

Interaction behavior and vocalization of the baird's tapir *Tapirus bairdii* from Talamanca, Costa Rica

Comportamento de interação e vocalização do tapir centro-americano *Tapirus bairdii* de Talamanca, Costa Rica

Diego A. Gómez-Hoyos^{1,2}
biodiego88@gmail.com

Sergio Escobar-Lasso³
biosergiobike@gmail.com

Esteban Brenes-Mora⁴
esteban@naiconseration.org

Jan Schipper^{1,5}
jschipper@phoenixzoo.org

José F. González-Maya^{1,6}
jfgonzalezmaya@gmail.com

Abstract

Baird's tapir is considered globally endangered, but most aspects of its ecology and natural history are still unknown. There are scarce previous reports regarding interaction behavior and vocalization for the species; this work is considered the first detailed description of call not only for *T. bairdii*, but the first for a tapir in the wild. Here we present observations on interaction behavior and the analyses of the first wild vocalizations for Baird's Tapir from Talamanca, Costa Rica. We distinguish two types of calls. The first call was composed of two notes (average 0.625 ± 0.069 s and 0.323 ± 0.080 s, respectively) with a dominant frequency of $4,940 \pm 248.3$ Hz. The second call was composed of a single note (average 1.121 ± 0.063) with a dominant frequency of $6,471 \pm 704.1$ Hz. Interaction is probably due to resource availability, and vocalizations likely reflect communication between bonding pairs or to avoid agonistic behavior. These observations provide clues into social interaction and use of vocal traits for communication among wild tapirs, as well as may contribute for future analyses regarding the phylogenetic signal within the genus.

Keywords: Bonding pairs, communication, Perissodactyla, social interaction.

Resumo

O tapir centro-americano é considerado em perigo globalmente, mas a maioria dos aspectos de sua ecologia e história natural ainda é desconhecida. Existem poucos relatórios anteriores sobre o comportamento de interação e de vocalização para as espécies; este trabalho é considerado a primeira descrição detalhada da vocalização não somente para *T. bairdii*, mas a primeira para uma anta na natureza. No presente trabalho, apresentam-se observações sobre o comportamento de interação e as análises das primeiras vocalizações selvagens para o tapir centro-americano de Talamanca, Costa Rica. Distinguimos dois tipos de chamadas. A primeira chamada foi composta por duas notas (média $0,625 \pm 0,069$ s e $0,323 \pm 0,080$ s, respectivamente) com uma frequência dominante de $4.940 \pm 248,3$ Hz. A segunda chamada foi composta por uma única nota (média $1,121 \pm 0,063$) com uma frequência dominante de $6.471 \pm 704,1$ Hz. A interação é provavelmente devido à disponibilidade de recursos, e as vocalizações provavelmente refletem a comunicação entre casais ou para evitar comportamentos agonísticos. Essas observações fornecem indícios de interação social e do uso de traços vocais para a comunicação entre antas selvagens, além de poder contribuir para futuras análises do sinal filogenético no gênero.

Palavras-chave: casais, comunicação, interação social, Perissodactyla.

¹ Proyecto de Conservación de Aguas y Tierras (ProCAT Internacional). Calle 97A No. 10-67, Oficina 202, Bogotá, Colombia. Fundación Sierra to Sea. Finca Las Alturas, Puntarenas, Costa Rica.

² Universidad del Quindío. Grupo de Investigación y Asesoría en Estadística. Carrera 15 Calle 12N, Armenia, Quindío, Colombia.

³ Grupo de Investigación en Biología de la Conservación y Biotecnología. Corporación Universitaria de Santa Rosa de Cabal (UNISARC). Campus Universitario El Jazmín. Kilómetro 4 Vía Santa Rosa de Cabal – Chinchiná, 17001000, Risaralda, Colombia.

⁴ Na! Conservation. San José, Costa Rica.

⁵ Arizona Center for Nature Conservation. Phoenix Zoo. 455 N. Galvin Parkway, Phoenix, AZ 85008, USA.

