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

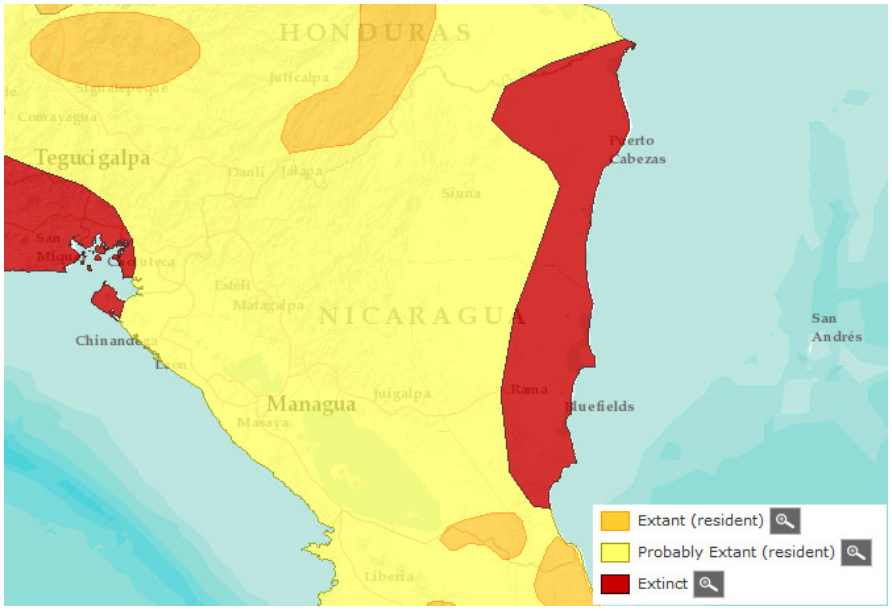

Figure 1: The IUCN Baird's tapir range map for Nicaragua. Note that the species is considered extinct along the Caribbean coast.

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.

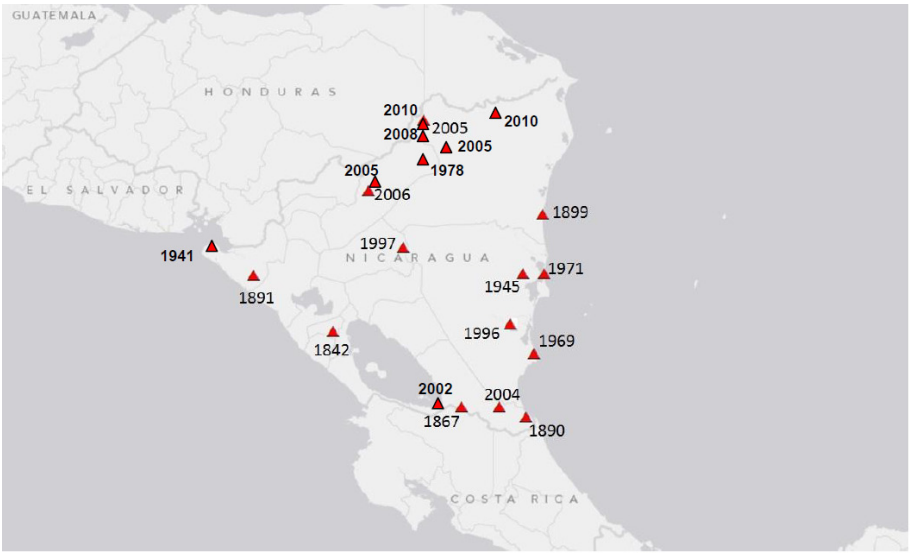

Figure 3: This map includes the various locations of Baird's tapir presence cited in the historical literature from Nicaragua. Locations are juxtaposed with the year the associated fieldwork was undertaken rather than publication date. Only citations with fairly specific geographic information were included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

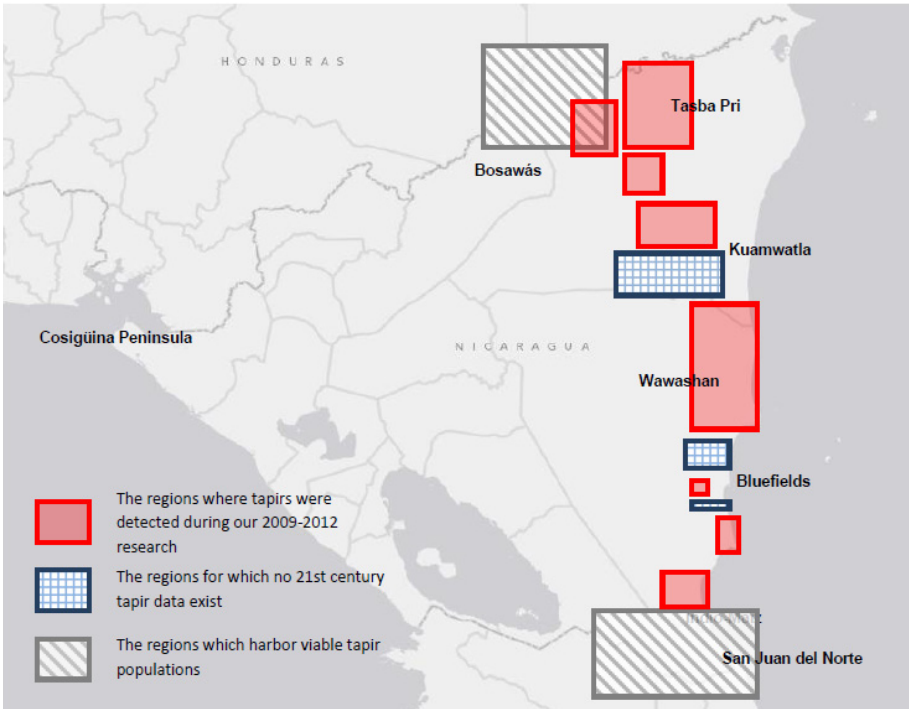

Figure 4: This map depicts: 1) the approximate locations of the known viable tapir populations in the northern and southern regions of the Caribbean coast of Nicaragua; 2) the areas of confirmed tapir presence from our 2010-2013 surveys; and 3) areas about which we were unable to find published literature 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.

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