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# Bucking and charging defense of Baird's tapir (*Tapirella bairdii*) from common vampire bats (*Desmodus rotundus*)

# Defensa del tapir centroamericano (*Tapirella bairdii*) frente a vampiros comunes (*Desmodus rotundus*)

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Camera trap studies have captured a wide diversity of wildlife behaviors, highlighting the importance of behavioral ecology in meeting wildlife management and conservation goals. We report on predation attempts by common vampire bats (*Desmodus rotundus*) upon Baird's tapir (*Tapirella bairdii*) and describe the tapir's defensive response. On September 2020, we obtained the records of this interspecific interaction at one camera-trap station located in a buffer zone of the Rincon Rainforest Reserve in northwestern Costa Rica. We recorded vampire attempts to feed on at least 2 individuals of Baird's tapirs. When detecting the bats, tapirs reacted to repel them by shacking, running, spinning, and chasing the bats in flight. These cases add to our current knowledge of tapirs' defensive behavior and are relevant to questioning the evolution of stealthiness in vampire attacks. In addition, it emphasizes the role of monitoring these interspecific interactions in relation to zoonosis in human-modified landscapes.

**Key words:** Buffer zones; defensive behavior; Guanacaste Conservation Area; interspecific interactions; One Health; zoonotic risk.

Los estudios con cámaras trampa han capturado gran diversidad de comportamientos de la fauna silvestre, resaltando la importancia de la ecología del comportamiento para cumplir con los objetivos de gestión y conservación de la vida silvestre. Reportamos intentos de depredación de vampiros comunes (*Desmodus rotundus*) hacia el tapir centroamericano (*Tapirella bairdii*) y describimos la respuesta defensiva del tapir. En septiembre de 2020, capturamos registros de esta interacción interespecífica en una estación de cámara trampa ubicada en la zona de amortiguamiento de la Reserva Rincón Rainforest en la zona noroeste de Costa Rica. Registramos vampiros intentando alimentarse de al menos 2 ejemplares de tapir centroamericano. Al detectar a los vampiros, los tapires reaccionaban para repelerlos sacudiéndose, corriendo, girando y persiguiendo a los murciélagos en vuelo. Estos registros generan nuevo conocimiento sobre el comportamiento defensivo de los tapires y son relevantes para preguntas relacionadas a la evolución del sigilo en el ataque de los murciélagos vampiro. Además, enfatizan el papel del monitoreo de estas interacciones interespecíficas en relación con la zoonosis en paisajes modificados por humanos.

**Palabras clave:** Área de Conservación Guanacaste; comportamiento defensivo; interacciones interespecíficas; riesgo zoonótico; Una Salud; zonas de amortiguamiento.

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The growing use of camera-traps in field studies of wild mammals has increased the potential and probability to identify new animal behaviors. The rigorous use of these tools has also highlighted the importance of behavioral ecology to achieving wildlife management and conservation goals (Caravaggi *et al.* 2020). Thus far, images recorded by camera-traps of wild animals have depicted a surprising diversity of behaviors (Caravaggi *et al.* 2017). This is even true when camera-traps are used opportunistically, or as a tool to achieve other research or conservation objectives.

Between 1998 and 2015, Baird's tapirs (*Tapirella bairdii*) were recorded in 39.4 % of 94 camera trap studies in Costa Rica (Artavia 2015). Although data from these studies suggest that the relative abundance of tapirs varies widely across the country, there has thus far been little effort to coordinate sampling effort and design among studies. This precludes direct comparisons of important population parameters (relative abundance, absolute abundance, or density) for tapirs and other ungulates (Ramírez-Vargas and Piedra-Castro 2019). Moreover, even less is known regarding the behavior of Baird's tapirs, whether from Costa Rica or anywhere across their range.

The diet of the common vampire bat (*Desmodus rotundus*) purportedly includes tapirs as prey (Sánchez-Cordero *et al.* 2011; Bobrowiec *et al.* 2015); however, the literature makes explicit reference only to 1 tapir species in particular: the lowland or Brazilian tapir (*Tapirus terrestris;* Castellanos and Banegas 2015). We could not find any verified reports of vampire bats feeding on the mountain tapir (*Tapirus pinchaque*), or the Baird's tapir (*T. bairdii*). Interestingly, the blood of wild prey does not appear to be preferred to that of livestock when the latter is present

(Delpietro *et al.* 1992), although tapirs and other mammals constitute native and natural prey.

