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Observation of an apparently human-directed agonistic throat display in two adult males of *Alouatta caraya* (Atelidae: Primates) in Pilar, Paraguay

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Abstract

Agonistic displays have been observed in howler monkeys (genus *Alouatta*), not only through their well-described vocalizations but also through physical displays. This study describes a field observation of the agonistic display of two adult males of *Alouatta caraya* by showing their throats to observers in the city of Pilar, Paraguay. This behavior was not related to scratching, grooming solicitation, or thermoregulation. Given the energy conservation adaptations described in *Alouatta*, this throat display could serve as a ritualized threat, replacing high-energy demanding vocalizations with body displays. This behavior has only been seen in habituated urban-dwelling groups and thus more research is needed to understand the social context and significance of this behavior in urban and rural populations of *A. caraya*. This is the first recorded instance of such a display in *Alouatta*.

Key words: Agonism, Behavioural adaptation, Energy-conservation, Threat, Urban-dwelling.

Resumen

Los despliegues agonísticos en los monos aulladores (género *Alouatta*), no solo se han observado a través de las vocalizaciones sino también mediante exhibiciones físicas. Este estudio describe la observación de campo del comportamiento agonista de dos machos adultos de *Alouatta caraya* al exhibir su garganta a los observadores en la ciudad de Pilar, Paraguay. Este comportamiento no se vinculó con el rascado, la petición de acicalamiento o un comportamiento termorregulador. Dadas las adaptaciones para la conservación de la energía descritas en *Alouatta*, esta exhibición de garganta podría servir como una amenaza ritualizada, reemplazando las vocalizaciones altamente energéticas por comportamientos posturales. Este comportamiento solo se ha visto en grupos urbanos habituados y se requiere más investigación para comprender el contexto social y la

significancia de este comportamiento en poblaciones urbanas y rurales de *A. caraya*. Esta es la primera instancia registrada de tal exhibición en especies de *Alouatta*.

Palabras clave: Agonismo, Adaptación comportamental, Conservación de energía, Amenaza, Urbano.

As anthropogenic pressure increases, direct human-wildlife conflicts are becoming more frequent (Schell *et al.* 2020). In direct conflicts, animals often exhibit agonistic responses that vary according to the level of experienced threat (McLennan & Hill, 2010; Xia et al. 2017).

Agonistic behaviour in primates is frequently mediated by multimodal signs, reflecting the ecological importance of body displays as a communicative function (Call and Tomasello, 2007). Howler monkeys (genus *Alouatta*) have been observed to communicate by using multimodal non-vocal signals in reproductive, affiliative and agonistic contexts (Carpenter, 1934; Jones, 2002; Jones and Cantfort, 2006; Van Belle *et al.* 2009; Corewyn, 2019). They often display aggression through ritualized exhibitions including branch manipulation, lingual gestures, and facial expressions (Carpenter, 1934; 1983; McKinney, 2014; Dias & Rangel-Negrín, 2015). These behaviors are effective for short-distance intragroup communication (Moynihan, 2017), making high-energy agonistic interactions rare as an energy-conservation strategy (Mendez-Carvajal *et al.* 2005).

Visual signals in howler monkeys remain under-described, especially in anthropogenic habitats and human-wildlife conflicts. Here, we describe the event where two adult black-and-gold howler monkey (*Alouatta caraya*) males presented their throats without vocalizing to the observers in Pilar, Paraguay. This display is undocumented in the species.

The city of Pilar, department of Ñeembucú, Paraguay (26°52'04''S, 58°17'46''W, WGS84, 61 masl) is located along the Paraguay River and the Ñeembucú Stream and has approximately 33.700 residents (INE, 2023). Its climate is humid, with an average annual temperature of 22°C and noticeable seasonal fluctuations. The city houses an estimated population of 300 black-and-gold howler monkeys distributed across 50 groups (Unpublished Data, Para La Tierra 2024).

The behaviour typified as "throat display" was first seen in September 2023 and it was only included in our ethograms after two consecutive observations in different habituated urban groups "NC" and "O" on July 14th, 2024. The NC group consisted of one adult male, two adult females, one subadult male, and one infant. The O group included one adult male, three adult females, two subadult males, one juvenile female and one infant. Age and sex categories followed Rumiz's (1990) classification. The groups inhabit a public church and a private building complex, respectively (Figure 1a), that are surrounded by residential buildings and roads. Both groups are accustomed to observers and react typically during the initial presence of an observer by grunting and eye-gazing.

