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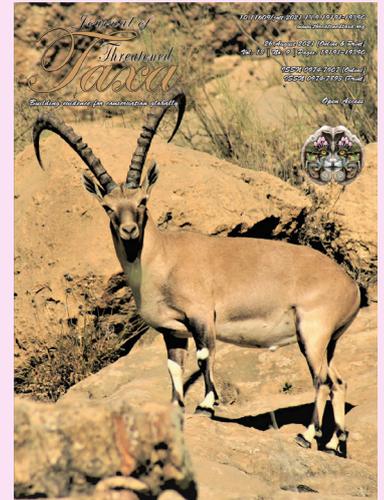
COMMUNICATION

FIRST RECORD OF INTERSPECIES GROOMING BETWEEN RAFFLES' BANDED LANGUR AND LONG-TAILED MACAQUE

Zan Hui Lee, Andie Ang & Nadine Ruppert

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First record of interspecies grooming between Raffles' Banded Langur and Long-tailed Macaque

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Abstract: In primates, observations of interspecies grooming are not uncommon, especially between species of the same genus. However, little is reported about grooming between different genera and less is discussed about its ecological significance. Here, we report the first sighting of Long-tailed Macaques grooming the Critically Endangered and rare Raffles' Banded Langur during two independent events at Gunung Lambak Recreational Forest in Kluang, Malaysia.

Keywords: Interspecies interactions, *Macaca fascicularis*, Malaysia, *Presbytis femoralis*, primate, Singapore.

Bahasa Malaysia: Pemerhatian terhadap proses hias diri ('grooming') antara spesies dalam kalangan primat bukanlah sesuatu yang jarang berlaku, terutama antara spesies yang memiliki genus yang sama. Walau bagaimanapun, sangat sedikit laporan ditemui berhubung proses hias diri antara genera yang berbeza dan kepentingan ekologi perilaku ini amatlah kurang dibincangkan. Di sini kami melaporkan pemerhatian awal Kera melakukan proses hias diri ke atas Lotong Cenekah yang merupakan spesies yang amat jarang ditemui dan terancam kepupusan dalam dua insiden berasingan di Hutan Rekreasi Gunung Lambak, Kluang, Malaysia.

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Author contributions: conceptualisation—NR; field work and data analysis—ZHL; first manuscript draft—ZHL; manuscript corrections—NR, AA; advisory role—AA.

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INTRODUCTION

Most primate species are highly social, and behaviour like allogrooming, alloparenting, and playing between members of the same species are regularly observed in langurs and macaques (Lehman et al. 2007; Matsuda et al. 2015). Social grooming is a key behaviour in primates to facilitate kinship reciprocity (Schino & Aureli 2010), affiliation (Dunbar 1991; Lehman et al. 2007), and hygiene (Goosen 1981), involving at least two actors (groomer and recipient) physically touching each other. As an affiliative interaction, grooming plays a significant role in primate societies to reinforce social bonds and networks (Dunbar 2011). Grooming also facilitates communication, contributing to the development of social cohesion (Dunbar 2011; Dunbar & Lehman 2013; Grueter et al. 2013). Within social groups of macaques, post-conflict reconciliation and consolation often involve grooming (Long-tailed Macaques *Macaca fascicularis*: Cords 1992; Stump-tailed Macaques *M. arctoides*: Call et al. 2002; Barbary Macaques *M. sylvanus*: McFarland & Majolo 2011). Social grooming has a direct effect on the physiological health of individuals, and other positive effects are associated with release of pleasure hormone (i.e., oxytocin and endorphin; Dunbar 2010) or suppression of stress hormones (i.e., cortisol: Wooddell et al. 2016). Seyfarth (1977) proposed that social grooming in female Cercopithecidae is principally directed toward high-ranking individuals (reviewed in Schino 2001). This rank-related reciprocity in allogrooming has been demonstrated for 16 species and nine genera (*Alouatta*, *Cercopithecus*, *Cebus*, *Erythrocebus*, *Lemur*, *Macaca*, *Miopithecus*, *Sapajus* and *Semnopithecus*) (Schino & Aureli 2008a; Tiddi et al. 2012). Evidence of trading allogrooming for alloparenting is also found in female Long-tailed Macaques (Gumert 2007).

