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Sand consumption by Hoffmann´s two-toed sloth (*Choloepus hoffmanni*) at Cahuita National Park, Costa Rica

Consumo de arena por el perezoso de dos dedos (*Choloepus hoffmanni*) en el Parque Nacional Cahuita, Costa Rica

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Mineral licking has been reported in most herbivorous mammal taxa; however, the frequency of mineral lick use by Pilosa at ground level in the wild is rare. Hoffmann's two-toed sloth (*Choloepus hoffmanni*), an herbivorous Pilosa species, is nocturnal and arboreal. We present the first case of saline sand consumption by a Hoffmann's two-toed sloth in Costa Rica. The observations occurred at Cahuita National Park, Limón, Costa Rica, on October 11, 2022, at 21:20 hr. We observed a sloth hanging from the base of a water apple tree (*Syzygium malaccense*), with its head pointing downward upon discovery. Pictures and notes were taken during the event. The sloth securely suspended itself from a lateral branch of the main tree trunk. In this position, it brought its snout nearly in contact with the ground and proceeded to lick the saline sand several times. The sequence of actions, including suspension from the branch, intermittent licking, and recommencement of climbing, transpired over a span of approximately 5 minutes. The case we present here involves the consumption of saline sand rather than licking of rocks. Our observations were conducted during the nighttime when potential sloth predators are active. Clearly, further foundational research is needed to understand these basic aspects of sloth´s natural history. Mineral licking by sloths might constitute an infrequent conduct, although essential to provide individuals with vital nutrients.

Key words: Herbivores; Megalonychidae; minerals; Pilosa; saline; salt.

El lamido de minerales ha sido reportado en la mayoría de los taxones de mamíferos herbívoros; sin embargo, la frecuencia de uso de saladeros por los Pilosa es rara. El perezoso de dos dedos (*Choloepus hoffmanni*), una especie herbívora de Pilosa, es nocturna y arborícola. Presentamos el primer caso de consumo de arena salina por parte de este perezoso en Costa Rica. Las observaciones tuvieron lugar en el Parque Nacional Cahuita, Limón, Costa Rica, el 11 de octubre de 2022, a las 21:20 hr. Observamos a un perezoso colgando de la base de un árbol de manzana de agua (*Syzygium malaccense*), con la cabeza apuntando hacia abajo al ser descubierto. Se tomaron fotografías y notas durante el evento. El perezoso se suspendió firmemente de una rama lateral del tronco principal del árbol. En esta posición, acercó su hocico casi al contacto con el suelo y procedió a lamer la arena salina varias veces. La secuencia de acciones, incluida la suspensión de la rama, el lamer intermitente y la reanudación de la escalada, transcurrió en un lapso de aproximadamente 5 minutos. El caso que presentamos aquí involucra el consumo de arena salina en vez de lamer rocas. Nuestras observaciones se llevaron a cabo durante la noche, cuando potenciales depredadores de perezosos están activos. Se necesita investigación fundamental adicional para comprender estos aspectos básicos de los perezosos. Lamer minerales por parte de los perezosos podría ser una conducta infrecuente, aunque esencial para proporcionar a los individuos nutrientes vitales.

Palabras clave: Herbívoros; Megalonychidae; minerales; Pilosa; sal; salina.

Animals require dietary salt to maintain their internal balance, and they exhibit corresponding behaviors to counteract the metabolic loss of sodium, chloride, and potassium ions (Denton 1982). This phenomenon is particularly evident among herbivores, as the naturally low-sodium content in plant tissue often fails to meet their nutritional needs (National Research Council 2005). As a result, various species such as African elephants, moose, and mountain gorillas actively seek dietary sources of additional sodium (Dudley *et al.* 2012). Mineral licking has been reported in most herbivorous mammal taxa but is especially common in ungulates and primates (Blake *et al.* 2010). The frequency of mineral lick use by sloths, or other Pilosa, at ground level in the wild is rare (Blake *et al.* 2010; Gómez-Hoyos *et al.* 2017).

Most frequent sightings of Hoffmann's two-toed sloth occur within the uppermost branches of trees, where it feeds on a diverse array of leaves from various plant species. This species is herbivorous, consuming fresh leaves, inflorescences, shoots, flowers, and fruits (Hayssen 2011), with apparently occasional consumption of animal material (Moraes-Barros 2018). At times, it engages in the behavior of licking and gnawing on tree trunks, possibly

to feed on lichen or moss growing on the bark (Reid 2009). The digestion of plant material is even slower in sloths compared to other herbivorous mammals, despite having a notably three-chambered stomach that occupies a significant portion of the abdominal cavity (Hayssen 2011).

Hoffmann´s two-toed sloth (Megalonychidae) distributes in 2 distinct geographical regions: from southern Honduras to the northern parts of South America, encompassing Colombia, western Venezuela, and northern Ecuador, and an area extending across the Peruvian, Brazilian, and Bolivian Amazon regions (Hayssen 2011; Plese *et al.* 2016). The species inhabits various types of forests, including primary and secondary forests, as well as both lowland and montane forest ecosystems (Moraes-Barros 2018). It is predominantly observed within the canopies of continuous forests characterized by mature trees in a range of environments, such as rainforests, dry forests, and riparian forest ecosystems (Moraes-Barros 2018). The distribution of this sloth spans from sea level up to altitudes exceeding 3,000 m (Molina *et al.* 1986; Reid 2009).