Here we report on records of predation attempts by common vampire bats (*D. rotundus*) upon Baird's tapirs (*T. bairdii*), and describe the defensive behavior adopted by the tapirs to thwart the attacking bats. These records were obtained during our camera-trap study on human-wildlife interactions.

Between October 2019-April 2021, we deployed 24 camera-trap stations (Bushnell Trophy Cam HD; Bushnell Inc., Overland Park, USA) arranged as a stripe at the interface of multiple protected and private lands. The original purpose of our research was to document human-wildlife interactions, as well as threats due to poaching and other illegal incursions, the presence of domestic animals, and potential conflicts due to depredations by predators. It was also intended to foster the involvement of local communities in monitoring and surveillance of their local ecosystems (Amit and Valverde-Zúñiga per. obs.).

We obtained the specific defensive behavior records described herein for tapirs at one of the stations deployed as part of the above-mentioned study. This station, containing one camera trap operating 24 hr/day, was located in a private livestock farm in the district of Dos Ríos of Upala, northwestern Costa Rica (10° 52' 31" N, 85° 21' 21" W). The area corresponds to secondary evergreen forest of the Tropical Wet Forest life zone with some areas transitioning to Premontane Forest (Holdridge 1967). The site elevation is 697 m and had a mean annual precipitation of 3,000-4,000 mm and mean annual temperature of 22-24 °C (Ortiz-Malavasi 2014). The camera station was situated along a small creek with several potential bat roosting caves at its slopes. It was at 590 m from the farm owner's house, 100-150 m from the nearest cattle pastures (small pastures with < 50 animals each), and 62 m from the nearest protected area (Rincon Rainforest Reserve; Figure 1). This protected area is within the Guanacaste Conservation Area, a World Heritage Site (UNESCO 1999), and was acquired as recently as 2019 through a broader land acquisition strategy and restoration plan (*i.e.*, regenerative pasture occurs ~240 m from the camera). One outcome of this plan has been to reduce livestock density and open pastures in the area.

We obtained records depicting defensive behaviors by Baird's tapirs on 2 independent occasions in the span of 4 days of September 2020 around midnight, and close to the new moon (Appendix 1). In the first record (15 September 2020 at 00:11 hr), a male tapir walked quickly along a trail, making small jumps with its hind legs as it went; then, it stopped suddenly and turned to its right side. The tapir then ran in the opposite direction just as a vampire bat flew in from behind, near the ground to the right of the frame, and then up again. Quickly turning again to his left, the tapir jumped with his front legs and raised its trunk; in response, a vampire bat flew in from the right of the frame, and towards a tree further back. As it did, the tapir quickly walked out of the frame. We interpreted these movements by the tapir as "bucking and charging" motions to repel the vampire bat (Figure 2).