Asymmetries in allogrooming resemble the context of ecological economy as a trade for other commodities including food (reviewed in Barrett & Henzi 2001; see Russell & Phelps 2013) and services (Lazaro-Perea et al. 2004). Several studies have identified asymmetrical cost and benefits between groomer and recipient, considering that altruistic behaviour benefits the recipient but imposes some cost to the donor (Schino & Aureli 2008b; Russell & Phelps 2013). Grooming time is considered as cost to the groomer in their daily activity budgets as metabolic cost and loss of foraging opportunities (Russell & Phelps 2013). Cost and benefits can also be categorised into immediate and delayed effects. For example, ectoparasite removal is an immediate hygiene benefit to the recipient and

constitutes a food source for the groomer but has a delayed risk of disease transmission from the close contact and ectoparasite consumption (reviewed in Veá et al. 1999; Russell & Phelps 2013). Furthermore, there is an immediate cost of time spent on grooming in return of immediate tension reduction with delayed agonistic support through social bonding (reviewed in Veá et al. 1999; Russell & Phelps 2013).

Grooming is not restricted to members of the same species but has been documented in members of different species in the wild such as between Rhesus Macaque *M. mulatta* and Sambar Deer *Rusa unicolor* (Vasava & Mahato 2013), Rhesus Macaque and Hanuman Langur *Semnopithecus entellus* (Nerlekar 2012), and Red-tailed Monkey *Cercopithecus ascanius* and Blue Monkey *C. mitis* (Gathua 2000). Interspecies allogrooming has also been seen in captivity between Long-tailed Macaque and Patas Monkey *Erythrocebus patas* (Baker & Preston 1973), capuchin monkeys *Cebus albifrons* & *Sapajus apella* and spider monkeys *Ateles geoffroyi* and *A. paniscus* (Maple & Westlund 1975). However, most available studies were only reviewed within the context of intraspecies allogrooming. Anecdotal records of interspecies allogrooming have been reported from the field, usually for species of the same genus and/or within mixed species groups with hybrids (e.g., *M. nemestrina* x *M. fascicularis* at Sepilok, Sabah; Gilhooly & Colquhoun 2018) but, to the authors' knowledge, published observations of intergeneric grooming in wild sympatric primates are not available. Interspecies grooming between primates of different genera is rarely reported from the wild, and has, to our knowledge, not been documented for the Critically Endangered (Ang et al. 2020; status currently being revised, A. Ang, pers. comm. 01.vi.2021) and rare Raffles' Banded Langur *Presbytis femoralis*.

Here, we report the first sighting of Long-tailed Macaques grooming Raffles' Banded Langurs in Gunung Lambak Recreational Forest in Johor, Malaysia, and discuss the potential meaning of this interspecies interaction.

METHODS

The state of Johor in Peninsular Malaysia is home to six species of non-human primates, namely: Sunda Slow Loris *Nycticebus coucang*, Long-tailed Macaque *Macaca f. fascicularis*, Southern Pig-tailed Macaque *M. nemestrina*, Reid's Dusky Langur *Trachypithecus o. obscurus*, Raffles' Banded Langur *Presbytis femoralis*,

