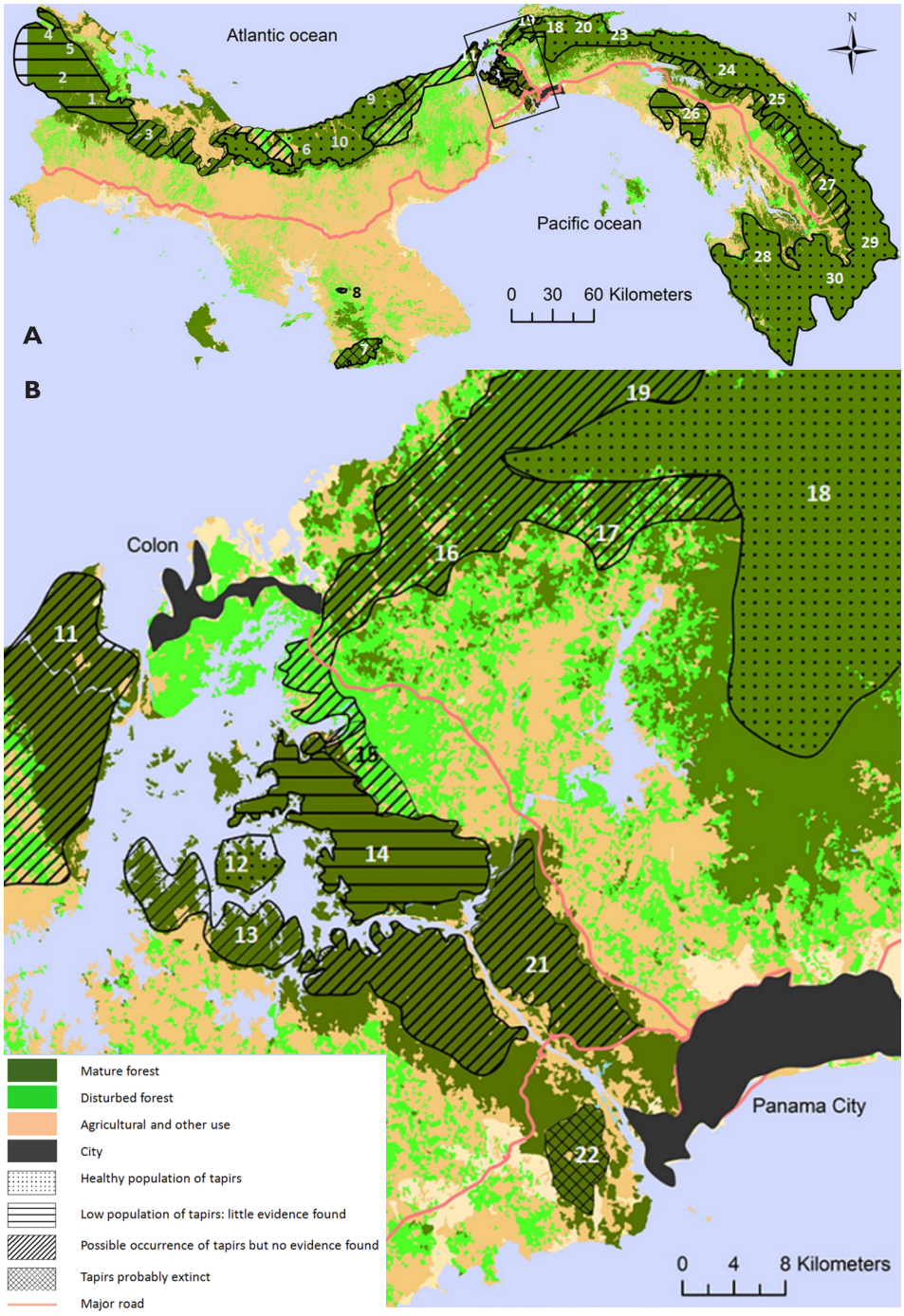

Figure 1: Distribution map of *Tapirus bairdii* in Panama (A) and an inset of Central Panama (B). The numbers correspond with the sites listed in table 1.

The third area where poaching, deforestation and resulting habitat fragmentation make it difficult for tapirs to persist (Brooks *et al.* 1997), is in the Comarca de Ngöbe-Bugle between the forests of Santa Fé - El Copé - Donoso and La Amistad International Park (PILA).

Few tapir data are available for the forested area of Chiriquí in Western Panama. Tracks of tapirs have been found in some places and photos taken in the highlands of Costa Rica (Gonzalez-Maya *et al.* 2009) that are part of the cross boundary continuous forests between Costa Rica and Panama. Poaching levels remain high in some parts of Chiriquí and Western Panama which contributes to the extinction process (Smith, 2008; J. Giacalone-Willis, pers. com.).

The lack of evidence of tapir in the two last remaining forests of the Peninsula de Azuero over the past decades leads us to believe that tapirs are extinct in those areas.

The information compiled in this assessment is an important addition to the existing knowledge about tapirs in Panama. A key point is the importance of restoring the connectivity between forest fragments in Panama thereby allowing for gene flow between tapir populations (Norton & Ashley, 2004). This is especially true for the region in Central Panama, a key area for the species, and where a small population size may reduce the genetic viability of this population. Special attention should also be paid to conserve the corridor between the Comarca de Ngöbe-Bugle to avoid the same problem as in Central Panama. To improve conservation intervention more research is needed regarding tapir population density and habitat requirements in Panama.

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Baird's tapirs *Tapirus bairdii* in Nicaragua

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Abstract

Nicaragua has a high level of biocultural diversity that has brought many researchers to the country for centuries. There exist many reports about their studies and explorations that describe Nicaraguan cultures, languages, and ecosystems. Nonetheless, terrestrial fauna has been significantly under-represented in these investigations and subsequent publication. Due to this, there is a great deal regarding Nicaraguan fauna, especially for rare species such as the Baird's tapir, that remains unknown to international conservationists. The IUCN range map for this species is a case in point. In this article we clarify the historical and contemporary status of the Baird's tapir in Nicaragua through a literature review and a preliminary discussion of our long-term ecological research using camera trap and track surveys along the Caribbean Coast of Nicaragua.