All Fundación Para La Tierra research is approved by the Ministerio de Ambiente y Desarollo Sostenible (MADeS) and complied with all local laws. The Fundación Para La Tierra Urban Howler Monkey Project is non-invasive and followed the American Society of Primatology Code of Best Practices for Field Primatology (2014).

At 11h30, the NC group was observed sleeping (26°52'05''S, 58°18'09''W, WGS84, 60masl). As observers approached, the group moved to a visible area, grunting at the observers. The group was positioned six meters above the ground, just above the observers. The adult

male and one adult female remained stationary while the rest of the group hid in a bamboo area. Subsequently, the adult male laid on his back fully supported by the branch, extending his right arm, and tilting his head back, clearly displaying the hyoid bone protrusion in his throat, which pointed vertically for three seconds. The display lasted approximately ten seconds, after which the male stood up and remained stationary looking at the observers within two meters of the adult female. Suddenly, she approached the adult male and huddled passively while the rest of the group remained out of sight.

At 11h50, we encountered the O group (26°52'01.40"S, 58°18'00.20"W, WGS84, 60masl). The group was five meters high and ten meters from the observers. The individuals were divided into four huddled groups. The individuals remained passive and stationary, observing from resting postures without vocalizing. An adult male then separated from his huddle (composed of him and an adult female carrying an infant) and stared at the observers while laying on his left shoulder (Figure 1b). The male then performed the display described earlier by extending its body, supporting himself on the branch, raising his chin, and yawning this time (Figure 1c-1e). The display lasted ten seconds, after which he laid in a ventral position, silent and without looking at the observers. The other members of his huddle joined him within 30 seconds. No significant behavioural changes were observed after 12h00.

FIGURE 1a. Satellite view of the locations of NC (in yellow) and O (in blue) groups in Pilar, Paraguay. 1b-1e. Sequence of the throat display performed by the adult male in the O group. The behaviour is depicted from the vigilant stationary position (b), laying back supporting on the branch (c, d), to the full body stretch of the focal animal while tilting its head upwards (e). This display was accompanied by yawning (d, e). Panels 1d and 1e show the throat protrusion formed by the hyoid bone of the actor male.

Consistent with previous observations, the males were not seen scratching themselves against the branches, nor were there any subsequent reactions from the rest of the group. This suggests the display is unlikely to be a form of rubbing-defined as repeated scratching of any body part on a substrate (Hirano *et al.* 2008), grooming petition, or scent communication. It also appeared unrelated to thermoregulation, as both instances occurred in shaded areas. Instead, the display aligns with agonism, which includes behaviours associated with fighting, *threats*, and defense (Scott and Fredericson, 1951). Presently, the throat display has been observed ten times in different groups.

Due to their mainly folivorous diet, *Alouatta* shows several energy conservation strategies including behavioural and metabolic adaptations (Amato *et al.* 2014; Martínez-Mota *et al.* 2016). These may restrict energy-demanding behaviors to ritualistic displays (Jones, 1980). We hypothesize that the throat display serves as an energy-saving ritualized threat, replacing roaring with less energy-demanding exhibitions of the capability to produce them, indicating a high investment in weaponry (Coehlo *et al.* 1976; Dunn *et al.* 2015), similar to the threat-sensitive responses observed in other atelids (Papworth *et al.* 2013).

In *Alouatta*, the direct responses to human observers are generally limited to vocalizations (McKinney, 2014), and occasionally the presence of tourists can lead to increased locomotion such as moving to branches where the monkeys become more visible to observers, as seen in both cases. This may serve as an intimidatory strategy, despite the increased energy expenditure (Rodríguez-Peña *et al.* 2023).

In Pilar, the throat display has been exclusively observed in (semi) habituated groups, which initially react with agitation to non-intrusive observers before calming down. This suggests that the throat display may be triggered by the observer's effect (Lehner, 1996) rather than the monkeys perceiving observers as threatening. Similar observer-influenced behaviors have been documented in other primates (Jack *et al.,* 2008; Iredale *et al.,* 2010). Urban monkey groups in Pilar are regularly exposed to people with positive attitudes towards them (Alesci *et al.,* 2022), reducing the likelihood of perceiving humans as a threat.

Among eight natural groups studied by Fundación Para La Tierra, this display has not been recorded, suggesting it may be exclusive to urban habitats, where forest patch isolation could favor non-vocal agonistic behaviors (Orihuela *et al.,* 2014). It might also be a locally learned behavior, similar to other culturally transmitted signals in *Alouatta* in high-competition environments (Briseño-Jaramillo *et al.,* 2015). Further investigation is needed to investigate its occurrences within intra- and intergroup contexts. To our knowledge, the throat display has not been recorded in any *Alouatta* species.

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