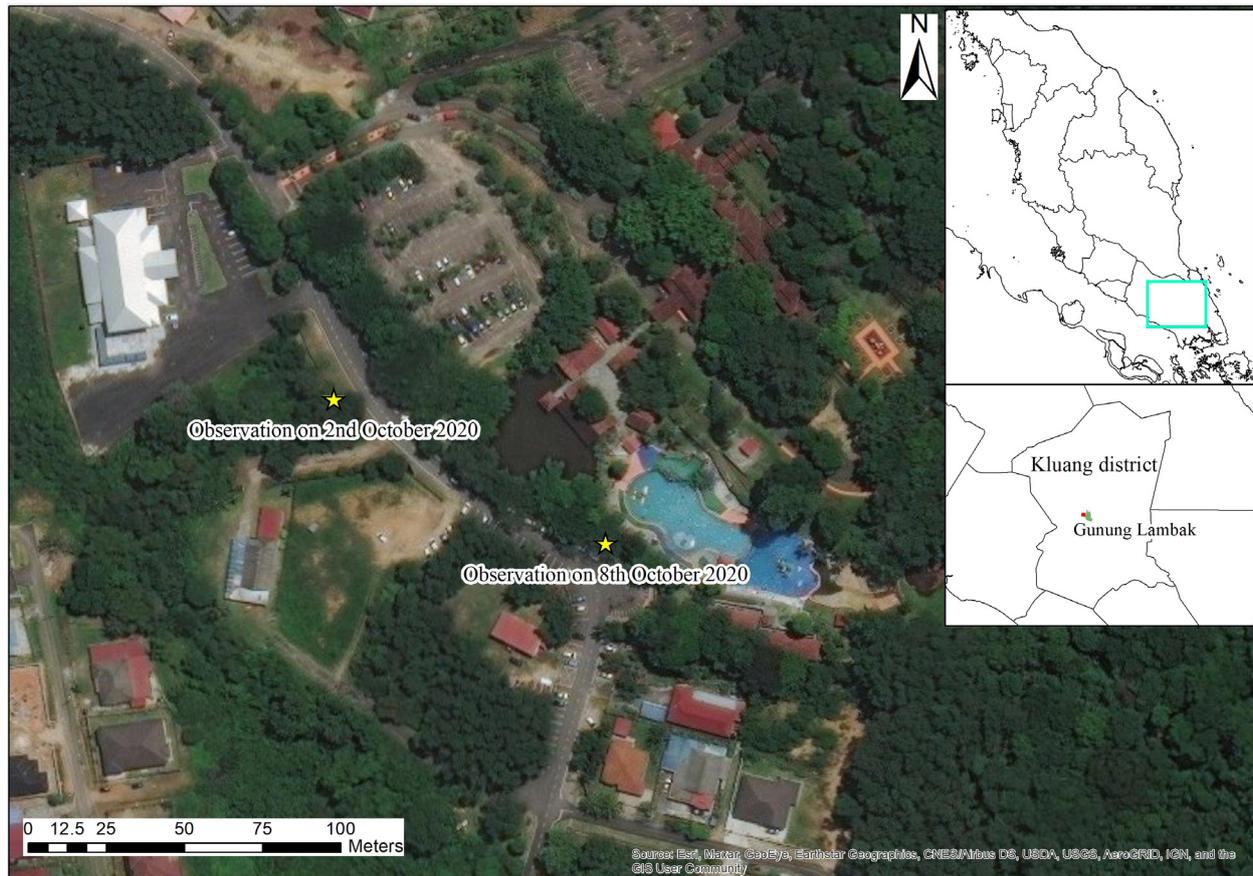


Image 1. Forest edge environment where interspecies grooming was observed at Gunung Lambak in Kluang district, Johor, Malaysia.

and Malaysian White-handed Gibbon *Hybulates l. lar*. Specifically, the Raffles’ Banded Langur is Critically Endangered (Ang et al. 2020) due to its small population size and restricted distribution in fragmented habitats. This species is only found in southern Peninsular Malaysia (states of Johor and Pahang) and the Republic of Singapore with an estimated global population size of fewer than 400 individuals (Ang et al. 2020).

Gunung Lambak is a twin-peak hill (highest at 510 m) located in Kluang, Johor (2.0275° N, 103.3575° E). Also known as Gunung Lambak Recreational Forest, it has an area of 744 ha (i.e., Renggam Forest Reserve) (Image 1). The vegetation consists mainly of secondary forest with patches of old growth trees. Pioneer tree species, such as *Camposperma auriculatum*, *Macaranga* spp. and non-native *Acacia* spp. are common at the foot of the recreation forest and along the trails (Lee Zan Hui pers. obs. 14.iv.2021). Despite being an isolated secondary forest, trees of the Fagaceae family, *Lithocarpus cantelanus*, *L. sundaicus*, *Castanopsis acuminatissima*, *C. scortechinii*, and *C. inermis* have been observed fruiting at different times throughout the year providing

a food source to the primate community at the site (Lee Zan Hui pers. obs. 14.iv.2021). All six species of primates in Johor can be found in Gunung Lambak. Renggam Forest Reserve also holds a high in situ conservation value for endangered Dipterocarpaceae species, with *Hopea glaucescens* and *H. johorensis* being listed as Critically Endangered, *Dipterocarpus sublamellatus* as Endangered, and *Shorea exelliptica*, *S. gibbose*, *S. gratissima*, *H. nutans*, and *Anisoptera megistocarpa* as Vulnerable (Chua et al. 2010).