Key Words: Baird's tapirs, biological corridor, Nicaragua

Introduction

Nicaragua has rich biocultural diversity characterized by ecologies and cultures that differ greatly between the Pacific and Caribbean coasts. The *nahuatl* speaking indigenous groups of the Pacific coast have become largely assimilated both culturally and linguistically into *Mestizo* culture, defined by a mix of indigenous Nicaraguan and Spanish descent. The Pacific coast area was historically covered with expansive tracts of tropical dry lowland forest in the lower elevations, and cloud forests and dwarf forests in montane and volcanic habitats. In contrast, the Caribbean coast continues to harbour higher cultural diversity, including the Rama, Miskito, and Mayangna indigenous peoples, and the Garifuna and Kriol afro-descendent groups. Linguistic diversity likewise remains higher than in the Pacific coast; extant languages include Miskito, Kriol English, Spanish, Garifuna, Rama, and several Mayangna dialects, with the last three being the most endangered nationally. Historically, the Caribbean coast was covered primarily by large swaths of lowland tropical evergreen rainforest, seasonally flooded swamp forests, pine forests and mangrove forests.

This confluence of diverse ecosystems, cultures and languages has attracted a relatively consistent flow of explorers and researchers over the past several centuries that have collectively authored an extensive literature (Bell, 1899; Collinson, 1867; Craig, 1992; Davidson, 1980; Jamieson, 2010). There are numerous ethnographic publications available describing the country's Rama, Ulwa, Miskito, and Garifuna cultures and languages. There also exists a variety of reports on geographical and biological explorations detailing Nicaragua's forests, topography and hydrology. However, research in Nicaragua has been characterized by a general deficiency of systematic investigations of the country's wildlife, especially along the Caribbean coast (Jordan & Roe, 2010). Among the studies that do exist, few focus on the country's terrestrial mammalian fauna (Jordan & Roe, 2010). Due to this, scientific information on this fauna is not common; much of the available data are anecdotal and found in sources outside the realm of the natural sciences.

Not unexpectedly, this lack of scientific information has resulted in misperceptions among international conservationists regarding Nicaragua's terrestrial mammals and the current state of their populations. For instance, in the case of the Baird's tapir *Tapirus*

bairdii, the species' range map provided by the IUCN suggested that the species had been extirpated from the Caribbean coast (IUCN, 2008) (Fig. 1). Yet, our literature review and field data suggests that a population of global significance exists in Nicaragua's Caribbean Coast ecosystems (Jordan *et al*., 2010).

In this paper we help illuminate the status of tapirs in Nicaragua for conservationists and scientists by reviewing two lines of evidence: (i) the historical literature on Nicaraguan tapirs and (ii) our tapir survey data from four years of ecological monitoring in the Southern Atlantic Autonomous Region (RAAS) and Northern Atlantic Autonomous Region (RAAN). The results serve to provide evidence that can be used to update the IUCN map, highlight the Caribbean coast as a potentially key segment in the Baird's tapir's global range and clarify what we do and do not know about Nicaraguan tapirs.

Materials and Methods

Study Species

Baird's tapirs are large-bodied, odd-toed ungulates that consume browse, bark, fruits, and seeds (Fig. 2). The IUCN estimates that there are fewer than 5,500 mature adult Baird's tapirs in the wild and approximately 500 in Nicaragua (IUCN, 2008). The species is considered endangered and has been greatly affected by habitat fragmentation and hunting throughout its range (IUCN, 2008).

Literature Review

A brief literature review was undertaken by searching for the following key terms in the Google Scholar search engine: tapir +Nicaragua, Baird's tapir +Nicaragua, *Tapirus bairdii* +Nicaragua, danto +Nicaragua, mountain cow +Nicaragua, pamka +Nicaragua, and tilba +Nicaragua. A few additional, less systematic but related phrases were also included. All publications from the search were reviewed to separate those mentioning Baird's tapirs from those not mentioning the species. We then read each remaining source carefully and separated the literature that made geographically referenced accounts of Baird's tapirs in Nicaragua from those simply mentioning the Baird's tapir as part of the Nicaraguan fauna. The former group of sources was utilized in the review. We also reviewed the bibliographies of all results to find additional sources. Pertinent titles within the bibliographies were subject to the same selection process. Those sources from the bibliographies with geographically specific information on Baird's tapirs in Nicaragua were also included in the review. We compared the prevalence over time of sources describing tapirs in Caribbean coast Nicaragua with the prevalence of those describing tapirs in Pacific coast Nicaragua to create a narrative on the historical and contemporary status of Nicaraguan tapirs.

Tapir Sampling and Study Area

From 2009-2013 we undertook a broad, systematic camera trap surveys throughout most of the RAAS. Detailed descriptions of the methodology and study area can be found in Jordan & Roe (2010). During 2010-2013, in the same study area, we used camera traps to sample specifically for Baird's tapirs by hiring forest specialists from rural communities to help us install cameras in locations of high local tapir activity. From 2010-2013 we also carried out Baird's tapir track surveys in the RAAS, during which the same local forest specialists were hired to help us find tapir footprints in the forests surrounding their communities. Tapir footprints are quite unique and therefore unmistakable if the prints are relatively recent. Accordingly we only classified recent tapir tracks that were unmistakable as positive detections. Older tracks or tracks that could not be identified with 100% certainty were not recorded as detections. We thus avoided false presence data. These last two, tapir specific methodologies, have also been carried out in the RAAN since January 2012.

