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Tapirus terrestris and *Milvago chimachima*: tick-cleaning interactions observed in the Brazilian Pantanal (Perissodactyla: Tapiridae; Aves: Falconiformes)

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Abstract. The bird-mammal tick-cleaning associations are considered an example of mutualistic interactions in which the birds (cleaners) obtain food, and the mammals (hosts) get rid from ticks. In some cases, this mutualistic relationship can be complicated by "cheating" during the cleaning session, where the cleaner also feeds on the host's wounded tissue or blood. Here we report on tick-cleaning interactions between the yellow-headed caracara (*Milvago chimachima*) and the South American tapir (*Tapirus terrestris*) observed in the Brazilian Pantanal. Our observations indicate that tick-cleaning interactions between the caracara and tapir may not always have a fully mutualistic character. It seems that in some cases, tapirs' willingness to accept cleaner birds may be reduced by the negative experience that the birds will also peck at the wounds.

Key words. Yellow-headed caracara, South American tapir, *Amblyomma*, ticks, cleaning associations, mutualism.

INTRODUCTION

The bird-mammal tick-cleaning associations are considered a typical example of mutualistic interactions in which the birds (cleaners) obtain food, and the mammals (hosts) get rid from ticks. In some cases, this mutualistic relationship can be complicated by "cheating" during the cleaning session, where the cleaner also targets the host's wounds and consumes its tissues and blood (Peres 1996, Weeks 2000, Sazima 2007, Sazima et al. 2012, Coulson et al. 2018). Cleaning behaviour has been reported for a wide range of birds (for a review see Sazima & Sazima 2010 and Sazima 2011). One of the best-known Neotropical cleaner birds is the widely distributed omnivorous yellow-headed caracara *Milvago chimachima* (Vieilot, 1816) (Falconiformes: Falconidae), for which the highest number of host species has been reported (Sazima 2007, Sazima et al. 2012, 2024, Bierregaard et al. 2022). It is often seen picking ectoparasites such as ticks (*carrapatos* in Portuguese) from cattle, capybaras and tapirs (hence its vernacular name *carrapateiro* in Brazilian Portuguese; Reis et al. 2017).

Behavioural interactions between the yellow-headed caracaras and capybaras *Hydrochoerus hydrochaeris* (Linnaeus, 1766) (Rodentia: Caviidae) involve various inviting postures that

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capybaras adopt to allow the birds access to otherwise inaccessible body parts. This supports the idea of a well-established symbiotic relationship between the two species (Sazima 2007). Similar inviting postures indicating co-evolved processes are also taken by tapirs when cleaned by the yellow-headed caracaras (Sazima & Sazima 2010, Reis et al. 2017, Coulson et al. 2018, Mosquera-Guerra et al. 2024). Moreover, Peres (1996), who reported on the cleaning association between the black caracara *Daptrius ater* Vieilot, 1816 (Falconidae) and the South American tapir *Tapirus terrestris* (Linnaeus, 1758), mentioned an information obtained from indigenous hunters that tapirs and caracaras are able to approach one another through a series of vocal exchanges, which helps to coordinate their encounters within a closed-canopy habitat. Such form of communication apparently exists also between the yellow-headed caracara and the South American tapir (see GTG EPTV, 2024).

New World tapirs are very important hosts of Neotropical ticks. Their tick infestation can be very heavy (several hundred ticks year-round; Hernandez-Divers et al. 2005). In addition, tick species richness is substantially higher in tapirs than in other Neotropical vertebrate species (Labruna & Guglielmone 2009). Therefore, the tick-cleaning associations between the yellow-headed caracaras and tapirs have the potential to significantly improve the condition of both caracaras and tapirs. On the other hand, the question arises to what extent the benefit of tapirs can be affected by "cheating" on the part of cleaner birds? A case of pecking into open wounds of the Baird's tapir *Tapirus bairdii* (Gill, 1865) by the yellow-headed caracara was reported by Coulson et al. (2018).