Non-invasive opportunistic observations were made on a group of Raffles’ Banded langurs (hereafter RBL) during the assessment of phenology transects for the study of the feeding ecology of this species. Footage of behaviour was recorded with a DSLR camera (Nikon D5600) with a telephoto lens (Nikkor 200–500 mm). The study group consists of 11 individuals (one adult male, five adult females with three dependent infants, and two juvenile females). Long-tailed Macaques (LTMs), which are observed in groups of up to 20 individuals in the area, range sympatrically with RBLs and can often be observed in close proximity to RBLs.



RESULTS

The first interspecies grooming event was observed in the late afternoon of 02 October 2020 at the foot of Gunung Lambak during light drizzling rain. At 1715h, a group of ca. 20 LTMs were attracted to food provided by people with the intention to feed macaques at the roadside. Intragroup aggression among LTMs competing for the provisioned food was observed and some LTMs climbed up the trees nearby where the focal RBL troop of 11 individuals was resting, likely trying to avoid direct confrontation with dominant LTMs who guarded the food. At 1730h, RBLs moved from the forest toward the roadside, preparing to cross the road to their sleeping sites. At 1733h, two LTMs, who both appeared to be subadult males, approached an adult female RBL and groomed her (Image 2, Video 1). The grooming event was unidirectional and only LTMs engaged in grooming while the RBL female was solely receiving. This RBL was a lactating mother who had a dependent infant (which was out of sight during the grooming event). The rest of the RBLs who were not engaged with the LTMs were resting and feeding on flower buds and leaves of *Garcinia mangostana*, *Acacia mangium*, and other trees nearby. One of the two LTM groomers stopped grooming and moved onto a higher branch after ca. half a minute while the other LTM continued grooming for eight minutes. This LTM was observed picking substances from the RBL's fur and feeding on it. Without leaving its location, the LTM also occasionally fed on flower buds of the tree (species unidentified) that they sat on. No aggression was observed in this interspecies interaction. The female RBL was observed being vigilant, actively scanning the surrounding environment and responding to vehicles that passed by. At 1753h, the grooming event was

interrupted by the alpha RBL male as he approached the female and displaced the LTM, before directing the RBL group to cross the road. The LTM group, including the two groomers, followed the RBLs to cross the road. Both species separated after the road crossing and headed to their respective sleeping sites.

The second observation of interspecies grooming was on 08 October 2020, around 1808h during clear, sunny weather. A female subadult LTM was observed actively seeking RBLs to groom while the RBL group was feeding on sprouting leaf buds of a tall Saga Tree *Adenanthera pavonina* at the same site (Image 3, Video 2). The RBL group was observed foraging on leaf buds, which were limited and sparsely distributed across the crown of the Saga Tree, then the LTM groomer approached for grooming. In contrast to the first observation with a fairly long grooming bout (around eight minutes) between the fixed groomer and recipient pair, RBLs actively terminated this grooming event by leaving the position for foraging, hence leaving the LTM groomer to seek another recipient. Having been rejected by some RBLs, the LTM female seemed cautious about approaching RBLs, especially female adults. She started by touching a RBL's tail from a distance with an extended hand, and only if the RBL stayed in position, she got closer to inspect (possibly for ectoparasites), also presenting her body in front of the RBL recipient. At least two RBL juvenile females and two adult females were eventually groomed at different timings by the same LTM (Table 1). The LTM groomer was also observed extracting substances from RBL's fur by hand-picking and feeding on it as well as directly biting the RBL fur with her mouth. Although no direct confrontation or aggressive behaviour was observed, some RBLs appeared impatient towards the groomer and prioritised feeding on the leaf

Table 1. Interspecies grooming observation of Long-tailed Macaques (LTM) grooming Raffles' Banded Langurs (RBL) and possible reason (SR—stress relieve with oxytocin hormone | Co—post conflict consolation | ER—ectoparasite removal | Fo—foraging for ectoparasite by actors | na—non-applicable).

