Daily and seasonal activity of the mountain tapir (*Tapirus pinchaque*) in the Central Andes of Colombia

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Abstract

Daily and seasonal activity of the mountain tapir *Tapirus pinchaque* was measured along trails and at two salt licks in mature and secondary montane forests of the Central Andes of Colombia using active and passive infrared monitors. Daily activity of the mountain tapir showed a clear bimodal pattern, with maxima during the early hours of the day (5:00–7:00) and early hours of the evening (18:00–20:00). This bimodal activity pattern has also been found in radio-tracking studies of *T. terrestris* and *T. bairdii*. Overall, there was more activity in mature than in secondary forest and at lower (3100 m) than higher altitudes (3600 m). Night-time activity was higher during full moon than during quarter and new moons. There was no correlation between monthly rainfall and seasonal activity. The time the mountain tapir was at the salt licks varied between 1 and 190 min. Daily activity at Quebrada Paraiso salt lick (3400 m) showed a clear bimodal pattern with maxima around midnight (0:00–2:00) and midday (11:00–14:00). These patterns of diurnal and nocturnal activity of the mountain tapir could be used in combination with future radio-tracking studies to better understand habitat use by this species.

Key words: mountain tapir, *Tapirus pinchaque*, activity, Colombia

INTRODUCTION

There are three species of tapirs (Tapiridae) in the Neotropics *(Tapirus bairdii, T. pinchaque* and *T. terrestris)* and one in Asia (*T. indicus*). Of these species, the least known is the mountain tapir (*T. pinchaque*) which occurs in the high Andes (2200–4800 m) of Colombia (Acosta, Cavelier & Londoño, 1996), Ecuador (Downer, 1996) and northern Peru (T. Lerner, pers. comm.). The mountain tapir is the smallest of all species, and is currently threatened by hunting and the destruction of its habitats, tropical montane forests and 'paramos' (i.e. neotropical alpine plant formations; IUCN, 1996; Brooks, Bodmer & Matola, 1997). Although information has been obtained on the mountain tapir's diet (Hershkovitz, 1954; Acosta *et al.*, 1996; Downer, 1996), distribution (Hershkovitz, 1954; Lizcano & Cavelier, 1999), home range (Downer, 1996) and behaviour in captivity (Shauenberg, 1969), little is known about its movements in its natural habitats (Downer, 1997).

In Colombia, it has been hypothesized that the mountain tapir is more active at higher altitudes (i.e. paramos and the upper limit of montane forests) during

the dry season, while during the wet season, activity increases at lower altitudes. Apparently, horse fly (Tabanidae) abundance during the dry season at lower altitudes forces tapirs to move to paramos (Acosta *et al.*, 1996). In Ecuador, a 1-year radio tracking study showed that there was more activity during the wet season in a cloud forest than in the paramo (Downer, 1996), supporting the hypothesis of seasonal altitudinal movements. Former tapir hunters have suggested that habitat use may correlate with moon phases, with more use at higher altitudes during the full moon (N. Monsalve, pers. comm.). In the cloud forests and wet paramos of Ecuador (3200–4200 m), daily activity of a young mountain tapir (3–10 years old) was higher during the morning (07:00–09:00) and late afternoon–evening (15:00–21:00). In the same study, activity of a mature individual was higher during the night but showed no defined peaks (Downer, 1996). Preliminary results of a study of Amazonian tapir *T. terrestris* in Brazil, suggested that activity is higher between 18:30–00:00 (P. Medici, pers. comm.). These results support the idea that tapirs, can be active both during the day and night (van Schaik & Griffiths, 1996).