⁶ Universidad Nacional Autónoma de México. Instituto de Ecología, Ciudad Universitaria, Circuito Exterior s/n, México DF, México.

Introduction

There are four living tapir species in the world (Nowak, 1999). Three of these species inhabit the Neotropics (*Tapirus bairdii* (GILL 1865), *T. pinchaque* (ROULIN 1829), *T. terrestris* (LINNAEUS 1758)) and one in Southeastern Asia (*T. indicus* DESMAREST 1819) (Ruiz-Garcia *et al.*, 2015). All extant species are currently considered to be vulnerable or endangered, mainly by hunting and habitat destruction (Naveda *et al.*, 2008; García *et al.*, 2016; Lizcano *et al.*, 2016; Traeholt *et al.*, 2016). Despite the critical conservation status of tapirs, their ecology, behavior and natural history are still barely known (Olmos, 1997). This basic information is important to implement appropriate conservation actions, since the tapirs have key roles in the ecosystems dynamic as prey and seed dispersers (Olmos, 1997).

Baird's tapir (*T. bairdii*) is the largest mammal species in the Neotropics, occurring from southern Mexico to north-west Colombia (Eisenberg, 1989). *Tapirus bairdii* is currently listed as globally endangered (García *et al.*, 2016). Despite this, there is scarce scientific literature regarding its ecology and natural history, especially at high elevations (Tobler, 2002; González-Maya *et al.*, 2009; González-Maya *et al.*, 2012) undermining ecological and evolutionary research and appropriate conservation planning.

Social behavior in *T. bairdii* is scarcely documented; it is known that it is generally solitary, even though sometimes they form groups from two to five individuals (Naranjo and Cruz, 1998). Groups are formed during estrus or parental care (Lira-Torres *et al.*, 2014a; Lira-Torres *et al.*, 2014b). Within these groups, interactions occur, such as acute vocalizations for communication (Lira-Torres *et al.*, 2014a).

The knowledge of interaction behaviors in tapirs has been mainly recorded from captive animals (Hunsaker and Hahn, 1965; Lira-Torres *et al.*, 2004; Tortato *et al.*, 2007; Pukazhenth *et al.*, 2013), but with scarce information from wild individuals, especially for *T. bairdii*. Previous studies in Costa Rica have reported large overlap of their home range due to familiar units and attraction of food sources (Foerster and Vaughan, 2002, 2015). Furthermore, observation of some individuals in Barro Colorado Island, Panama, also showed that group feeding responded to resource availability, and vocalizations were also recorded (Terwilliger, 1978).

Since tapir interactions in the wild occur only in specific cases (during estrus, courtship or with a limited food resource), records of their calls emitted during these interactions are rare and difficult to obtain (Hunsaker and Hahn, 1965). Therefore, the scarcity of records from wild populations do not allow conclusive hypothesis regarding both group activities, vocalizations and the role of these calls on interactions. Herein, we report on obser-

vations of baird's tapir interaction behavior in the wild and describe quantitatively the first vocalizations of wild tapirs during interactions.

Material and methods

Study area

We recorded videos of *Tapirus bairdii* between 10 and 31 December 2015 at Las Tablas Protected Zone (LTPZ; 8.97388°, -82.87933°, 1650 m asl) and between 12 December 2015 and 27 August 2016 at Los Quetzales National Park (LQNP; 9.61073°, -83.81562°; 3060 m asl), Costa Rica (Figure 1). Both protected areas are located in the Talamanca mountain range and La Amistad Biosphere Reserve, which is considered one of the last frontiers for mammal conservation in Central America. Also this mountain range holds the highest reported density of tapirs in their distribution (González-Maya *et al.*, 2012). LTPZ is passively managed with restrictions on land use, but is privately owned and maintained; the area represents an important conservation area since it is part of the buffer zone of La Amistad International Park (González-Maya and Mata-Lorenzen, 2008). On the other hand, LQNP is connected to one of the largest protected areas of Costa Rica, Tapanti-Macizo de la Muerte National Park, and represents an important link for wildlife populations between the Caribbean Pacific slopes of the range.