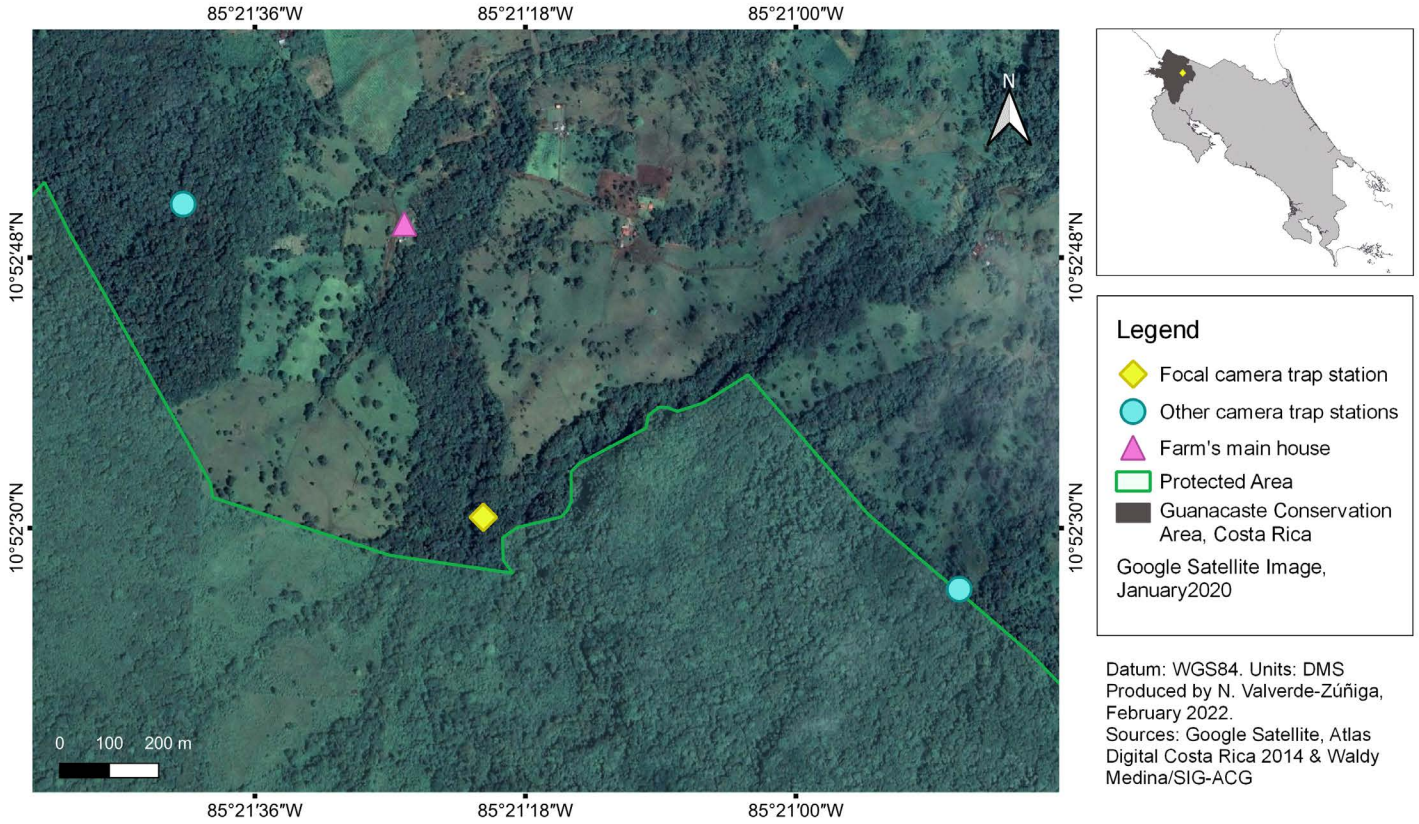


**Figure 1.** Landscape surrounding the focal camera trap station in relation to the limit of the Rincon Rainforest Reserve (protected area) in Upala, Costa Rica.

In the second record (18 September 2020 at 00:06 hr) we obtained two consecutive video captures (with a delay of 3 s between activations). Initially, a female tapir walked into the frame; followed by a vampire bat that flew in from behind and landed close to the tapir's hind legs. In the subsequent video, from a further plane, a vampire bat flew out and over the tapir, flying in a circle and returning towards the tapir. At the same time, a second vampire bat can be seen flying lower around the tapir. As this happens, the female tapir appeared to make a "running turn", raising her head and shaking her trunk while turning. A minute later, an adult male tapir can be seen walking in the same location as a vampire bat flies and perches on a thin tree, undetected by the tapir; another vampire is seen flying around the frame. To provide further context, we also recorded a prior incident at a different camera station (18 April 2020 at 02:06 hr). This incident photo captures showed a vampire bat lurking near a male tapir attempting to feed on the fruit of a *Parmentiera valerii*. Although in this case, the tapir did not display defensive behavior, it seemed uncomfortable while moving around the tree after it detected the vampire bat, and then leaved the area after spending < 4 min at the site (Appendix 1).

Other big mammals we detected at this site, and around the same time, included jaguar (*Panthera onca*), puma (*Puma concolor*), and white-lipped peccaries (*Tayassu pecari*); the last of which vampire bats also attempted to feed upon.

*Desmodus rotundus* has extraordinary adaptations for approaching and feeding undetected by its prey (see Greenhall *et al.* 1971 for a description). However, tapirs are well-known for their defensive behavior when disturbed. This is true even when they are disturbed by humans, particularly in the context of females defending their young during encounters in the wild (Castellanos and Gomez 2015).