In the present study, we measured the activity of the mountain tapir during 1997 in mature and secondary montane forests (3100 m and 3600 m) of the Central Andes of Colombia using active and passive infrared

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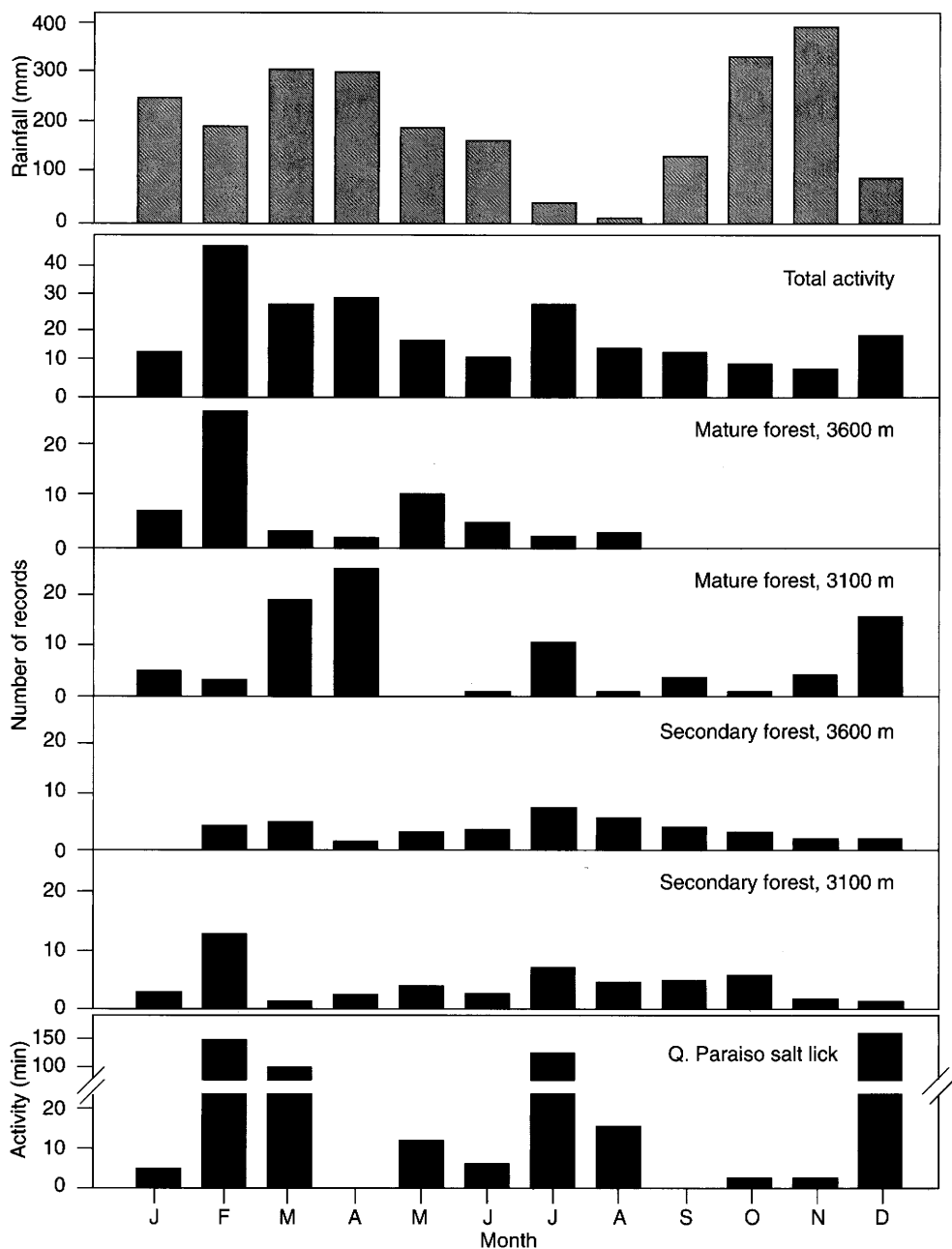E-mail: jcavelie@earthlink.net

Fig. 1. Seasonal variation (1997) in rainfall, number of records obtained with the active trail monitors (total and at the four sites), and activity (min) measured at the Quebrada Paraiso salt lick with the passive infrared trail monitor. Each record represents the pass of a mountain tapir across the infrared beam between the receiver and transmitter of the trail monitor.

monitors. In particular, we wanted to observe the daily (diurnal and nocturnal) and seasonal activity of this species measured along trails and in two salt licks.