Methods

Interactions between Baird's Tapir individuals and their calls were recorded using camera traps (Bushnell Trophy Cam HD) placed strategically to maximize tapir captures. In LTPZ the camera was placed inside a mature forest and baited with artificial salt licks. The videos were obtained as part of a pilot experiment to decrease hunting in the area and understand salt-licks efficiency for attracting the species. In LQNP the camera station was located in a mature forest on a tapir trail with recent signs of tapir presence and as part of a larger tapir population occupancy study. The individuals were recognized, when possible, by traits such as skin and pelvic waist scars, as used in previous studies in the area (González-Maya *et al.*, 2012).

We described the behavior of *T. bairdii* when issuing calls and estimated the temporal and spectral parameters of these calls using the software RAVEN Pro 1.4 (Bio-acoustics Research Program, 2014). Call parameter definitions follow Browning and Herstein (2010) and Naundrup (2012). We digitalized records at 16 bits resolution and 44.1 kHz sampling rate. We analyzed oscillograms and spectrograms with a Fast Fourier Transformation window of 256 points and Blackman algorithm. We measured low and high frequencies of the calls at 20 dB (re 20 mPa) be-

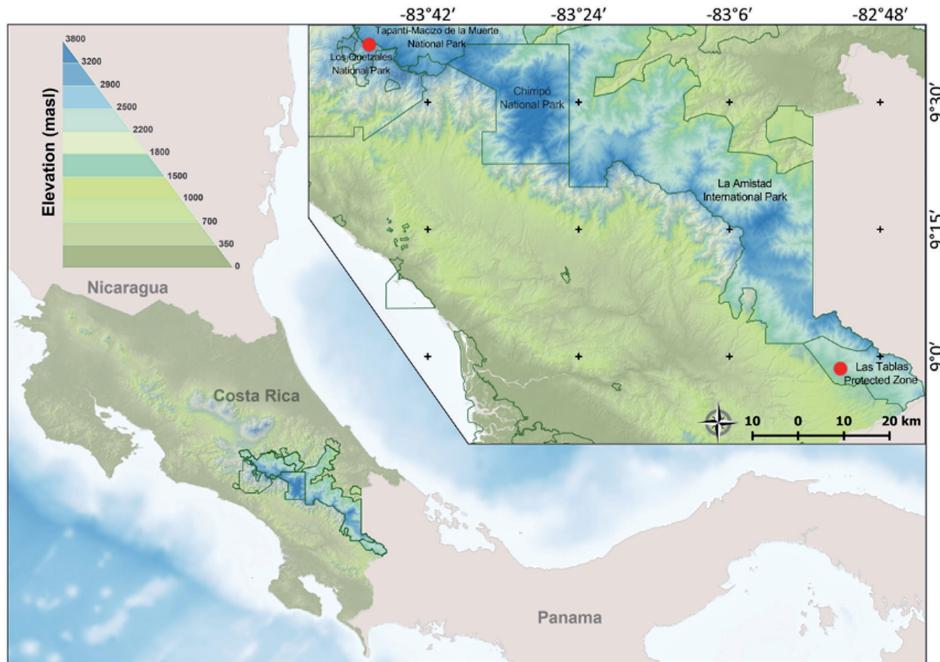


Figure 1. Location from observations (red dots) on *Tapirus bairdii* interaction behavior in Las Tablas Protected Zone (LTPZ) and Los Quetzales National Park (LQNP), Costa Rica.

low the peak of intensity of the dominant frequency, which is the value at which the signal energy could still be clearly distinguished from the background noise. We reported the measures as the mean \pm one standard deviations from the mean followed by the range.