The South American tapir is generally a shy, mostly nocturnal animal (de Magalhães 1992, Padilla & Dowler 1994, Medici et al. 2024). Detailed observations of its behaviour in the wild are therefore rare. In order to provide additional information on cleaning interactions between the yellow-headed caracara and the South American tapir, we summarize our observations of tick-cleaning associations between the two species in the Brazilian Pantanal.

MATERIAL AND METHODS

Field observations of South American tapirs were conducted in the Reserva Particular do Patrimônio Natural (RPPN) in the territory of the Fazenda Nhumirim in the Brazilian Pantanal (Nhecolândia Region, Mato Grosso do Sul State) on 1–12 November 2023, and 30 October to 11 November 2024. Fazenda Nhumirim serves as an experimental research area of the Brazilian Agricultural Research Corporation (EMBRAPA), Corumbá. Its wildlife is protected, and the tapirs have become accustomed to the presence of scientists in the field. The area of the Fazenda Nhumirim is covered by a patchwork of three major habitats: seasonally flooded grassland, pockets of forest and permanent or temporary lagoons. There are two basic types of lagoons in Fazenda Nhumirim – freshwater lakes and soda lakes. Soda lakes are saline-alkaline aquatic ecosystems characterized by a high concentration of various salts in the water (e.g. sodium and potassium salts) and a high pH ranging from 9.1 to 10.1 (Mourão et al. 1988, Guerreiro et al. 2019; Table 1). The soda lakes play an important role in the nature of the Pantanal. Among other things, they are a source of minerals for large mammals and some parrots. During our visits, we observed that they are regularly

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Fig. 1. The soda lake no. 82 and tick-cleaning interactions between the yellow-headed caracara (*Milvagus chimachima*) and a female of the South American tapir (*Tapirus terrestris*) guarding a juvenile (Reserva Particular do Patrimônio Natural, Fazenda Nhumirim, Nhecolândia, Mato Grosso do Sul). A – the soda lake no. 82, normal water level, October 2019. B – the same lake with extremely low water level in November 2024. C – a male caracara inspecting the back of a female tapir. D – the male caracara walking around the female tapir. E – the male caracara removing ticks from the tapir's hind leg. Photos by J. Moravec.


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visited by tapirs, peccaries (*Tayassu*), anteaters (*Myrmecophaga*, *Tamandua*), deers (*Mazama*), and great parrots (*Anodorhynchus*, *Ara*, *Primolius*). Mammals drank water, the parrots ate clay soaked in minerals. In addition, tapirs apparently preferred to bath in alkaline water rather than fresh water, which could be related to their desire to get rid of ectoparasites.

Cleaning interactions between the yellow-headed caracara and the South American tapir were observed at the forest soda lake no. 82 (18.96072°S, 56.62435°W; the lake number corresponds to the standard numbering of the EMBRAPA research lagoons). This soda lake, locally called "salina", was the place where the tapirs most often came to drink and bath. The tapirs came in the early morning and late afternoon. A total of ten tapir visits lasting 10–77 min (mean = 25.8 min) was monitored in the vicinity of the lake no. 82. In 2023, tapirs were observed six times (two males and one female in total), but no interaction between the yellow-headed caracaras and tapirs was recorded. Observations of the individual animals lasted 10–77 min. In two cases, an already bathing male tapir was chased into the forest by another newly arrived strongly dominant male, and this antagonistic behaviour terminated these observations. The remaining four observations lasted until the animal voluntarily left the lagoon or until the observation was interrupted due to darkness. In 2024, tapirs were observed four times (two males, one female, and one juvenile in total). Observations of the individual tapirs lasted 10–41 min and all individuals were observed until they voluntarily left the lagoon. Interactions between the yellow-headed caracara and tapirs were observed during three tapir visits (five interactions in total).