Results and Discussion

Literature Review

We found 26 sources describing tapirs in Nicaragua that referenced a geographical location. Four sources described the same dataset (Koster, 2006; 2008a; 2008b; 2011). We included one additional known account (Urquhart, 1997). Two of the publications were our own and are not discussed here, but the data are included in *Tapir Sampling*.

19th century tapir literature is not very common, but some was found. Some of the first publications describing the Caribbean coast of Nicaragua document the adventures of French and English Buccaneers in the 18th and 19th centuries. These stories tend toward the dramatic and exaggerative, and sometimes describe indigenous peoples in discriminatory ways. Nonetheless, they simultaneously include extensive cultural and ecological accounts of the region, including the first published accounts of Baird's tapir presence (Fig. 3). The most common references of tapir sightings come from 1850-1860 publications detailing surveys of the south-eastern waterways and forests connecting Lake Nicaragua and the Caribbean Sea, part of a route that was nearly chosen over the Panama Canal (Collinson, 1867; Nicaragua Maritime Canal Company, 1890). Other 19th century tapir references place the species in more northern regions of the Caribbean coast, including Bell's (1899) work Tangneera, which describes tapirs in the surroundings of the town of

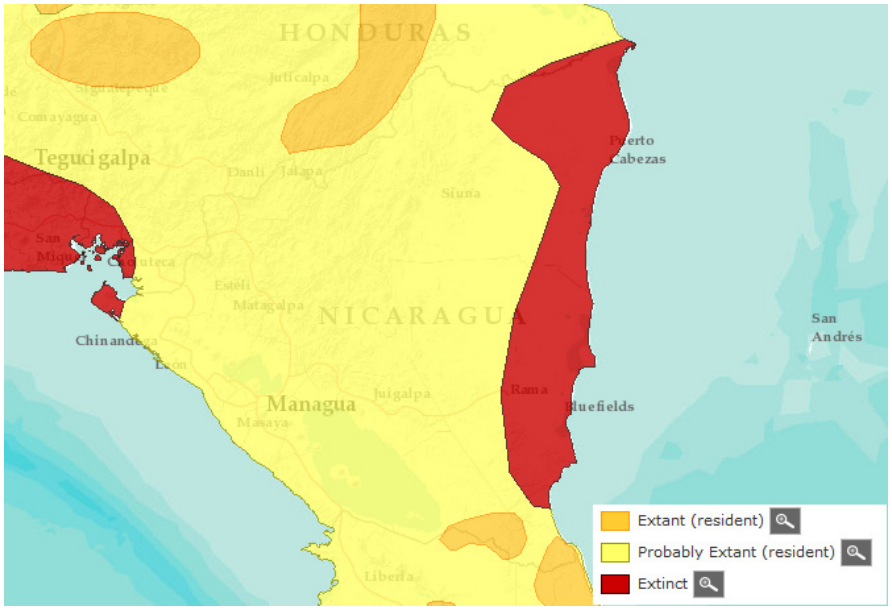

Figure 1: The IUCN Baird's tapir range map for Nicaragua. Note that the species is considered extinct along the Caribbean coast.

Kuamwatla in the RAAN, and Berckenhagen's (1894) account of Miskito lore in the RAAN.

19th century accounts of tapirs in the Pacific region are less common, but do exist. In a description of linguistic data collected in 1842, Brinton (1886) related the significance of the species within the Mangue dialect of a people located in the area of two Pacific Coast lakes, Masaya and Apoyo. Another 19th century Pacific coast account appears to come from a rare zoological expedition in the department of Chinandega that is referenced in a more recent publication (Martinez-Sanchez, 2004).

Nicaraguan tapir information from the 20th century is more common than the tapir literature from the prior century and is quite informative. Carr (1953) relates multiple experiences with tapirs from his 1945 expedition around the Wawashang River in the RAAS, calling the ecosystem a "jungle full of tapirs". Most other tapir references are found in ethnographic accounts. Hamilton & Loveland (1976) provide explanations of the significance of the tapir in Rama culture based on fieldwork around the area of Wirin Cay, RAAS from the 1920s and late 1960s. They documented two types of narratives about tapirs, one describing the origin of the species and the other describing its behaviour. For instance, the Rama related to the researchers that tapirs and manatees were originally brothers before a swimming competition across a river went awry when only one brother managed to make it across. This brother became the tapir, while the brother who became trapped in the water became the manatee (Loveland, 1967).

In another Rama story of tapir behaviour, the first tapir lived within human society before he subsequently decided to leave the human community to live in the forest because he was often ridiculed by his uncles for making "so much noise when he walks" (Loveland, 1976). Loveland (1976) references this latter tale to argue that the tapir signifies the marginalized members of Rama culture and society. Around the RAAS community of Tasbapauni, Nietschmann (1973) recorded multiple accounts of Miskito hunters killing Baird's tapirs during his fieldwork from 1969-1971. He also described tapir meat as historically taboo in Miskito communities (Nietschmann, 1973). Finally, Urquhart (1997) observed tapir tracks in 1994 and 1996 approximately 30 km north of Loveland's (1967) study area.

These accounts provide evidence of tapir presence in a fairly extensive portion of the RAAS during the 20th century. Furthermore, the ethnographic evidence supports the assertion that tapirs occurred there for many centuries, to the extent that they became embedded within local cultures and traditions. The northern Caribbean coast is somewhat underrepresented in 20th century literature, though Ryan (1978) describes tapirs as extant in the southern Bosawás Reserve, 20 km west of the town of Siuna, during the 1970s.

Pacific coast accounts of tapirs, available from the 19th century, all but disappear from the 20th century literature. Those that exist are unreliable at best, with an unclear description of a small remnant population of tapirs in the northwest of the country (Brooks *et al.*, 1997), a citation describing one specimen and community testimony from the Cosigüina Peninsula from around the middle of the century (Genoways & Timm, 2005) and a brief, vague assertion that some tapirs occur in Matagalpa state comprising the only information (Brooks *et al.*, 1997).