Hoffmann´s two-toed sloth primarily exhibits nocturnal behavior, although it occasionally engages in diurnal activities (Reid 2009). It possesses an impressive ability to blend into its surroundings through exceptional camouflage (Suutari *et al.* 2010) and tends to prefer habitats high in the canopy or nestled in the shaded junctures of trees (Reid 2009). These attributes have contributed to the scarcity of literature exploring the activity patterns of sloths in their natural habitat (Cliffe *et al.* 2023). Despite its remarkable slowness, this sloth is equipped with swift and potent strikes when faced with a threat, making it notably dangerous due to the strength and sharpness of its claws (Hayssen 2011). It descends to the ground for defecation every 3-8 days, yet it refrains from digging cavities for this purpose (Hayssen 2011).

In this note, we present the second case of mineral consumption by Hoffmann´s two-toed sloth in Costa Rica. However, in this instance, it involves the consumption of sand rather than licking rocks, as described in the first case (Gómez-Hoyos *et al.* 2017).

The observations took place within the Puerto Vargas sector of Cahuita National Park, Limón, Costa Rica (9° 43' 55" N, 82° 48' 53" W, 10 m; Figure 1). This is a well-preserved tropical forest in the Caribbean coast, Limón Province, Costa Rica (Mora *et al.* 2020). On October 11, 2022, at 21:20 hr, we witnessed a sloth hanging from the base of a tree of the introduced water apple *Syzygium malaccense* (L.) Merr. & L. M. Perry