The tapirs and their interactions with the yellow-headed caracaras were photographed from ca. 30–100 m with a Nikon Coolpix P900 digital camera equipped with 83× optical zoom. The obtained photographs were deposited in the Department of Zoology of the National Museum of the Czech Republic (NMP-P6F). The length of individual interactions was recorded using photographic sequences and is given to the nearest 1 min.

In 2023 and 2024, the Nhecolândia region experienced extremely hot and dry weather, resulting in most of the lagoons being dry in November 2024. The soda lake no. 82 was one of the few lagoons that had little residual water during October–November 2024 (Figs. 1A, B).

RESULTS

Interaction between caracara and an adult female tapir accompanied by a juvenile

The observation was made on 30 October, the female tapir with its juvenile came to the lagoon at 5:33 p.m. and left the lagoon at 5:57 p.m. The episode of cleaning interaction took place between 5:48 and 5:54 p.m. An adult male yellow-headed caracara landed on the female at 5:48 p.m. and shortly thereafter examined the female's back and removed the ticks (Fig. 1C). Between 5:48 and 5:52 p.m. the caracara jumped twice on the ground, inspected the female's legs and returned to the female's back. At 5:51 p.m. the caracara tried to land on the back of the juvenile tapir, but the juvenile rejected immediately the caracara's landing and ran away. The caracara then landed on the ground next to the female tapir. Between 5:51 and 5:54 p.m. the caracara walked on the ground around the female (Fig. 1D) and repeatedly removed ticks from her hind legs (Fig. 1E). At 5:54 p.m., the caracara spotted a male tapir emerging from the edge of the forest and immediately flew to it and attempted to land on its back (see below). The female tapir did not adopt any obvious inviting postures while being cleaned and left the bird unnoticed.

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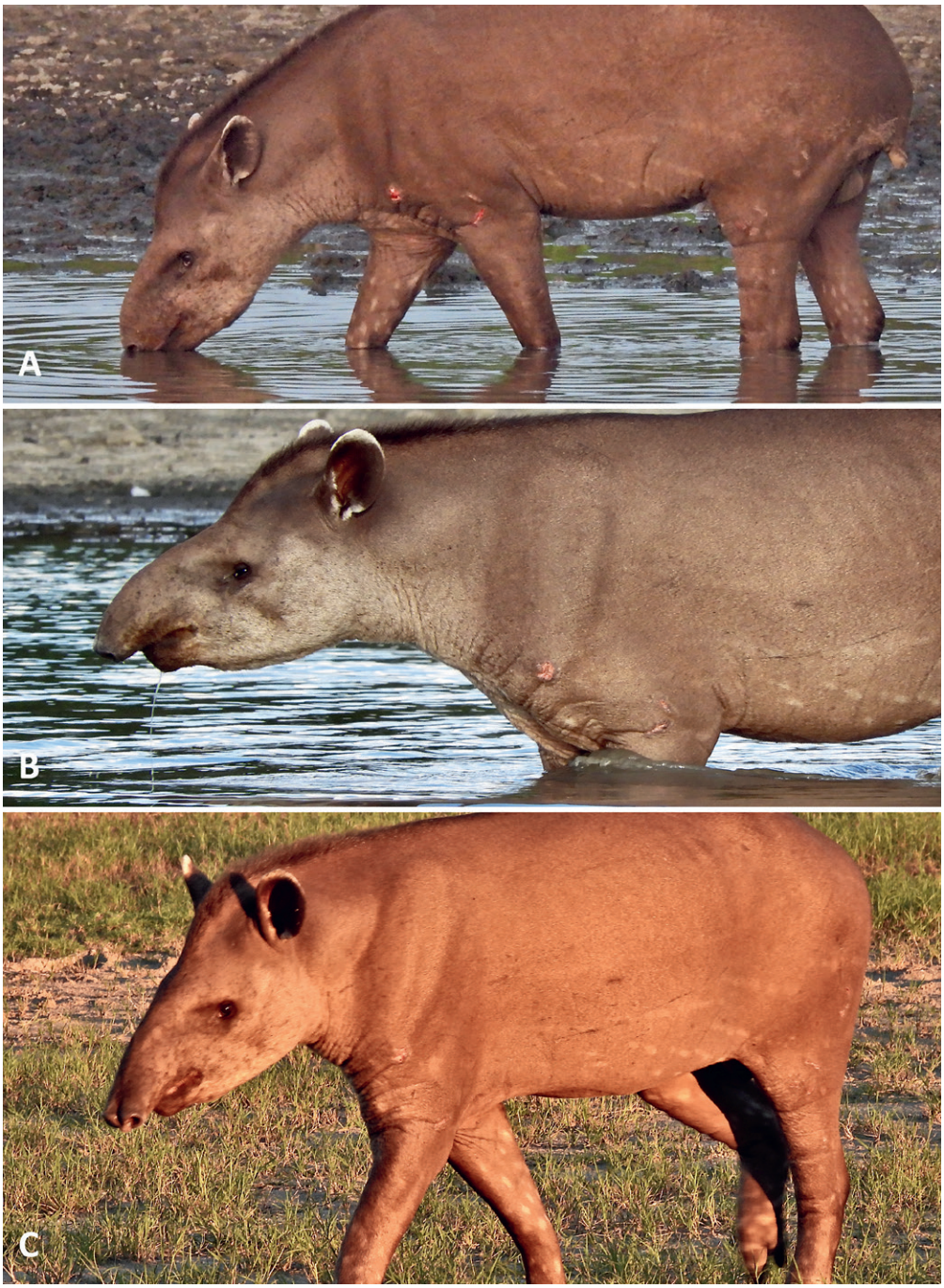
Fig. 2. Healing process of the wounds on the chest and left upper arm in a male of the South American tapir (*Tapirus terrestris*). A – the male tapir having the wounds freshly open by a male of the yellow-headed caracara (*Milvagus chimachima*), 30 October 2024. B – the wounds are clean and healing well, 8 November 2024. C – the wounds are closed, dry and healing well, 10 November 2024. Photos by J. Moravec.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Interaction between caracaras and an adult male tapir