Results

Vocalizations

Taking into account the spectral and temporal features of the *T. bairdii* calls, we distinguish two types of calls (Figures 2 and 3). The description of the first type of call is based on seven calls recorded from four individuals of two locations (LQNP and LTPZ) and the description of the second type of call is based on 14 calls recorded from two individuals in one location (LQNP). The first type of call is denominated “advertisement call” (Audio 1) according to the social context in which it was issued (see below). This call is composed of two different notes (Figure 2a). The first note was composed by 4.1 ± 1.21 pulses (3-6 pulses) and it had an average of 0.625 ± 0.069 s (0.534-0.745 s). The second note was not pulsed and it had an average of 0.323 ± 0.080 s (0.205-0.412 s). The second note can also be issued independently, without first one (Figure 2b). Mean call duration was 1.677 ± 0.402 s (1.227-2.234 s) and the silent intervals between calls were 4.373 ± 1.475 s (2.441-6.443 s). The dominant frequency of the call was

$4,940 \pm 248.3$ Hz (4,444-5,212 Hz) while the lowest and highest frequencies were $2,439.9 \pm 98.03$ Hz (2,333.3-2,567.2 Hz) and $12,572.5 \pm 1,262.2$ Hz (10357.2-14051.8 Hz), respectively.

We denominate the second type of call as “pair bonding” (Audio 2), according to the social context in which it was issued (see below). This call is composed by a single note, which has an average of 4.28 ± 1.32 pulses (3-7) (Figure 3a). Mean call duration was 1.131 ± 0.0631 s (1.031-1.231 s). The dominant frequency of the call was 6471 ± 704.1 Hz (5321-7452 Hz), the lowest frequency was 1536.1 ± 334.7 Hz (1083-1964 Hz) and the highest frequency was 10963.3 ± 827.8 Hz (9745-12186 Hz). The spectrogram of this type of call has a typical form of Gaussian bell (Figure 3). This call can be issued alone (Figure 3a), in duo (Figure 3b) or in trio (Figure 3c).

Interaction behavior

We observed interaction behavior between Baird's Tapir individuals during salt-licks in LTPZ (Figures 4a and 4b), as well as shelter usage in LQNP (Figures 4c and 4d). These interactions included female and male individuals (Figure 4), as well as issuing calls (Figures 2 and 3).

Salt-licks usage: We recorded at least two baird's tapir individuals, an adult male and a female, visiting the artificial salt-licks. The male was recorded more times than the female with 12 and two visits, respectively, while in-

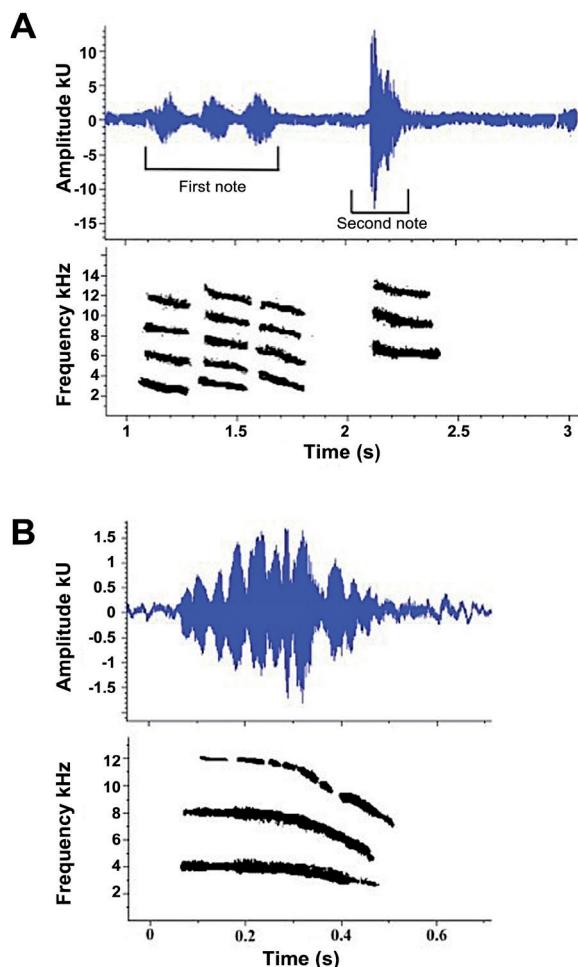


Figure 2. Graphic representations of the advertisement call recorded for *Tapirus bairdii* in Talamanca, Costa Rica. Oscillogram and spectrogram of the call composed of two different notes (a) and of the call composed only by the second note (b), which is emitted independently without the first one.

take times were between 3 and 146 minutes (mean 50.3 min) for the male, and between 16 to 106 minutes for the female. During male's salt intake alone, the individual showed frequent erections.