Given the rarity of 20th century Pacific coast tapir accounts, it is not a surprise that they disappear entirely in 21st century literature. The only source is Medina (2005), who mentions that tapirs are only found on the Pacific side of the country within the buffer zones of the Bosawás and Indio-Maíz reserves bordering the Caribbean region. In other words, Medina (2005) posits that the last surviving Pacific coast tapirs represent the western limit of the Caribbean populations. Medina (2005) also explicitly states that he believes that tapirs are extirpated from all Pacific coast locations far from the two aforementioned reserves. Nonetheless, this publication does not reveal how the author collected and analysed his data to arrive at these conclusions.

The picture is different for Caribbean coast Nicaragua, where surveys of protected areas in the far north and south suggest the presence of viable populations of tapirs in each of these locations.

In particular, biodiversity surveys describe viable populations within the Bosawás Reserve and its buffer zones along Nicaragua's border with Honduras (Medina, 2005; Mijail-Perez & Siria, 2006) and within the Indio-Maíz Reserve along the southern border with Costa Rica (Almanza & Medina, 2002; Hueck-Espino, 2005; Medina, 2005). In these examples, and in the remainder of this text unless otherwise indicated, we define viable in the less rigorous sense employed by Iverson & Rene (1997), "the likelihood that habitat conditions will support persistent and well distributed fish and wildlife populations over time". While perhaps not the most ideally detailed definition, the lack of rigor in the available data does not allow us to be more specific. Almanza & Medina (2002) indicate that the population centred in the Indio-Maíz Reserve reaches its Western limit in a region that could be classified as the Pacific side of the country. However these tapirs are classified as part of the Caribbean population because its nucleus and source are located there.

A number of publications that are the product of research projects on the daily activities of various indigenous communities provide more information about the viable population in the Bosawás Reserve (Cordon & Toledo, 2008; Koster, 2006; 2008a; 2008b; 2011; and Williams-Guillen *et al.*, 2006). Koster (2006), in particular, underscores the viability of the population by describing tapir hunting strategies and accounts, and the local tapir population's capacity to continually rebound despite observed Miskito hunting pressure that he calculated should have been unsustainable.

One 20th century source outside of the Bosawás and its buffer zone is a non-scientific report of concerning the indigenous community of Kuakuail II in the Tasba Pri territory, municipality of Puerto Cabezas that describes the cultural importance of the tapir (Tebtebba Foundation, 2010). Similar to the case in Wirin Cay (Loveland, 1976), the fact that the tapir assumes an important cultural role in this community suggests that the tapir historically occurred in the Tasba Pri territory (Tebtebba Foundation, 2010). Furthermore, the text references tapirs in a way that indicates that the species still exists in the region. Yet it does not include contemporary observations or confirmed sightings, so the evidence for contemporary tapirs is equivocal.

References of tapirs in other regions of the Caribbean coast of Nicaragua were not found. At the same time, the source from the Tasba Pri (Tebtebba Foundation, 2010) and the observations from the late 1990s (Urquhart, 1997) constitute evidence that prevents us from concluding definitively that tapirs have become locally extinct in Caribbean areas of Nicaragua outside of the Bosawás and Indio-Maíz Reserves. In other words, given the information available in the literature, it is not possible to make convincing conclusions regarding the presence or absence of tapirs in these areas at the turn of the 21st century.

Despite the variation in the quantity, type, and content of the Nicaraguan tapir literature throughout history, the major trends in the last several centuries' of Baird's tapir literature from Nicaragua are the disappearance of Pacific coast tapir accounts and the continued presence of Caribbean coast accounts into the 20th and 21st centuries. These trends suggest that the population that historically occurred in the Pacific regions of the country was not viable and has subsequently become extinct whereas the Caribbean coast population was viable and persisted widely in the 20th century and at least within large nature reserves into the 21st century.

Using the literature, we thus conclude that the IUCN (2008) map is correct in two sectors: in the Bosawás Reserve along the border with Honduras and in the

Figure 2: A photo of a Baird's tapir taken with a camera trap in the Maya Creek area, located in the Western Wawashang Reserve, RAAS, Nicaragua.

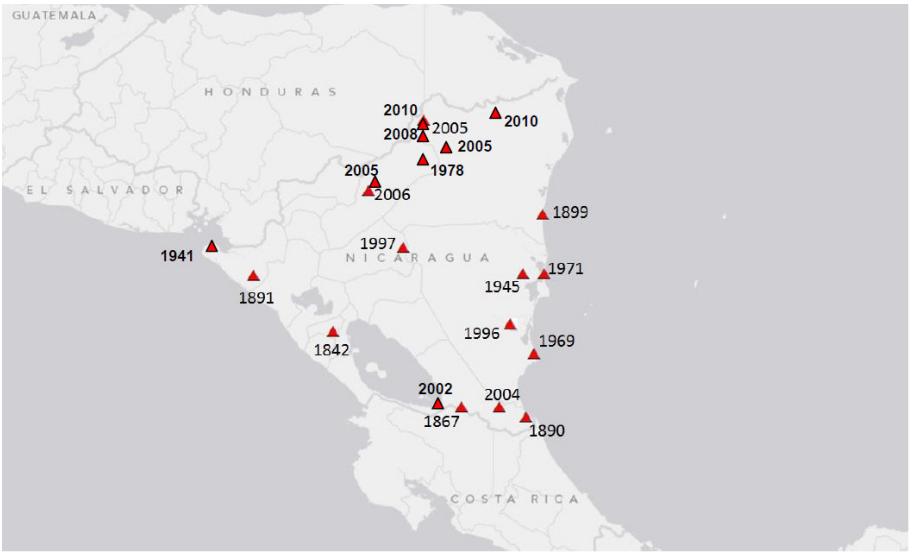

Figure 3: This map includes the various locations of Baird's tapir presence cited in the historical literature from Nicaragua. Locations are juxtaposed with the year the associated fieldwork was undertaken rather than publication date. Only citations with fairly specific geographic information were included on this map. Our survey data from 2009-2013 are not included here.