Compared to other Perissodactyls, tapirids may not be as flexible as equids in their torso-lumbar movements, and they are certainly not armored like rinocerontids (*i.e.*, horns and thick collagen-layered skin); however, tapirs are heavy and bulky animals that can "run" somewhat (Christiansen 2002). In our recordings, *T. bairdii* actively charge against the vampire bats with deliberate movements. The most similar record we could find was a camera trapping video of a lowland tapir (*Tapirus terrestris*) attacked by a common vampire (*D. rotundus*) posted by Alysson Santos from IFRO Campus Ariquemes (Santos 2020). However, our records' individuals of *T. bairdii* exhibited a more energetic and direct attempt to repel and escape from their attackers.

These tapirs' behavior also differs significantly from the response of livestock when disturbed by vampire bats. Cattle exhibit a predominantly passive response, mostly by shaking their heads, flapping their ears and tail, and moving from a place to another. Not surprisingly, cattle is reported as vampire's preferred prey (Greenhall *et al.* 1971; Delpietro 1989; Bobrowiec *et al.* 2015). The relative ease or difficulty with which common vampire bats might successfully feed on tapirs compared to cattle, as well as their foraging response to land-use change is an important conservation question in mixed-use landscapes such as ours (*i.e.*, livestock ranches or agriculture adjacent to protected areas).

To feed successfully, common vampire bats need to approach stealthily; they often try to avoid detection by flying close to their target animal, and then walking until a biting opportunity is possible (Greenhall 2018). We interpret our observations as "failed attacks", whereby bats continued to approach after being initially detected, and with tapirs thus more alert and actively exhibiting defensive behavior. We are unable to speculate about the precise moment where and when the tapirs detected the bats (*e.g.*, before or after they entered the frames), whether bites occurred or not at any point, or if the interactions we observed led to continued attacks, whether successful or failed. This information is beyond the range and scope of our camera traps. Improved sensorial detection by these tapirs and lack of stealth by the bats could be factors to question about these events. Our records could be relevant to future inquiries on community dynamics of predator-prey co-adaptations, especially when evolutionary relationships are affected by anthropogenic landscape changes. Human activities can affect the availability and distribution of resources in a landscape, in some cases creating novel food resources (Becker *et al.* 2018). A relevant example of the vampire bats is the introduction of domestic cattle by Spaniards in the Americas.

Our reports on *D. rotundus* attempts to feed upon *T. bairdii* in proximity to livestock pastures suggests this relationship needs to be further explored under the framework of vampires as zoonotic vectors preying wildlife, cattle, and humans. Monitoring and detection of wild reservoirs that could potentially infect humans is central to zoonotic risk management (Wille *et al.* 2021). Vampire bats are the primary reservoir of the rabies virus in Latin America, a disease affecting livestock production and human populations every year (Schneider *et al.* 2009; Streicker and Allgeier 2016). Streicker and Allgeier (2016) found that cattle presence is a strong predictor of vampire bat density, and that vampire bats prey both on livestock and wildlife only in certain areas.

The current pandemic has shown how easy is to disrupt the separation between the sylvatic and the urban-domestic cycle of a zoonotic disease, particularly in landscapes with intense human-wildlife interactions. Additionally, climate change is expected to expand common vampire bat's suitable habitat (Lee *et al.* 2012), thus monitoring the consequences of this type of interspecific interactions becomes more relevant. In this context, the One Health approach becomes even more relevant, compelling collaborative and interdisciplinary approaches to respond to emerging and global disease management, emphasizing the wildlife health component (Mackenzie and Jeggo 2019). Future research, directed through the One Health approach, might account for the population density of vampire bats, tapirs,