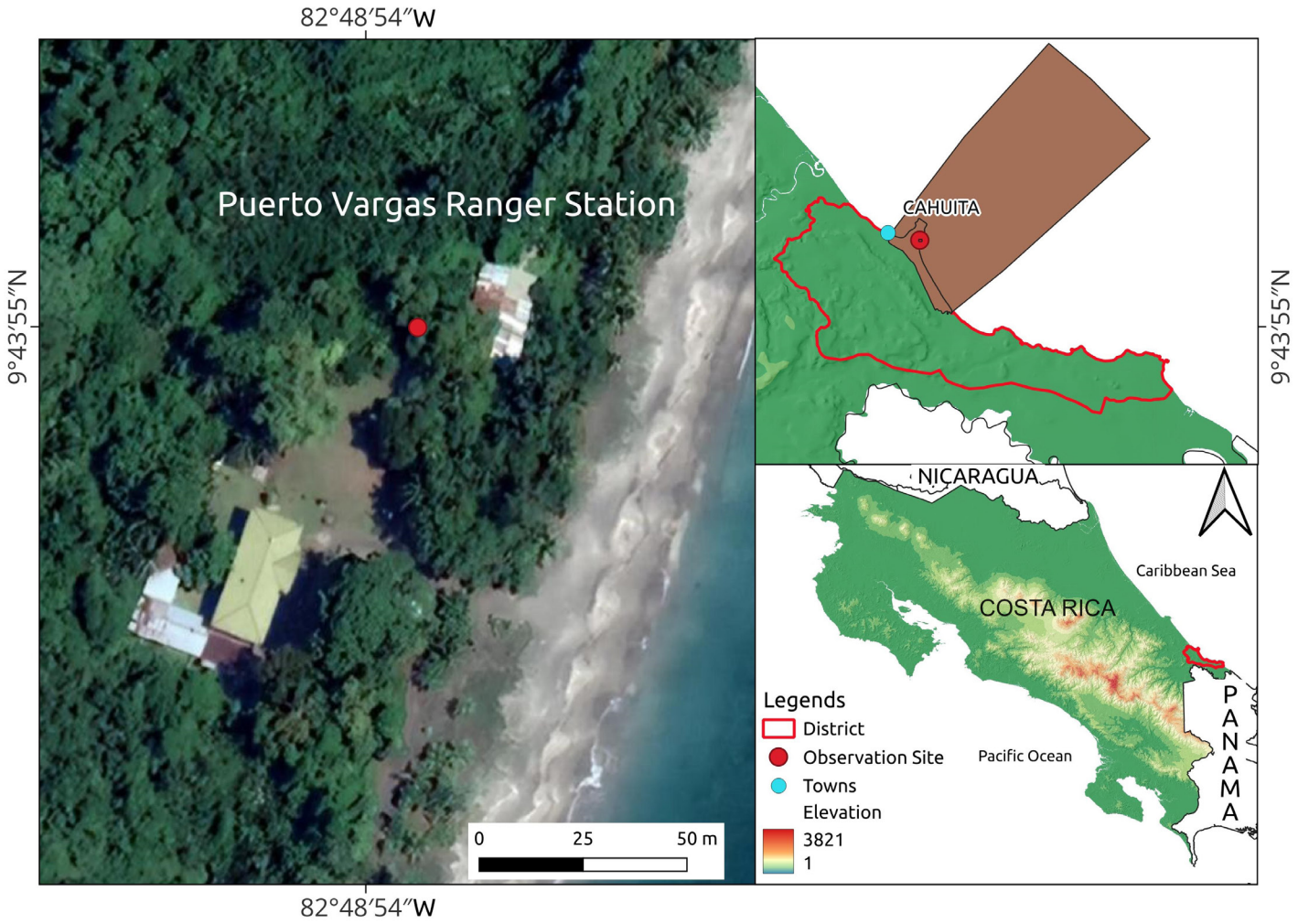

Figure 1. Location (marked with a red dot) where a Hoffmann's two-toed sloth (*Choloepus hoffmanni*) was observed consuming saline sand near the Puerto Vargas Ranger Station at Cahuita National Park, Costa Rica.

(Barrie 2007), its head pointed downward upon discovery. Our observation persisted for approximately 5 min before the sloth returned to the tree's up branches. The ground beneath the tree was sandy and devoid of vegetation, situated about 50 m from the beach (Figure 1). The tree itself exhibited a slender profile (with a diameter at breast height less than 15 cm), possessed a modest height, and featured branching near the ground, with a height measuring under 10 m.

The sloth securely suspended itself using its hind legs from a lateral branch of the main tree trunk, which it embraced effortlessly (Figure 2). It also maintained its hold on the branch with its hands, albeit less firmly. In this stance, it brought its snout nearly in contact with the ground and proceeded to lick the sand for several seconds in a series of 3 or 4 movements for at least 5 times. Following this, it turned around and initiated an ascent, with its head held aloft toward the tree's branches. This sequence of actions, involving suspension from the branch, intermittent licking, and recommencement of climbing, elapsed over a span of approximately 5 min.

In vast expanses of the continents, sodium is notably scarce due to meteorological processes, leading to a correspondingly low sodium content in plants (Lundquist and Varnedoe Jr. 2006). This situation bestows an evident evolutionary advantage upon animals capable of detecting and consuming salt from geological sources. Among these animals, herbivores are particularly in need, given the inherent low sodium content found in plants (Lundquist and Varnedoe Jr. 2006).

Numerous hypotheses, not mutually exclusive to the quest for sodium, have been proposed to elucidate these behaviors. These include the utilization of clays to aid in the detoxification of alkaloids, as well as potential medicinal functions of ingested soil (Dudley *et al.* 2012). Recent investigations have concluded that the primary driving force behind the well-known geophagy displayed by Amazonian parrots is the acquisition of sodium (Dudley *et al.* 2012).

The analyses of soil composition at Amazonian salt licks have confirmed heightened levels of sodium (and, in some instances, magnesium) relative to control sites (Brightsmith *et al.* 2008; Powell *et al.* 2009). Geophagy observed in other coexisting avian species, such as columbids and cracids (Brightsmith and Muñoz-Najar 2004), similarly aligns with sodium-seeking tendencies linked to diets predominantly reliant on plants (Dudley *et al.* 2012). All documented vertebrates that visit Amazonian salt licks have a predominantly phytophagous diet (Dudley *et al.* 2012). The herbivorous mountain tapir (*Tapirus pinchaque*) in Colombia also consumes water at salt licks that has a higher concentration of nitrogen and sodium relative to a control stream (Lizcano and Cavelier 2004).

We found only 3 previous records of mineral licking by sloths, which confirm the rarity of such events. One case is from Linné's two-toed sloth *Choloepus didactylus* from Ecuador (Blake *et al.* 2010; Gómez-Hoyos *et al.* 2017), and the other 2 events are from Hoffmann´s two-toed sloth (*Choloepus hoffmanni*), 1 in the tropical rainforest of Costa Rica (Gómez-Hoyos *et al.* 2017), and 1 from Perú. Nonetheless, this last instance involved an individual that ingested human feces and urine from latrines, ostensibly in pursuit of mineral resources (Heymann *et al.* 2011). The employment of mineral licks by sloths might constitute an infrequent behavior that supplies individuals with vital nutrients required either in small quantities or during specific periods (Gómez-Hoyos *et al.* 2017).

Some studies have indicated that sloths exhibit an increased frequency of vertical movements within the canopy during the nighttime compared to the daytime (Cliffe *et al.* 2023). This trend might imply a heightened inclination to descend to the ground at night, which is somewhat unexpected given the elevated risk of predation from large nocturnal felines (Cliffe *et al.* 2023). Our own observations of Hoffmann's two-toed sloth engaging in salt licking in Costa Rica were also made during the nighttime, in alignment with other instances of this behavior. The notion that sloths descend to the ground during the night does not seem to arise from diminished visual capabilities, considering that sloth eyes function effectively under extremely low light conditions (Cliffe *et al.* 2023). Evidently, further fundamental research is necessary to delve into the core natural history aspects of Hoffmann's two-toed sloth.

Figure 2. A Hoffmann's two-toed sloth (*Choloepus hoffmanni*) consuming saline sand near the Puerto Vargas Ranger Station at Cahuita National Park, Costa Rica. Available at josemora07@gmail.com.

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