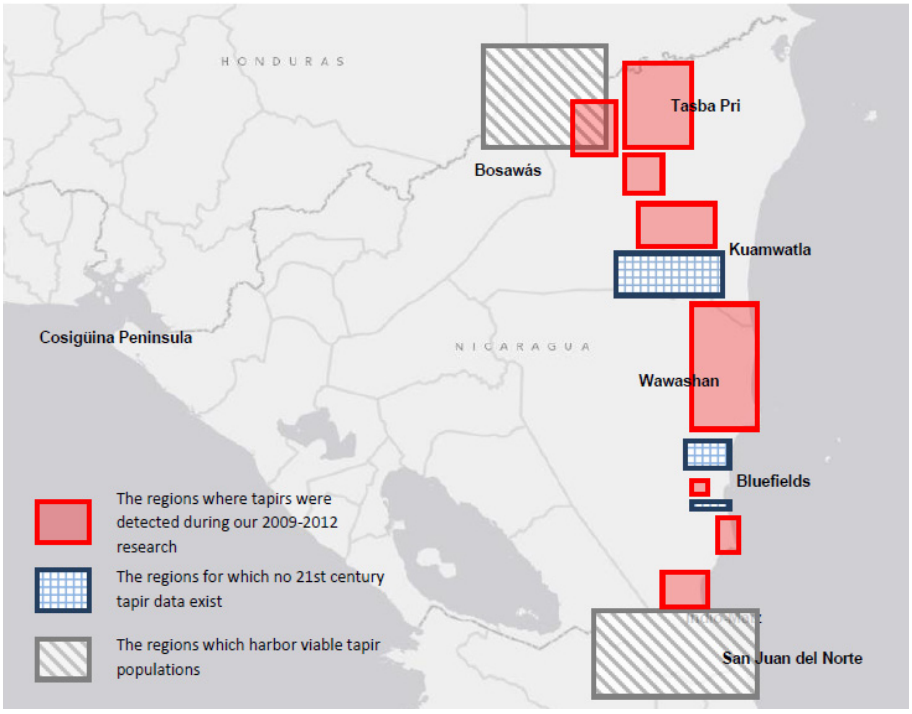

Figure 4: This map depicts: 1) the approximate locations of the known viable tapir populations in the northern and southern regions of the Caribbean coast of Nicaragua; 2) the areas of confirmed tapir presence from our 2010-2013 surveys; and 3) areas about which we were unable to find published literature on tapir presence, absence, or ecology. Note: this map only describes information from the Caribbean coast; Pacific coast sources are not represented. Key locations mentioned throughout the article are labelled.

Indio-Maíz Reserve along the border with Costa Rica. Both the literature and the map indicate that viable populations of tapirs are found within and around these reserves. However, the conclusions from the literature review put two other sectors of the IUCN (2008) map in question. First, the map identifies the entire Pacific coast of Nicaragua as inhabited by tapirs, while the literature indicates that tapirs are likely extinct in this region. Second, the map identifies the majority of the Caribbean coast outside of the aforementioned reserves as an area of widespread tapir extirpation. The literature describing these locations is sparse, but suggests that this hypothesis is also incorrect. Indeed, the references found indicate that the species still occurred in several Caribbean coast locations outside of reserves during the 20th century, but with the exception of the Bosawás and Indio-Maíz and their respective buffer zones, strong evidence of the species' survival into the 21st century is not available. However, as mentioned above, we consider that the confirmed observations from the late 1990s (Urquhart, 1997) and the source describing tapirs from 2010 (Tebtebba Foundation, 2010) constitute evidence that prevent us from making a definitive conclusion about tapir extirpation in the region. According to this interpretation, it would have been more appropriate to label this area on the IUCN (2008) map as an area in which tapirs are "Possibly Extinct".

Although the lack of systematic investigation and the immense variation in the Nicaraguan tapir literature mean that these literature-based conclusions about the historical and contemporary status of tapirs should not be accepted as definitive, it is important to make the point that the history of Nicaragua's development and deforestation strongly supports our interpretations. Indeed, the Pacific coast is widely dominated by *Mestizo* culture. This culture has traditionally employed expansive cattle ranching and market-oriented, monoculture agriculture to the extent that most arable Pacific coast land was converted to cattle ranches, coffee plantations, or cotton fields by the 1950s. Intact forest that could function

as wildlife habitat was for the most part was reduced to small patches. In contrast, the indigenous and afro-descendant groups of the Caribbean coast were historically dedicated to smaller-scale subsistence horticulture, fishing, and hunting. Although the impact of these subsistence activities is debatable, they are undoubtedly more sustainable than the practices typical of Pacific coast *Mestizos*. In addition, larger forested areas are currently preserved in the Caribbean coast than in the Pacific coast. In short, throughout recent history the ecological conditions have been more favourable for tapir conservation in the Caribbean coast regions of Nicaragua than in the Pacific. Finally, it is important to mention that the country endured a Civil War during the end of the 20th century, which certainly reduced and likely prevented any scientific investigation on tapirs for all regions of the country.

Tapir Sampling

Our work with tapirs in the RAAS and RAAN reveals that tapirs still occur in many areas of the Caribbean coast outside of the Bosawás and Indio-Maíz Reserves, including several areas that are amongst the most highly affected by the agricultural frontier and land-colonization that is being driven by *Mestizo* Nicaraguans (Fig. 4). Our preliminary data reveal without question that this species continues to inhabit the Caribbean region that we could only identify as an area of possible extinction through our literature review and that the IUCN (2008) previously identified as an area of widespread tapir extirpation. Our tapir survey results also: a) confirm our conclusion that there existed a viable population of tapirs along the entire Caribbean coast throughout recent history, and b) suggest the possibility that the two main viable populations of tapirs previously identified in the Bosawás and Indio-Maíz Reserves could be genetically linked via Caribbean coast ecosystems.