MATERIALS AND METHODS

Study site

Activity of the mountain tapir was measured at 3100 and 3600 m in mature and secondary upper montane rain forests (*sensu* Grubb, 1977) on the western slope of the Central Andes of Colombia (*c.* 4°42′N, 75°29′W),

within Parque Nacional Natural Los Nevados. Activity was also measured at 2 salt licks, 1 at Quebrada Paraiso (*c.* 3400 m) within the National Park, and the other at Quebrada La Cuenca (*c.* 2000 m), within Parque Regional Natural Ucumarí.

The montane forests in this area are mostly continuous. In a study of vegetation cover of 147 000 ha in this region, there were *c.* 98 000 ha of montane forests (1200–3600 m) and *c.* 19 200 ha of pastures, mostly at lower altitudes (Lizcano & Cavelier, 2000). The rest of the area was covered by paramos (Smith & Young, 1987). Upper montane rain forest can be found between 2500 and 3700 m elevation, in contact with lower

montane rain forest (c. 1500–2500) and paramo vegetation (above 3700 m). The site at 3600 m is within the forest, and is only 50–100 m lower in elevation than the paramos.

At high altitude (3600 m), the canopy of the mature forest is c. 10–15 m and is dominated by *Weinmannia mariquitae, Freziera* sp., *Rapanea ferruginea, Sauraia scabra* and *Oreopanax* sp. The understory is dominated by *Miconia* spp., *Neurolepis* sp., mosses and liverworts (Cleef, Rangel & Salamanca, 1983). At the lower altitude, the canopy is much higher (30–35 m), and is dominated by *Brunellia goudotii, Miconia* sp., *Weinmannia* cf. *hirtella, Weinamannia rollottii, Nectandra* sp. and *Ocotea* sp. The understory is dominated by *Chusquea* and tree ferns *Cyatheacea* (Cleef *et al.*, 1983). The epiphytic flora includes abundant Bromeliaceae and mosses. The canopy of the secondary forest is c. 2–10 m and is dominated by *Weinmannia pubescens, Miconia* spp. and *Tibouchina grossa*. The forest is usually open with small to large patches of the introduced grass *Penisetum clandestinum*. The secondary forest is 15 years old, and resulted from the abandonment of pastures originally created during the 1950s for high altitude cattle ranching (Londoño, 1994; N. Monsalve, pers. comm.). The original mature forests were cleared for the extraction of fine woods and for the production of charcoal.

Mean annual rainfall decreases from 2500 mm at 2120 m (Estación El Cedral; 4°42′N, 75°32′W) to 980 mm at 4000 m (Estación Laguna del Otún; 4°47′N, 75°25′W). Rainfall is distributed bimodally with drier seasons during December and July–August (Fig.1). Mean annual temperature at 4000 m is 5.5 °C and 15 °C at 2120 m.

Population size and density

In a previous study of 7000 ha of forests in this region, 11–19 tapirs were identified using statistical analysis of the measurements of rear foot prints, for a mean density of 1 individual for each 551 ± 85 ha (Lizcano & Cavelier, 2000). This density is similar to the value obtained in Ecuador using radio-telemetry of 1 individual for each 587 ha (Downer, 1996). Although we do not know which tapirs are using which trails, they are free to move along the altitudinal gradient and are likely to be 'captured' by 2 different infrared monitors used in this study and located along trails or in salt licks.

Equipment

Activity patterns were measured using camera traps (Carthew, 1991; Griffiths & van Schaik, 1993*a*; Kucera & Barrett, 1993; Karanth, 1995) attached to active infrared trail monitors TM1500 ('Trailmaster' Goodson and Associates, Inc.). These monitors consist of a transmitter and a receiver of an infrared beam. When this beam is interrupted by a passing animal, the receiver stores the event with date and time. Active infrared trail monitors were located along tapir trails at 3600 m and 3100 m along the ridge of 'La Italia' in a mature upper montane rain forest and at the former cattle ranch of 'Casagrande', a 15-year-old secondary upper montane rain forest. Four monitors ran continuously between 12 January 1997 and 15 January 1998. Batteries were changed and data collected every 45 days using a TM data collector (Trailmaster). The monitors were located 50–60 cm above the forest floor. The time frame was set at $P = 5$ for the interruption of the infrared beam in order to trigger the counter. This value is a setting in the Active Infrared Trail monitor, recommended by Trailmaster Inc. for animals about the size of the mountain tapir (i.e. deer). With this setting and height, we excluded small animals such as *Nasua* sp. (cusumbo), *Eira barbara* (tayra) and *Agouti* sp. (paca). Large animals such as *Tremarctos ornatus* (spectacle bear) and *Odocoileus virginianus* (white tail deer) were not excluded.