Date	Raffles' Banded Langur recipients	Long-tailed Macaque actors	Grooming duration	Possible reason or benefit from grooming
02.x.2020	Adult female 1	Subadult male 1 & 2	8 minutes	LTM: SR, Co, Fo RBL: ER
08.x.2020	Juvenile female 1	Juvenile female 1	1 minutes 10 seconds	LTM: Fo RBL: ER
08.x.2020	Juvenile female 2	Juvenile female 1	50 seconds	LTM: Fo RBL: ER
08.x.2020	Adult female (Unidentified)	Juvenile female 1	1 second	LTM: Fo RBL: na
08.x.2020	Adult female (Unidentified)	Juvenile female 1	28 seconds	LTM: Fo RBL: ER
08.x.2020	Adult female (Unidentified)	Juvenile female 1	1 minutes 10 seconds	LTM: Fo RBL: ER



Image 2. First observation of the interspecies allogrooming between Long-tailed Macaques and a Raffles' Banded Langur on 02 October 2020. © Lee Zan Hui.



Image 3. Second observation of the interspecies allogrooming between a Long-tailed Macaque and different individuals of Raffles' Banded Langur on 08 October 2020. © Lee Zan Hui.

buds. While being groomed, the RBLs seemed to pay high attention on locating the scarce food resources instead of being vigilant to the surroundings. It could not be observed whether the other individuals nearby and/ or the alpha male of the RBL group were engaged in the event or groomed by the LTM at any time but the troop was directed by his call to leave the Saga Tree and headed to the sleeping site by 1820h, eventually ending the grooming event as the LTM groomer was left behind.

DISCUSSION

Interspecies grooming between RBL and other primate species has not been reported before. In Singapore, where the two species are also found sympatrically, grooming has been observed only once between the two species during more than four years of continuous research (A. Ang pers. obs. 13.ii.2021). However, interspecies grooming between Dusky Langurs *T. obscurus* and LTMs has frequently been observed between different individuals in mainland Penang, Malaysia with a mixed-species group reported from CheroK Tokun (Nadine Ruppert pers. obs. 2019–2020), and Dusky Langurs, LTMs and White-thighed Langurs *Presbytis siamensis* form tolerant foraging associations with juveniles being observed playing together near a residential area in Ampang Jaya, Selangor, Malaysia (N. Ruppert pers. obs. 08.ii.2020). Published information on interspecies grooming, with clear explanations, is

often from studies conducted in captivity, such as zoos with mixed species displays, e.g., capuchin monkeys and spider monkeys grooming each other (Maple & Westlund 1975), or laboratory settings designed to test hypotheses in interspecies interactions, e.g., interspecies infant interactions between LTMs and Patas Monkeys (Baker & Preston 1973). There are only a handful of publications on interspecies grooming in the wild, such as the unidirectional grooming events by macaques toward non-primate species such as deers, mostly occurring during social coalition when the ungulates followed a primate troop and foraged on fallen food items (Tsuji et al. 2007; Vasava & Mahato 2013).

The reported interspecies grooming here was unidirectional in both observations, with young LTMs of both sexes being the groomers. As adult RBLs have larger body sizes (weight around 6 kg, 59 cm in body length and up to 84 cm with tail length), ca. two times the size of young LTMs (Ang et al. 2016), the LTMs likely groomed for rank-related benefits (Schino & Aureli 2008b), especially in the first observation where a macaque intragroup conflict was observed just before the grooming event when the young macaques were displaced from the food provisioning site. Post-conflict consolation is an affiliative interaction from the victim of aggression and individuals other than the former aggressor (Aureli 1992). Bystanders, who are not directly involved in the aggression may offer affiliative interactions to relieve stress of the victim by putting themselves at risk of receiving aggression from



the aggressor (Fraser et al. 2009). RBLs, as a different species, have no apparent relation with the aggressor, nor any long-term association with the macaque group. It is uncertain if post-conflict consolation happens between different primate species, yet genera (Kazem & Aureli 2005), but this might explain our observation. As the LTM groomers made their way to the higher strata and away from LTMs that competed for the provisioned food on ground, the LTM groomers might have found an opportunity to relieve stress by grooming the large female RBL who might simultaneously have deterred some other low-ranking macaques due to her body size (Schino & Aureli 2008a). In addition, there was no apparent competition between RBLs and LTMs over the provisioned anthropogenic food in this context. However, the possibility of LTMs solely seeking food, i.e. ectoparasite on langurs' skin, from grooming, and RBLs' desire for grooming for hygiene purposes, cannot be ruled out (Johnson et al. 2010).