Concerning conclusion *b*, while preliminary analyses support this hypothesis, there is still a large portion of the Caribbean coast that remains to be surveyed. This lack of data does not allow us to conclude whether or not Nicaragua's Caribbean coast serves as a tapir corridor between the Bosawás and Indio- Maíz Reserves. This gap includes the riverine habitats along the Rio Grande between Karawala and Makantanka, and much of the forests along the highway between El Rama and Pearl Lagoon (Fig. 4). This latter region includes a sizeable oil palm plantation. Surveying these areas and better understanding the viability of the potential corridor is one of our high research priorities, because if gene flow exists between the Bosawás and Indio-Maíz tapirs, or even if it is feasible to establish such gene flow through conservation initiatives, the Caribbean Coast of Nicaragua would be a key part of the Baird's tapir global distribution and a priority area for tapir conservation.

If tapirs cannot inhabit these areas, the remaining tapirs in the RAAN and RAAS may simply be isolated individuals, rather than a viable population. Analysis of satellite photos with regard to our current tapir data can help to clarify this, but we consider additional surveys and telemetry data necessary because proper ecological elements may not be indicative of tapir presence due to the high degree of human activity. Indeed, hunting data we have recorded for a limited portion of the RAAS indicate that harvest levels are potentially unsustainable, with almost 50 tapirs reported to have been killed in the last decade by a mix of *Mestizo*, indigenous, and afro-descendant hunters. This could mean that even if a corridor currently exists, the population within it may not be viable in the near future due to high hunting pressure. This would entail the effective extinction of Nicaragua's Caribbean coast tapirs, at least outside of the Bosawás and Indio-Maíz Reserves.

Conclusion

The historical literature on tapirs in Nicaragua provides evidence that confirms certain sectors of the IUCN's species distribution map, but provides other evidence that puts other sectors in doubt (IUCN, 2008). In particular, the literature indicates that: 1) tapirs still exist in viable populations in the Bosawás and Indio- Maíz Reserves, 2) that tapirs historically occurred in viable populations along the Caribbean Coast outside of these reserves, 3) that the extirpation of these other Caribbean coast tapir populations is possible but uncertain, and 4) that a population of tapirs historically occurred in Pacific Coast Nicaragua, but it was not viable and has since gone extinct. Nicaragua's history of deforestation and development agrees with these conclusions regarding the status of Nicaragua's tapirs.

The preliminary results from our current research on tapirs confirm conclusion two and provide evidence that tapirs are not extirpated from the majority of the Caribbean coast. The tapir still has a wide distribution along the coast. In fact, our results suggest that the Caribbean Coast of Nicaragua may serve as a genetic corridor between the known viable populations of tapirs in the Bosawás and Indio- Maíz Reserves. If such a corridor exists, or if it is feasible to establish such a corridor through conservation planning, the Caribbean Coast of Nicaragua would be a priority area for the global Baird's tapir conservation community. In terms of national tapir conservation, all of the evidence indicates that the Caribbean Coast should be the priority.

Today we have more knowledge than ever about Baird's tapirs in Nicaragua. Nonetheless there remains much that we do not know about tapirs in the country; too little, for instance, to draft a conservation plan that includes detailed, practical, long-term prescriptions

for conservation based on tapir ecology data collected in Nicaragua. As mentioned above, we do not have the ecological or genetic data to confirm or refute the genetic corridor along the Caribbean coast. We also know very little about the species' reproductive success versus mortality rates or dispersal capabilities, and habitat use and preferences in Nicaragua are unknown.

Additionally, though the evidence suggests that the Caribbean coast should be considered the priority for tapir conservation, science infrastructure and investigation are highly deficient in Nicaragua. Nicaraguan scientists and field studies on terrestrial fauna, while increasing, are rare and have been rare throughout history and were likely prevented entirely during the Civil War in the late 20th century. Due to this, despite the conclusions of other researchers (i.e. Medina, 2005) and the dearth of 21st century tapir accounts from the Pacific coast, we should not be consider the species extirpated from this region.

Based on these uncertainties, we can outline several key research priorities for tapir researchers in Nicaragua:

- Gain a complete understanding of tapir distribution in the potential corridor between the viable populations of the far north and south Caribbean coast regions.
- Gather data on tapir daily movements, habitat use and preferences in this potential corridor, including within protected areas and in landscapes inhabited by *Mestizo*, indigenous and afro-descendant peoples to confirm or refute its corridor function.
- Use data to derive density and abundance estimates for Nicaragua's tapirs and then determine the potential impact of previously reported hunting levels and estimate the viability of the population, defined in a more rigorous manner: the probability the population will become extinct over a specified period of time.
- Analyse satellite photos of and additional literature on Pacific Coast Nicaragua to identify areas with the necessary resources to support tapirs
- Undertake surveys in those Pacific coast ecosystems identified to confirm or refute the species' extirpation in the region

If Nicaraguan tapirs are to be conserved, it is also important to begin using the information we currently have and continue applying all of the new data we collect to design and implement:

- A national education and awareness program focused on Nicaraguan tapir conservation
- A conservation action plan that outlines conservation priorities and feasible actions to achieve them.

Indeed, long-term tapir conservation can only be achieved with a clear vision and the understanding and support of the Nicaraguan public.

Acknowledgements

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Nuevo registro de Tapir centroamericano (*Tapirus bairdii*) atropellado en el Noroeste del estado de Campeche, México

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Key Words: Atropellamiento, carreteras, Campeche, registro

El tapir centroamericano (*Tapirus bairdii*) es uno de los mamíferos silvestres más grandes de Latinoamérica, y una de las especies amenazadas de los trópicos, por tal razón se encuentra catalogado como en peligro de extinción en la Red list de la UICN (Castellanos *et al.*, 2008; UICN, 2011) y se le considera en el Apéndice I de CITES desde 1975 (CITES, 2012). En México está en peligro de extinción debido principalmente a la pérdida y fragmentación de su hábitat, y a la cacería sin control (Naranjo, 2009).