Two passive infrared trail monitors were used, 1 placed in front of a salt lick at 3400 m on Quebrada Paraiso from January to December 1997, and the other at 2000 m on Quebrada La Cuenca from January to April 1997. Each infrared monitor consists of a receiver that records heat and motion signals from moving animals (TM, Trailmaster). The salt lick at Quebrada Paraiso was a rocky cliff 3–5 m tall, covered by thin mosses and liverworts that received dripping water from above. In the upper part of the cliff, there were large plants of *Gunnera manicata*. The salt lick at Quebrada La Cuenca was also a cliff ending in a small cave and a pond measuring 10×4 m. There were small stalactites, a few mosses and liverworts and water was dripping from the walls. Monitors were located 60 cm above ground. The settings of these monitors include the number of heat and motion pulses received by the TM 500 ($P = 3$) and the time these pulses must persist in order to be recognized as an event (Pt = 5). These values are arbitrary units and are selected on the TM 500 based on the animal whose activity will be monitored. Batteries were changed and data collected every 45 days using the same data collector used with the active infrared monitors.

Photographic cameras (Olympus Infinity Mini DLX) were attached to the active and passive trail monitors using the TM35-1 camera kit (Trailmaster). The cameras operated continuously until the batteries ran out after about 2 weeks. Photographic film for colour slides ASA 100 or 400 was used in all cameras.

Data analysis

With the data recorded in the receiver of the active infrared monitor (TM1500), the patterns of daily and seasonal (month-to-month) activity of the mountain tapirs were obtained. Since counts in the TM1500 could not be assigned to individual tapirs because the cameras were not working all the time, data were used to
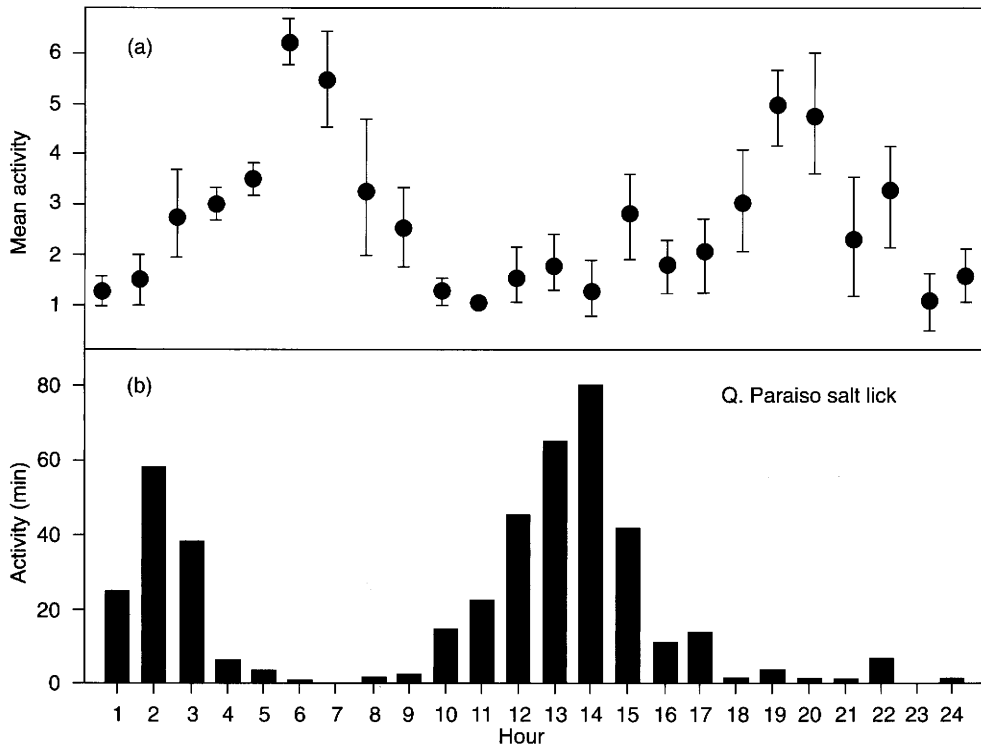
Fig. 2. (a) Daily variation in activity measured with the active infrared trail monitors. Each point represents the average activity (records) at the four sites (SEM) throughout the year. (b) Activity (min) measured with the passive infrared trail monitor at the Quebrada Paraiso salt lick. The bars represent the total activity during1997.