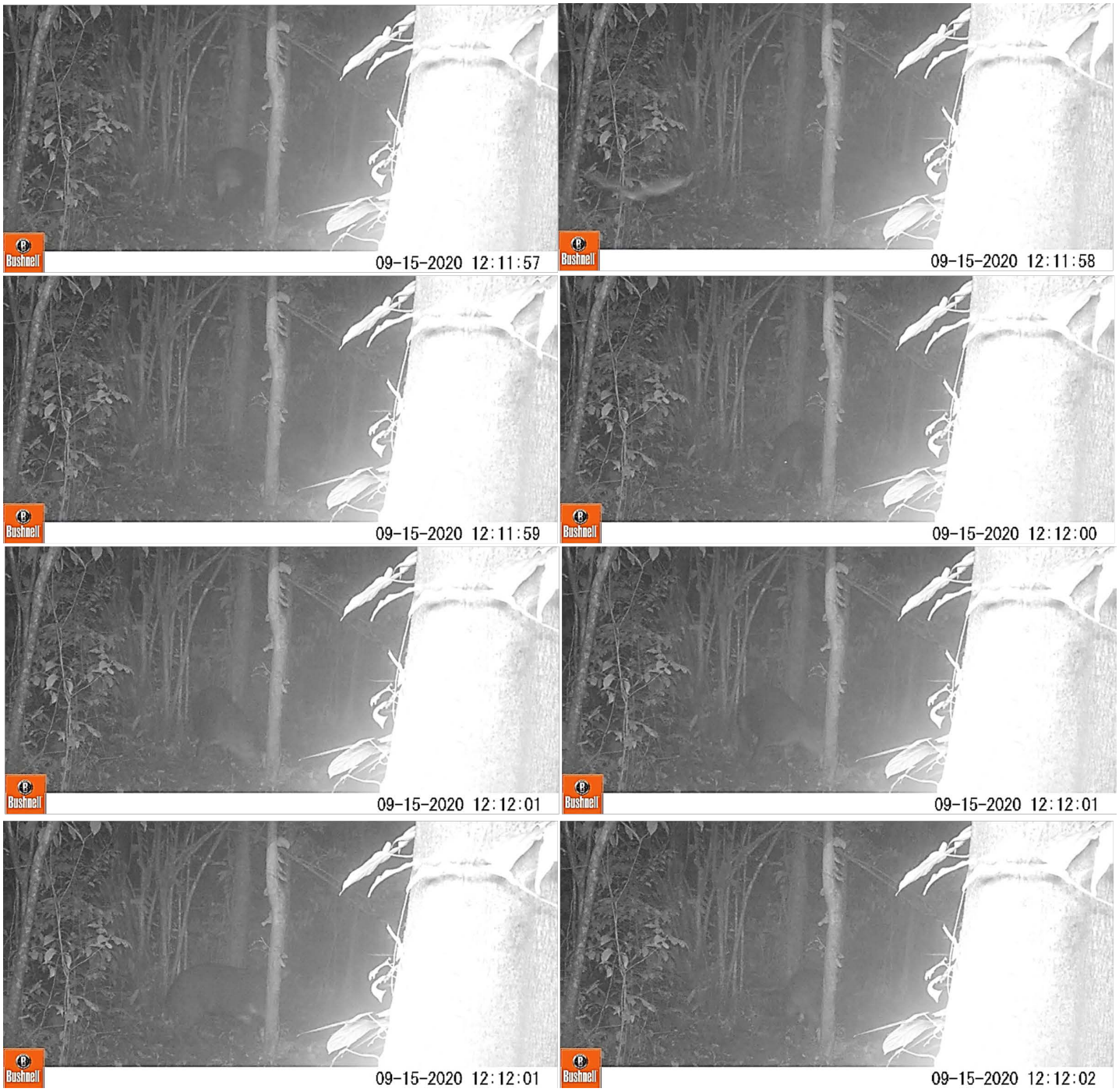


**Figure 2.** First record of Baird's tapir (*Tapirella bairdii*) bucking and charging behavior towards common vampire bats (*Desmodus rotundus*). Captures recorded in September 2020 at a secondary forest patch within the buffer zone of the Rincon Rainforest Reserve in Upala, Costa Rica.

and livestock, as they relate to landscape alterations, as well as a socio-ecological methods that acknowledges the complex needs of all interacting species, including humans, such as explored by Shapiro *et al.* (2020).

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## Appendix 1

Video of complete records depicting defensive behaviors by Baird's tapirs (*Tapirella bairdii*) during attack attempts by common vampire bats (*Desmodus rotundus*). Captures recorded in September 2020 at a secondary forest patch within the buffer zone of the Rincon Rainforest Reserve in Upala, Costa Rica.

https://drive.google.com/file/d/18Im7cLzKOxcVgrnItTvvRFyDR2sjumRi/view?usp=sharing