Three observations of an identical male tapir were made on 30 October, and 8 and 10 November. On 30 October, the tapir appeared at the lagoon at 5:54 p.m. and the observation was interrupted at 6:15 p.m. due to darkness. The episode of cleaning interaction took place between 5:54 and 6:00 p.m. At 5:54 p.m. the male yellow-headed caracara landed on the tapir male approaching the lagoon. When the tapir stopped, the riding caracara began checking the tapir's back. At 5:55 p.m., the tapir laid down on its belly and the caracara examined the tapir's back and head. At 5:57 p.m., the tapir rolled onto its right side and raised its left hind limb to allow the bird access to the internal surface of thighs, inguinal region and lower abdomen. Between 5:57 and 5:58 p.m. the caracara walked along the tapir's body and repeatedly jumped to the ground and back, looking for ticks on the tapir's flank and its abdominal surfaces. Then the bird jumped on the tapir's left arm and began pecking at the wounds on tapir's chest and upper arm. At 5:59 p.m. the tapir got up abruptly and went to the lake. At 6:00 p.m., the caracara tried to land on the tapir again, but the tapir made a short run towards the lagoon and refused another contact. When the tapir approached the water, it had two fresh bloody wounds on its chest and upper arm (Fig. 2A).

On 8 November, the same tapir came to the lagoon at 5:00 p.m. and left the lagoon and the surrounding area at 5:45 p.m. When the tapir approached the water, the wounds on its chest and upper arm were closed, clean and healing well (Fig. 2B). The episode of cleaning interaction took place between 5:15 and 5:22 p.m. A male yellow-headed caracara flew up to the bathing tapir and sat on its back that was sticking out of the water (Fig. 3A). The tapir did not respond to the bird's presence and the caracara flew away after seven minutes without picking off a single tick.