The shortest time (3 min) in which the male was at the salt lick, the individual smelled, wiggled the ears and fled at 4h00 a.m. of 18 December 2015. Seven minutes later, the female arrived and stayed for 16 minutes. During the second interaction, the male arrived to the salt lick at 12h10 a.m. of 31 December 2015; 14 minutes later, the female approached cautiously and emitted advertisement calls (Figures 2 and 4a). Both individuals consumed salt until 12h36 a.m., during which time, the individuals groomed each other twice by licking their snouts (Figure 4b).

Shelter usage: Between February and August (133 days) we recorded a male and a female tapir at a resting

site at LQNP. This site was a shelter formed by a trunk of a fallen oak (*Quercus* sp.) and surrounded by bamboo (*Chusquea* sp.) (Figures 4c and 4d). During this period we detected the presence of Baird's Tapir on 24 one-day-occasions. Tapir detections were mainly of an adult male using the shelter repeatedly. On one occasion a lonesome female was detected checking the site. This same female was seen sharing the shelter (Figures 4c and 4d) and communicating vocally with the male. The interactions between the couple of tapirs were not aggressive and were accompanied by pair bonding calls and physical contact. The male initially issued the pair bonding calls and the female answered seconds later. Once the female answered the call, she followed the male to the shelter.

Discussion

Baird's Tapir is considered mostly solitary, though it occasionally forms groups during estrus or parental care (Lira-Torres *et al.*, 2014a; Lira-Torres *et al.*, 2014b), and individuals may also overlap their home ranges while searching for food (Terwilliger, 1978; Foerster and Vaughan, 2002). Furthermore, while considered a generalist herbivore (Naranjo, 1995; Tobler, 2002; Foerster and Vaughan, 2015), previous studies have found that food sources (Terwilliger, 1978; Foerster and Vaughan, 2002) including salt accumulations, can drive spatial and interaction patterns. Despite an apparent abundance of potential resources for the species in these high-elevation ecosystems (Tobler, 2002), it is likely that salt can be a restricted resource. Our observations indicated that the species can also interact in pairs, when foraging for this limited resource.

During salt intake both individuals groomed each other, mostly licking their snouts, which is a behavior previously reported by Terwilliger (1978) in Barro Colorado Island. Nevertheless, erections have been only reported previously during courtship (Lira-Torres *et al.*, 2004; Tortato *et al.*, 2007). Our observations of erections during the salt intake do not allow us to draw any conclusions regarding this behavior, but it is noteworthy to provide these details for future explorations on the species' behavior.

Calling behavior is one of the least known aspects of the *Tapirus* genus' natural history (Hunsaker and Hahn, 1965; Lira-Torres *et al.*, 2014b); for instance, of the four recognized species, temporal and spectral parameters of calls have only been described for *T. terrestris* (Hunsaker and Hahn, 1965). However, these descriptions were made in captivity (Hunsaker and Hahn, 1965), therefore, this work is considered the first detailed description of call not only for *T. bairdii* but the first for a tapir in the wild.

Although only *T. terrestris* (Hunsaker and Hahn, 1965) and *T. bairdii* (our study) are the species for which calls have been quantitatively described, it is important to high-