determine the average activity of an unknown number of tapirs that triggered the monitors.

The effects of moonlight on activity was obtained by assigning 1 of the 4 moon phases to each day (1997). Data were also sorted for mature and secondary forests and for high (3600 m) and low altitude (3100 m). Spearman rank correlation tests were run between monthly rainfall during the study period and tapir activity in mature and secondary forest at both altitudes, as well as with the overall activity (the sum of activities at the 4 sites). A comparison between the activity during the wet and dry months (100 or 200 mm/month) was made by χ^2 (Zar, 1996). A 1-way ANOVA was used to compare the activity between the mature and secondary forest, and between the high and low altitude sites. A multi-nominal test was used to compare the activity during the 4 moon phases at the mature and secondary forests and at high and low altitudes. Statistical analysis was carried using STATISTIXS for Windows (Analytical Software).

RESULTS

Active infrared monitors

There was no correlation between monthly rainfall and overall seasonal activity (Spearman $r = -0.22$; $P > 0.05$) or between monthly rainfall and activity at any of the four sites (mature or secondary forests at 3600 or

3100 m). Furthermore, there was no significant difference between the activity during the wet- and dry-months, when dry months were considered to be either < 100 mm (χ^2 0.10, d.f. = 1, $P > 0.05$) or < 200 mm ($\chi^2 = 1.04$, d.f. = 1, $P > 0.05$). Most of the activity in the mature forest (La Italia) and at high altitude (3600 m) occurred during February, while at the lower altitude, most activity occurred during March and April. During the rest of the year, there was relatively low activity at both altitudes (Fig. 1). Seasonal activity in the secondary forest was much lower and showed less variation than in the mature forest.

Daily activity of the mountain tapirs showed a clear bimodal pattern, with maxima during the early hours of the morning (5:00–7:00) and early hours of the evening (18:00–20:00). Low activity was recorded at midnight and around 10:00 (Fig. 2). This pattern was consistent for all four sites (not shown). Overall, there was more activity in mature (149 records) than in secondary forest (92 records) ($F = 3.86$, $P < 0.05$) and at lower (141 records at 3100 m) than higher altitudes (100 records at 3600 m) ($F = 3.61$, $P < 0.05$).