On 10 November, the identical male tapir emerged from the forest at 5:38 p.m. and left the surroundings of the lagoon at 5:55 p.m. The episode of cleaning interaction took place between 5:43 and 5:52 p.m. The wounds on the tapir's chest and upper arm were closed, dry and healing well (Fig. 2C). At 5:43 p.m. a male yellow-headed caracara flew at the tapir and attempted to land on its back. The tapir shook the bird off and made a short run towards the lagoon. Then the same situation was repeated twice – the caracara landed on the tapir and the tapir shook it off and ran towards the lagoon (Fig. 3B). At 5:45 p.m. the tapir stopped and laid down on its left side. Immediately afterwards, the tapir adopted an inviting posture with its right hind leg raised, the left hind leg stretched back, and the head stretched forward (Fig. 3C). The male caracara started removing the ticks from the tapir's belly, and at that moment the female caracara also flew at the tapir. However, the tapir soon turned on its belly to the ground. Then both caracaras perched or walked on the tapir's back, neck and head and picked ticks from these parts of the tapir's body. The birds also jumped on the ground, walked around the tapir and removed ticks from its flanks, legs and anus (Fig. 3D). At 5:46 p.m. the tapir rolled onto its right side and raised its left hind leg (Fig. 3E). Between 5:46 and 5:50 p.m., both caracara individuals

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Fig. 3. Tick-cleaning interactions between the yellow-headed caracara (*Milvagus chimachima*) and a male of the South American tapir (*Tapirus terrestris*). A – a male caracara inspecting the back of a male tapir, 8 November 2024. B – the male caracara trying to land on the back of the running male tapir, 10 November 2024. C – the same male tapir adopting an inviting posture with its right hind leg raised for tick-cleaning by the yellow-headed caracara, 10 November 2024. D – male and female of the yellow-headed caracara removing ticks from the body of the male tapir lying on its belly. E – the male tapir adopting an inviting posture with its left hind leg raised, allowing the caracaras to remove ticks from the axillary and inguinal regions, 10 November 2024 (note a large blood-engorged tick in the bill of the male caracara). Photos by J. Moravec.


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quickly jumped and ran both on the body of the tapir and on the ground around the tapir, rapidly picking off ticks. The birds mainly targeted axillary and inguinal regions heavily infested with ticks (Fig. 4A, B) and preferred large blood-engorged ticks (Fig. 3E). However, the two caracaras also pecked at the sores in the tapir's armpits (Fig. 4C) and the wounds on its chest and upper arm (Fig. 4B, D). The bill of the male caracara was clearly stained with tapir blood; Fig. 4D). At 5:50 p.m. the tapir drew its hind leg to its body. Between 5:50 and 5:52 p.m., the male caracara repeatedly pecked at tapir's sores and wounds. While pecking at the wounds on the tapir's chest and upper arm, the tapir jerked its leg repeatedly. The cleaning ended abruptly at 5:52 p.m. when the male caracara pecked the tapir on the edge of the left ear and the tapir quickly got to its feet. After that, the tapir moved from place to place for two minutes, then turned and slowly left the lagoon without drinking. The originally healed wounds on its chest and arm were now freshly open and bloody (Fig. 4E).

DISCUSSION

According to the obtained photographs, the tick infestation was very heavy in the repeatedly observed male tapir in 2024. This fact corresponds well with the finding that tick infestation is usually very high in the dry season (Hernandez-Divers et al. 2005, Cançado 2008, Ramos 2014). The high tick infestation in our case is probably also related to the extremely dry climate in 2024, which greatly limited the tapirs' bathing opportunities. According to Cançado (2008) and Ramos (2014), ticks of the genera *Amblyomma* Koch, 1844 and *Ornithodoros* Koch, 1837 are common in the Fazenda Nhumirim and the RPPN, with *A. cajennense* (Fabricius, 1787) being the most frequently encountered species. *Amblyomma cajannense* (sesu lato) is a typical savannah tick, commonly found parasitizing tapirs in the Cerrado and the Pantanal (Labruna 2009, Labruna & Guglielmone 2009). This tick species has been incriminated as the main vector of the bacterium *Rickettsia rickettsii*, the pathogen of the rickettsiosis named Rocky Mountain Spotted Fever (Labruna 2009, Labruna & Guglielmone 2009). In light of the potential transmission of pathogens, studies of bird-tapir tick-cleaning interactions are gaining importance (Labruna et al. 2021).