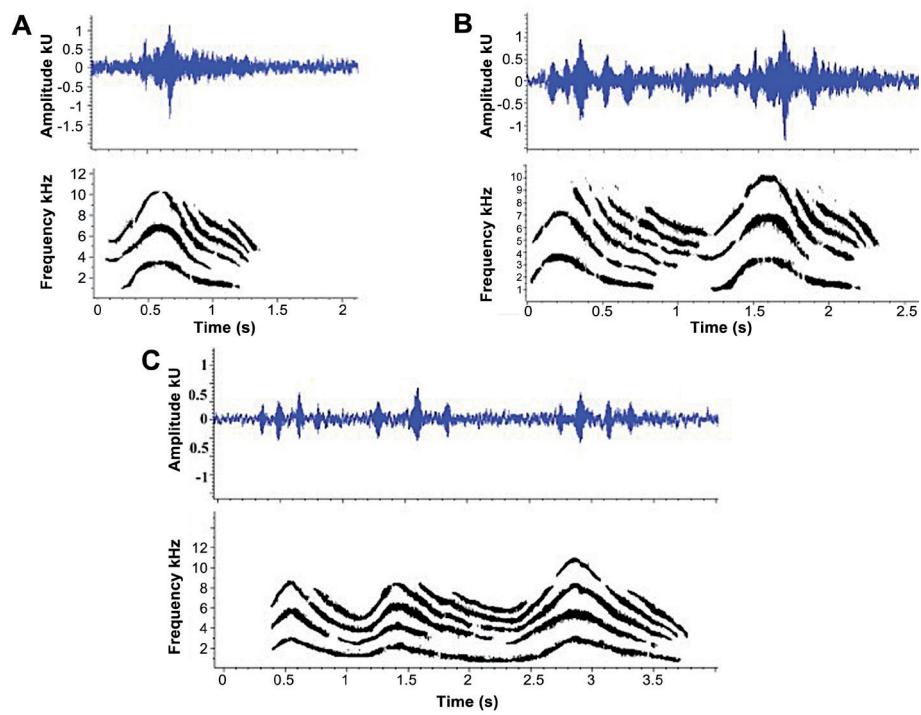


Figure 3. Graphic representations of the pair bonding call recorded for *Tapirus bairdii* in Talamanca, Costa Rica. Oscillogram and spectrogram of the call issued alone (a), in duo (b), and in trio (c). Notice how the spectrogram of this type of call has a typical form of Gaussian bell.