Nocturnal activity was higher in the mature forest during the days of full moon, than during new and quarter moons (χ^2 22.57, d.f. = 3, $P < 0.01$). This pattern was not observed in the secondary forest (Fig. 3). Nocturnal activity was also significantly higher during full moon both at the Quebrada Paraiso salt lick (χ^2 1664.92, d.f. = 3, $P < 0.01$) and at Quebrada La Cuenca (χ^2 411.99, d.f. = 3, $P < 0.01$).
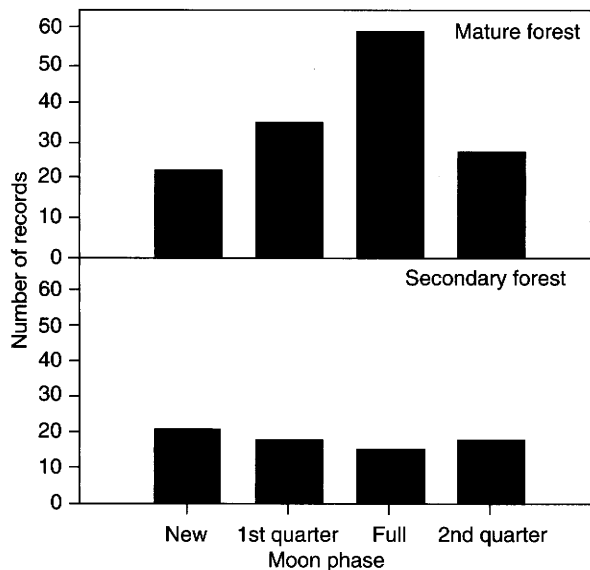
Fig. 3. Total number of records measured by active infrared trail monitors during the four moon phases (1997) in mature and secondary montane forests. Each record represents the pass of a mountain tapir across the infrared beam between the receiver and transmitter of the trail monitor. Nocturnal activity was significantly higher in the mature forest during the days of full moon, than during new and quarter moons (χ^2 22.57, d.f. = 3, $P < 0.01$).
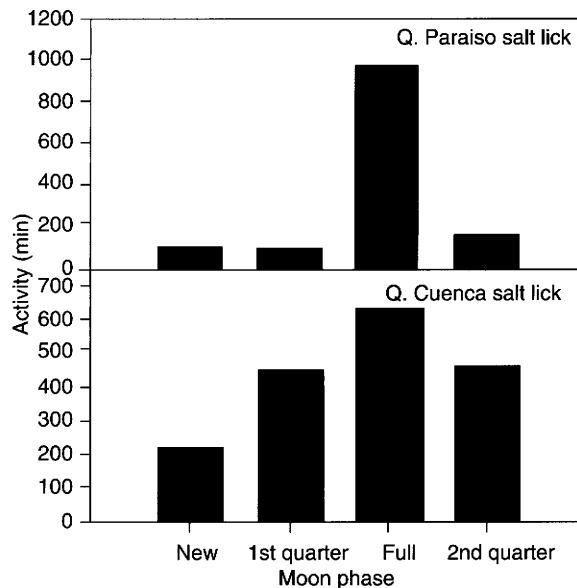

Fig. 4. Moonlight activity of the mountain tapir during 1997 at the two salt licks. The values represent the activity time of the mountain tapir during the four moon phases. Nocturnal activity was significantly higher during full moon both at the Quebrada Paraiso salt lick (χ^2 1664.92, d.f. = 3, $P < 0.01$) and the Quebrada La Cuenca (χ^2 411.99, d.f. = 3, $P < 0.01$).

Passive infrared monitors

Daily activity at the salt lick of Quebrada Paraiso showed a clear bimodal pattern (Fig. 2) with maxima after midnight (1:00–3:00) and after midday (12:00–15:00). Low activity was recorded between 04:00 and 09:00, and between 18:00 and 24:00. The daily activity at the salt lick of Quebrada La Cuenca showed a similar pattern, but with higher activity during late afternoon and evening (not shown).

Night-time activity at the Quebrada La Cuenca salt lick was higher when there was a full moon, than during new and quarter moons. Higher activity was also measured during full moon at the salt lick of Quebrada Paraiso (Fig. 4). This pattern was the same as the one measured with the active monitors along trails in mature forest (Fig. 3).

Seasonal activity (month to month), at the salt lick of Quebrada Paraiso showed a complex pattern with maxima during February–March, July and December (Fig. 1). No correlation was found between monthly rainfall and seasonal activity at the salt licks.

DISCUSSION

Active infrared trail monitors ran continuously for a year. Because camera batteries ran out faster, pictures were only taken during the first 14 days after unloading data and changing batteries in both the trailmasters and the cameras (every 45 days). Of the total pictures obtained (39 photos), 87% where of tapirs and 13% of other mammals (deer, spectacle bear and little spotted cat).

Seasonal activity (month to month)

Although there was more activity along trails during the first half of the year, there was no correlation between seasonal activity and rainfall patterns. During February there was a peak of activity at the higher site (3600 m) followed by a sharp decrease during March and April. This decrease contrasts with the increase of activity at the lower altitude site (3100 m) and may have been the result of an altitudinal migration. Because activity at 3600 m was also very low during July–August (the driest part of the year), there is no consistent pattern in our data to support the hypothesis that the mountain tapir is more active at higher altitudes (i.e. paramos and the upper limit of montane forests) during the drier part of the year (Acosta et al., 1996; Downer, 1996).