El tapir ha sido una de las especies menos estudiadas en México. A la fecha se ha determinado la importancia de algunas Áreas Naturales Protegidas del sureste del país, como refugios para esta especie, pero se desconoce casi en su totalidad, la importancia de las ANP más pequeñas, terrenos privados y comunales como hábitat del tapir (Mendoza & Carbajal, 2011).

En México se ha confirmado la presencia del tapir en los estados de Oaxaca, Chiapas, Campeche y Quintana Roo (Naranjo, 2009). Sin embargo, al interior de los estados aun existen vacios de información, como el caso del estado de Campeche, en donde algunos reportes recientes plantean que la distribución actual de la especie abarca únicamente la porción sureste del estado, principalmente en la región del gran Calakmul (complejo de reservas conformado por la Reserva de la Biósfera de Calakmul, así como las Reservas Estatales de Balam-ku y Balam-kin; Naranjo, 2009), así como en áreas de propiedad privada y comunal localizadas en la porción central del estado (Contreras-Moreno, 2012).

Esta nota trata del nuevo registro de un individuo de *Tapirus bairdii* (atropellado) en la región centro-oeste del estado de Campeche, donde no se tenía datos de la presencia reciente de esta especie. Al amanecer del día 9 de septiembre de 2012 se registró el atropellamiento de una hembra adulta de tapir centroamericano (Fig. 1) en el km 62 de la carretera federal 261 Escarcega-Champotón, a 2 km al norte del poblado San Pablo Pixtún, Campeche (19°08´49´´

Figura 1: Imagen del tapir centroamericano (*Tapirus bairdii*) hembra atropellado en el Noroeste del estado de Campeche, México.

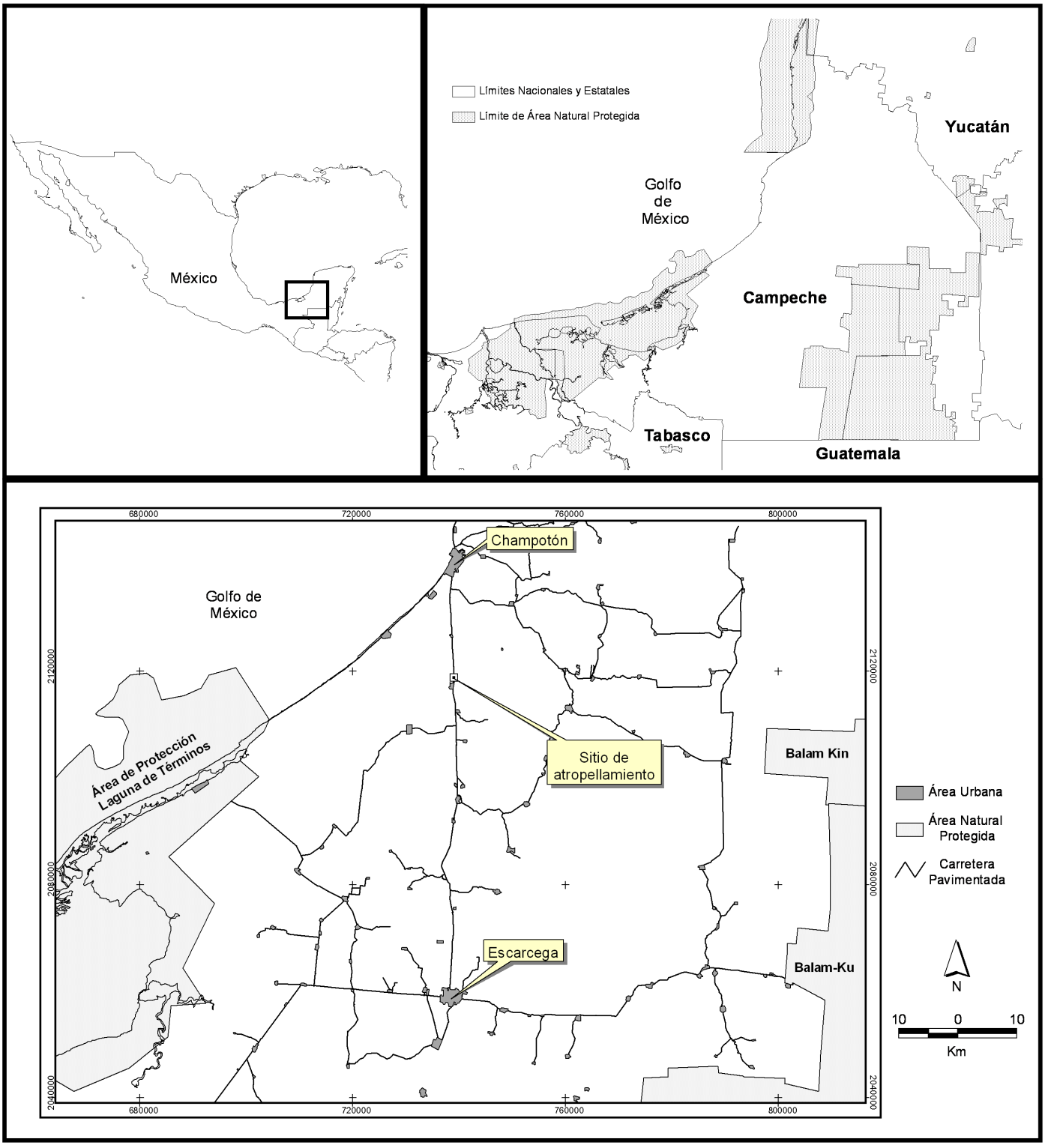

Figura 2: Localización del registro de tapir centroamericano (*Tapirus bairdii*) atropellado en el noroeste del estado de Campeche, México. Se observa que el tapir fue atropellado entre el complejo de reservas que conforman el gran Calakmul (Reserva de la Biósfera de Calakmul y Reservas estatales de Balam-kin, Balam-ku,) y el Área de Protección de Flora y Fauna Silvestre Laguna de Términos.