It appears that during the dry season, the ticks infesting South American tapirs can be an important food source for the yellow-headed caracaras. The tick infestation of the observed male tapir was so high that the birds were not able to remove all large ticks from the host's body. On the other hand, despite the large number of ticks available, caracaras also targeted the tapir's sores and wounds, including those that healed successfully. This "cheating" on the part of the caracara evidently prolonged (if not prevented) wound healing and was uncomfortable for the tapir. The observed male evidently tried to avoid contact with the caracara in the initial moments of their encounter on land. Although the tapir adopted inviting postures in the subsequent phases of these cleaning interactions, it terminated cleaning abruptly in both observed cases.

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Fig. 4. Tick-cleaning interactions between the yellow-headed caracara (*Milvagus chimachima*) and a male of the South American tapir (*Tapirus terrestris*), 10 November 2024. A – a female caracara removing ticks from the tapir's inguinal region. B – a male caracara pecking the wounds on the tapir's left upper arm, the female caracara continuing cleaning the tapir's inguinal region. C – the male caracara pecking at the sores in the tapir's armpit. D – the male caracara having the bill stained with tapir blood. E – a male tapir whose healed chest and upper arm wounds (compare Fig. 2C) were reopened by the caracaras during the cleaning session. Photos by J. Moravec.


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The inviting postures that tapirs adopt during cleaning interactions with birds are generally of the same character (compare with photographs published by Reis et al. 2017, Coulson et al. 2018 and Mosquera-Guerra et al. 2024). Therefore, they may represent elements of certain stereotyped behaviour that takes place after the landing of the caracara. The abrupt termination of cleaning sessions suggests that at least in the cases we observed, cheating by the caracara might have reduced the tapir's willingness to be cleaned. This is also supported by the fact that the duration of cleaning interactions in the observed male tapir (6–9 min) was considerably shorter than the duration (16–51 min) published for *Tapirus bairdii* and *T. terrestris* by Reis et al. (2017), Coulson et al. (2018) and Mosquera-Guerra et al. (2024). A case of myiasis was recently reported in an individual of the giant otter *Pteronura brasiliensis* (Gmelin, 1788) from the southern Pantanal (Foerster et al 2022). However, in the observed case, caracaras reopened clean and well-healing wounds, suggesting that the birds were not primarily interested in consuming necrotic tissue or dipteran larvae.

Our observations indicate that tick-cleaning interactions between the yellow-headed caracara and the South American tapir may not always have a fully mutualistic character. It seems that in some cases, the tapirs' willingness to accept cleaner birds may be reduced by the negative experience that the birds will also peck at their wounds. However, the tick-cleaning interactions are obviously more complex and depend on a number of other factors – e.g. on the climatic conditions (tick infestation of tapirs is higher in dry periods), on the physical and health condition of the animals (injured tapirs can probably experience bird "cheating" more often than healthy ones), on the sex of the animals (a female tapir guarding a juvenile cannot adopt the same inviting postures as a male), on the age of the animals (juvenile tapirs have less experience with cleaner birds than adults) or on the animal's personality (see e.g. Barber & Dingemanse 2010, Sih et al. 2012, Found 2017). In particular, the health condition and personality of the animal can influence the interpretation of observations of animal behaviour based on low numbers of individuals (which is our case). Thorough long-term field studies are therefore necessary to fully understand the very interesting complex of interactions between the yellow-headed caracara and the South American tapir.

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