The different duration of these interspecies grooming bouts during two independent observations was probably due to different extrinsic factors from the environment, and the intrinsic motivation of the primate individuals. The desire to be groomed usually follows a cyclical pattern of motivation and demotivation (Russell & Phelps 2013). Grooming is likely a crucial instigator of pleasure in primates, and the length of grooming time is the most available and applicable variable to reflect the quantity of the pleasurable effect (Russell & Phelps 2013). The female RBL recipient from the first observation was initially in a resting state before two young LTMs approached her and attempted to groom her. The relatively long grooming bout and her relaxed behaviour during the bout implied that she was not only tolerating but enjoying it. However, in the second observation, RBLs were already engaged in feeding while the young female LTM sought grooming opportunities, which were rejected or actively terminated by several individuals. It is unclear why the adult female RBLs tolerated the grooming in the first observation but not the second. A study on inter primates species interactions near Sungai Bernam, Malaysia, which included one of the closely related *Presbytis* langurs (older synonymization *P. melalophos* in the text; updated to either *P. robinsoni* or *P. s. siamensis* in the region) have concluded that intergenera interactions are typically non-competitive, and the association occurs with indication of selective preferences rather than by chance (Bernstein 1967).

In our study, both interspecies grooming events happened around dusk time, but there was a main difference in the RBL activities during both events. In

the first observation, LTMs followed RBLs from the developed area back to the forest by crossing a road, and afterwards the two groups separated to reach their respective sleeping trees without further interaction. In the second observation, the female RBL was observed feeding and actively terminated the grooming session without aggression toward the groomer, ending the session as the RBLs headed to their sleeping trees. Judging from the several short grooming bouts in the second observation, RBLs likely prioritized feeding shortly before reaching their sleeping sites rather than losing foraging opportunities from being groomed by the macaques. Being groomed can also be painful as it involves pinching and pulling substances off the skin's surface (Dunbar 2010). It was not obvious if the RBLs were uncomfortable or experiencing pain, especially when the groomer directly bit ectoparasites off the langurs' skin.

Indeed, time spent on grooming is a significant part of primates' activity budgets, but not much information related to grooming is published for *Presbytis* langurs. A study on Hanuman Langurs showed that recipients determine grooming spots on the body during allogrooming, directing the groomer also toward inaccessible body parts (Borries 1992). From our observation, RBLs autogroom themselves mostly on limb parts while resting, but no allogrooming between adult female RBLs or between mother-infant pairs have been observed in this study so far. However, our study period is still considered short and the study troop is not fully habituated.

LTMs that have been regularly provisioned by humans may alter their natural behaviour exhibiting more flexibility and are likely more willing to engage in interspecies interactions (Sugiyama 2015). It is not uncommon to see interspecies interactions and grooming in captive environments, especially in zoos and sanctuaries (Silva 2017). In general, LTMs that regularly receive provisioning reduce their foraging distance, resulting in smaller home ranges, as concentrated food resources can be obtained nearby (Sha & Hanya 2013). This may increase the likelihood of interactions with humans and domestic animals in these anthropogenically modified environments (Bicca-Marques 2017). However, it also raises concerns about interspecies disease transmission as a spillover effect of the human-macaque interface (Gillespie et al. 2008; Rushmore et al. 2017; Balasubramaniam et al. 2020a,b). When macaques engage in interactions and close proximity with threatened primates, such as RBLs who are Critically Endangered, the risk of transmitting

zoonotic diseases adds to the factors that already threaten this rare species (Ang et al. 2012, 2020).

In future studies, the frequency and ecological significance of interspecies grooming should be examined more thoroughly. The authors believe that this behaviour is more common in the wild than reflected by almost non-existent reports in literature. The role of anthropogenic factors, such as food provisioning and potential edge effects from habitat degradation should be investigated for their impacts on behavioural flexibility, which may facilitate interspecies interactions in disturbed sites. Cross-species transmission of diseases and parasites as a potential consequence of interspecies grooming should also be studied to reveal vulnerability of different primate species to potential pathogens.

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