N ,90°43´ 37´´W), por un vehículo de características desconocidas (Fig. 2). La vía Escarcega-Champotón fue construida hace mas de 40 años y ampliada en 2010 y 2011 de 8 a 12 m de ancho de corona (una de las partes transversales que componen una carretera), con superficie de concreto asfáltico. La

carretera en la actualidad se encuentra diseñada para alojar dos carriles de circulación de 3,5 m por sentido y acotamientos laterales de 2,5 m. La velocidad proyectada para los vehículos en el sitio donde el tapir fue atropellado es de 90 a 110 km/h, pues se trata de un área plana y sin curvas. El uso de suelo alrededor del sitio de atropellamiento se encuentra constituido por cultivos tales como maíz y calabaza, así como por áreas donde los cultivos y pastizales inducidos para la ganadería han sido abandonados. Una vez que los pobladores locales encontraron al animal a un lado de la carretera, tomaron fotografías y se lo comieron, por lo que no fue posible la recuperación de tejidos.

Este nuevo registro de tapir en la zona centro-oeste del estado es de destacar, ya que originalmente se consideraba que la distribución del tapir centroamericano abarcaba todo el estado de Campeche en México (Hall, 1981), sin embargo, años después se publicarían mapas en los que ya se descartaba la presencia del tapir en gran parte de su distribución original (Naranjo, 2001). Con este registro se confirma la presencia de *Tapirus bairdii* en el centro-oeste del estado de Campeche, México.

Existen numerosos estudios sobre el efecto negativo que las carreteras tienen sobre los ecosistemas naturales (Coffin, 2007). Se ha documentado que las carreteras en muchas ocasiones tienen efectos adversos en la fauna silvestre, pues transforman el hábitat donde se construye el camino, favorecen la entrada de nuevos pobladores humanos con el consiguiente cambio en el uso de suelo e incremento en cacería, limitan o impiden el paso de especies especialistas de hábitat, así como provocan mortalidad debido a colisiones con vehículos (Coffin, 2007; Laurence *et al*., 2009).

En el caso particular de las colisiones con vehículos, se ha documentado que millones de organismos mueren por atropellamientos cada año (Laurence *et al*., 2009), a tal grado que para algunas especies, la mortalidad producida por colisiones excede al provocado por la cacería (Forman & Alexander, 1998). El efecto de las carreteras es tal, que en la actualidad las carreteras se consideran como una barrera que limita el movimiento de los animales entre ambos lados de la vía, disminuyendo la accesibilidad a los recursos y el intercambio genético interpoblacional (Epps *et al*., 2005; Riley *et al*., 2006; Strasburg, 2006). Los tapires han sido reportados como organismos que raramente son atropellados (Fisher *et al*., 2004; Nigro & Lodeiro, 2009, Cáceres *et al*., 2010). En la actualidad se cuenta con muy poca información sobre atropellamientos de tapires centroamericanos (*Tapirus bairdii*). Únicamente se sabe de reportes aislados de atropellamientos de tapires en Belice (Medici *et al*., 2005), así como crónicas en medios de comunicación que informan de tapires muertos en carreteras de México (ej. http://www.comunicacarmen.com.mx/Php/noticiacomlocal.php?id=66481). Debido a su tamaño y hábitos, el tapir requiere de grandes áreas para sobrevivir (Naranjo, 2009), lo que muy probablemente implica que se vean obligados a cruzar continuamente carreteras y, al igual que otros grandes mamíferos que comparten estas características, se encuentran en riesgo constante de ser atropellados (Gunther *et al*., 2001; Laurence *et al*., 2009).

La región donde fue atropellado el tapir ha sido señalada como clave para grandes mamíferos como el jaguar, pues une las poblaciones de esta ultima especie entre el área del gran Calakmul y el Área de Protección de Flora y Fauna Laguna de Términos (Rabinowitz & Zeller, 2010). Así mismo, en modelos de dispersión de jaguar, la región localizada entre el km 54 y 68 de la misma carretera, ha sido identificada como un área clave para la conexión entre las áreas naturales protegidas (Hidalgo-Mihart *et al*., 2011). El hecho de que este tapir haya sido atropellado exactamente en las áreas identificadas como prioritarias dentro de un corredor biológico para otras especies, refuerza la importancia de conservación de este corredor, así como la necesidad de establecer propuestas de conservación para las diversas especies locales, además de implementar una serie de medidas para reducir los riesgos de atropellamiento de fauna silvestre en esta área.

El efecto que el atropellamiento de esta hembra de tapir tiene sobre la población en la región centro-oeste de Campeche se desconoce, sin embargo, en especies que presentan densidades bajas y tamaños poblacionales pequeños tales como los grandes carnívoros o herbívoros, las colisiones con vehículos, aún cuando sean poco numerosas, pueden convertirse en una causa importante de mortalidad y un factor significativo para reducir las posibilidades de supervivencia de la población local, como por ejemplo la pantera de Florida (Maher *et al*., 1991; Taylor *et al*., 2002).

Ante la evidente presencia de tapires en la zona (centro-oeste del estado de Campeche), es necesario realizar estudios enfocados a conocer el estatus que el tapir centroamericano presenta en esta región, para poder determinar si el individuo atropellado se trataba de un organismo dispersor o existe una población residente en la zona, y así establecer bases solidas sobre las cuales se elaboren estrategias de manejo y conservación de esta especie en la zona

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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 regrowth.
- Natural history and taxonomy of tapirs (e.g., evolution, palaeontology and extinction).

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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.

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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.

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Up to five pertinent words, in alphabetical order.

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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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TAPIR CONSERVATION

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