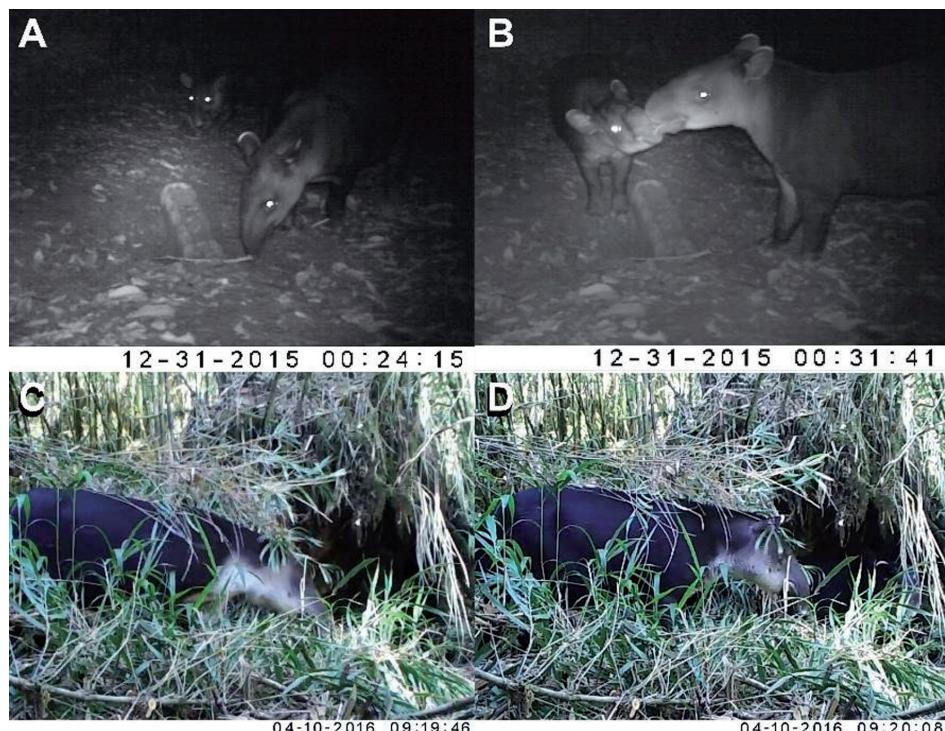


Figure 4. Interaction behavior between two individuals (male and female) of *Tapirus bairdii* at an induced salt-lick site, from Las Tablas Protected Zone in Talamanca, and a shelter from Los Quetzales National Park, Costa Rica. (a) Female approached cautiously producing audible calls. (b) Observed grooming interaction through snout licking. (c) Female approaching the shelter (d) followed by the male while producing calls.

light that this behavior has been anecdotally described also for *T. pinchaque*, *T. terrestris* and previously for *T. bairdii*. For instance, *T. pinchaque* was reported to emit high-pitched whistles during courtship and high-pitched squeals as danger warnings (Padilla *et al.*, 2010). Furthermore, *Tapirus terrestris* and *T. bairdii* were also reported to produce acute vocalizations similar to whistles and hiccups (Hunsaker and Hahn, 1965; Terwilliger, 1978; Lira-Torres *et al.*, 2004; Lira-Torres *et al.*, 2014b).

Vocalizations described in the salt-lick (Figure 2) were produced by the arriving individual, probably advertising of its presence; this might be a way to avoid aggression or agonistic behaviors, as previously observed for *T. terrestris* in captivity (Hunsaker and Hahn, 1965). Meanwhile, vocalizations described in the shelter (Figure 3) were produced by a couple in courtship. Since these two calls are acoustically different (Figures 2 and 3) and were emitted in different behavior and social contexts. Thus, we propose to name them as “advertisement call” and “bonding call”, respectively. According to our small sample size, we cannot be certain and conclusive to formalize the definition of these call types for *T. bairdii*. Therefore, we recommend performing systematic behavioral studies of *T. bairdii* to discard or formalize the description of advertisement and bonding calls.

Although little is known about the role of calls on tapir behavior, tapir’s acoustic repertoire seems to be broad and complex. For example, Hunsaker and Hahn (1965) described four different calls during social interactions for *T. terrestris*, and at least two different calls were also described during courtship and warning situations for *T. pinchaque* (Padilla *et al.*, 2010). Differences in call types and traits within the same species could respond either to behavior for specific interaction situations or can even be related to habitat-type or ecosystem (Wiley and Richards, 1978; Brown *et al.*, 1995). Our results demonstrate that according to different contexts of social interaction, *T. bairdii* can emit different types of calls. However, we think that we are far from registering the complete acoustic repertoire of *T. bairdii* and understanding the true social meaning of each type of call. Nonetheless, this work is a great contribution to understand the acoustic behavior between reproductive pairs of *T. bairdii*. However acoustic communication between females and their offspring or if there is any type of call to warn of danger is unknown. This highlights the need to do further field research to understand the social and acoustic behavior in tapirs.

Interestingly, the call described for *T. bairdii* in our study drastically differs from the four distinct call types described in *T. terrestris* by Hunsaker and Hahn (1965). In general, calls in *T. bairdii* are much longer, have a higher frequency and have more pulses and notes compared with the calls recorded in *T. terrestris*. Significant differences in call types and traits interspecies could respond to the

different evolutionary histories among species of tapirs. Despite important advances in understanding phylogenetic relationships among the species of the *Tapirus* genus (Ruiz-Garcia *et al.*, 2015), many uncertainties persist regarding phylogenetic affinities and taxonomic limits of the species, especially with the yet to confirm new species *T. kabomani* (Cozzuol *et al.*, 2013; Ruiz-Garcia *et al.*, 2015). The temporal and spectral parameters of the calls of many vertebrate groups are a useful character for species delimitation and evolutionary research (Margoliash and Hale, 2008). Further research is required to describe the temporal and spectral parameters of the calls of other *Tapirus* species, such as *T. indicus* and *T. pinchaque*, in order to improve our understanding of the behavior and evolutionary relationships among those species.

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