Differences in activity throughout the year at the high and low altitude sites, particularly in the mature forest, could also be an artefact of the sampling method. Since monitors were placed on fix locations during the entire study, tapirs could have kept the same activity from month to month but changing trails, and thus, producing 'noise' in the observed seasonal patterns. Monitors in the secondary forests recorded a less pronounced seasonal variation at both

altitudes, supporting the idea of relatively constant activity throughout the year. Future studies should consider increasing the number and relocate monitors along different tapir trails.

Daily activity

Daily movement along trails showed a bimodal pattern with maxima during early morning (5:00–7:00) and early evening (18:00–20:00). Activity at the salt licks also showed a bimodal pattern but with peaks around 01:00–03:00 and around 12:00–15:00. Low activity along trails may be the result of resting periods, including visits to salt licks as suggested by the difference in the peaks of activity at these two sites. Bimodal activity patterns have also been observed in radio-tracking studies of *T. pinchaque* in the montane forests and paramos of Ecuador with peaks between 15:00 and 21:00 and between 06:00 and 09:00 (Downer, 1996), in *T. terrestris* in the Atlantic forests of Brazil (P. Medici, pers. comm.), and in *T. bairdii* in Corcovado National Park in Costa Rica, where peaks occur at 03:00 and 19:00 (C. Foerster, pers. comm.). Differences in the peaks of activity in the two mountain tapir studies, may result, as suggested for other species, from simple local variations (Pépin & Cargnelutti, 1994) or from human interference as measured in Sumatran rain forests (Griffiths & van Schaik, 1993b) and Venezuelan savannas (Ojasti, 1991). The bimodal activity patterns of tapirs broadly fits the pattern of large mammals in Indonesian rain forests, where animals larger than 10 kg were potentially active during both day and night (van Schaik & Griffiths, 1996).

Night-time activity

Night-time activity was higher along trails and at the salt lick of Quebrada La Cuenca, during full moon than during new and quarter moons. Movement along mountain tapir-trails could be facilitated with some light (full moon) without fear of humans or natural potential predators like the spectacle bear *T. ornatus*, which although still present in the area, as shown in the photographic records of the trailmasters, they seem to occur at very low densities. Because the infrared trail-monitors were installed in the understory, activity during the full moon may also result from movement away from open areas, particularly in the secondary forest where forests patches are mixed with small open pastures. This result contrasts with low activity during the full moon in small desert rodents in apparent response to predation (Lockard & Owings, 1974; O'Farrel, 1974; Kaufman & Kaufman, 1982; Price, Waser & Bass, 1984) and with no significant difference in the nocturnal activity of small mammals related to moon phase (Benedix, 1994; Vieira & Baumgarten, 1995).

Use of salt licks

Daily use of the Quebrada Paraiso salt lick showed maxima at 01:00–03:00 and 12:00–15:00, while daily activity along trails (movement) showed maxima at 05:00–07:00 and 18:00–20:00 (Fig 2). The occurrence of activity peaks at the salt lick hours after the peaks of movement along trails could be interpreted as a signal of movement between food resources, like salt licks and feeding grounds inside tree fall gaps. The mountain tapir is using the salt licks at Quebrada Paraiso and Quebrada La Cuenca to drink water rich in mineral nutrients, particularly nitrogen and sodium (Lizcano, 1996). Visits to the salt licks usually last between 1 and 5 min, but may be extended up to 190 min. During the short visits, tapirs seem to drink water and move on, while during long visits, tapirs are likely to combine drinking with bathing and resting. Footprints on the rocky cliff at the Quebrada Paraiso salt lick clearly show that tapirs stand on their rear feet to lick the water dripping from the upper part, while at Quebrada La Cuenca, tapirs may drink from the edge of the 'pool' or inside while bathing (D. J. Lizcano, pers. obs.).

The patterns of activity of the mountain tapir, movement along trails and the use of salt licks, should be complemented with radio-tracking data, to determine the amount of time tapirs are using and moving between resources. Further research is needed to clearly determine if the mountain tapir moves along the altitudinal gradient during the day throughout the year.

Acknowledgements

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