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Abstract

Ecotourism is a fast growing branch of tourism generating millions of dollars for the profit of the global tourism industry (TIES Global Ecotourism Fact Sheet). As ecotourist numbers regularly increase worldwide, so do their impacts on ecosystems. Although, ecotourism includes a variety of activities such as wildlife viewing, tracking or feeding, from the literature it is seems that all these activities have a mainly detrimental impact on wildlife including primates. More than a decade ago, Kinnaird and O’Brien (1996) clearly showed that ecotourism had deleterious influences on the behaviour of SCBM. However, 15 years later, the current project, using a match-control method, demonstrated that ecotourism in Tangkoko did not affect daily time budget of both studied groups of SCBM ($p>5\%$), but all sex-ages classes of one group (Rambo 1) were still experiencing stress, with scratch and retreat ($d.f. = 26; p<5\%$) event behaviours being the most performed SDBs. As far as STs were concerned, their time of emergence and leaping were not affected by either the number of tourists around the nesting tree or the subsequent number of camera flashes ($r<5\%$). Although, ecotourism does not appear to have long-term behavioural effect on the primates of Tangkoko, it may have impacts on the parasite burdens and associate morbidity as a result of stress-related immune dysfunctions.
Keywords: ecotourism, Sulawesi crested black macaque *Macaca nigra*, self-displacement behaviours, long-term impacts.

Introduction

Indonesia is located in South-East Asia, between the Indian and Pacific Oceans. With its wide range of natural habitats, rich plant and animal resources and high numbers of island endemics, Indonesia is recognised to be a major world centre for biodiversity. Unfortunately, the world’s biological diversity is rapidly declining as direct and indirect consequences of human activities (Frankham *et al.*, 2004). Ecotourism can be an important tool for the preservation of biodiversity, and it is currently being realised that it can be used as a positive conservation tool by increasing funding or awareness (Sutherland, 2000). Indeed, ecotourism is a low impact nature tourism which contributes to the maintenance of species and habitats either directly through contributions to conservation, and/or indirectly by providing revenue to the local community sufficient for local people to value, and consequently protect, their wildlife heritage as a financial resource for the education, and the development of their society. Nonetheless, evidence about whether local communities benefit from ecotourism is very often contradicted in the literature, and doubts are regularly expressed that local communities do not greatly benefit financially from ecotourism (Russel and Wallace, 2004). Consequently, with the lack of income, promised by the principles of ecotourism, the development of their community is fairly slow. On the other hand, although parks and reserves are pre-eminently important as instruments of conservation, they often lack income. The practice of ecotourism in these protected areas can therefore generate income if managed properly. An important facet of ecotourism
is its association with environmental education of both ecotourists and local communities. According to Sutherland (2000), education is one of the major tools available to conservationists to make people understand what threats the planet’s biodiversity is facing, how it will affect them and future generations on the long-term, and what solutions can be used. Ecotourism could therefore help with human indifference, which was acknowledged by Balmford (1999) as one of the greatest problem in conservation. Improving environmental education through information centres in natural parks, schools and many other public places, may diminish impacts and inspire locals and ecotourists to become supporters for species conservation (Grossberg et al., 2003).

Nature tourism, which includes any type of tourism with a focus on the environment i.e. ecotourism, adventure tourism, sustainable tourism, responsible tourism, etc, is growing at 10%-12% per annum in the international market (TIES Global Ecotourism Fact Sheet). In 2004, ecotourism and the other types of nature tourism were growing three times faster than the whole tourism industry (TIES Global Ecotourism Fact Sheet). As far as Indonesia is concerned, the Indonesian Ecotourism Society was created in 1996. Ecotourism is practised all over Sulawesi where there are 22 national parks and reserves (Indonesia: Wildlife Parks & Sanctuaries by state website) both marine such as the Bunaken Marine National Park (North Sulawesi) and land such as the Kakinauwe Nature Reserve (South-East Sulawesi) and the Tangkoko-Batuangus Nature Reserve (North Sulawesi).

As ecotourist numbers regularly increase worldwide, so do their impacts on the environment. The degree to which nature tourism impacts on flora and fauna depends on numerous factors including the type of tourist (ecotourist, geotourist and so on), the nature of disturbance, characteristics of wildlife, the ecology of the
area and the time scale under considerations (Roe et al., 1997). A survey of tourist numbers, attending the Tangkoko-Batuangus Nature Reserve in the last few years, was conducted in the current project as well as a survey regarding the tourists’ experience within the park. This survey was used to establish what type of tourists came to the reserve and did they have empathy for, and what were their attitudes towards, wildlife. Although, ecotourism includes a variety of activities such as wildlife viewing, tracking or feeding, from the literature it is seems that all these activities have a mainly detrimental impact. According to Roe et al. (1997), the direct impact of ecotourism on wildlife arises from: disturbance of feeding and breeding patterns; increased vulnerability to competitors and predators; disruption of parent-offspring bonds; transmission of diseases and in certain cases, the death of animals. Indirect impacts include: habitat modification, increased collection of certain wildlife products for souvenirs and impacts from associated infrastructures (Roe et al., 1997). Unfortunately, most studies do not provide empirical data on the benefits of ecotourism, but they may include greater enforcement of anti-hunting laws, environmental education, preservation of habitats and, sometimes, increased income to local communities. Numerous case studies on the deleterious impacts of ecotourism on primates are present in the literature, for example Tibetan macaques (Macaca thibetana) have been attributed to be aggressive towards tourists (Zhao, 1991). This showed that macaques interacted with humans, rather than conspecifics, so their daily time budget was modified; Moreover, by being aggressive and creating accidents, Tibetan macaques would probably decrease the popularity of the ecotourism attraction, causing a chain reaction possibly leading to the diminution of number of tourists and income. Barbary macaques (Macaca sylvanus) fed by tourists, became obese and as a
consequence had their lifespan reduced (O’Leary, 1993). O’Leary and Fa (1993) revealed that daily activity patterns of fed Barbary macaques were affected and the number of interactions with tourists was very high. This was bad as individuals were interacted with humans instead of their conspecifics as well as Tibetan macaques, also showing they were highly habituated to humans. Long-tailed macaques (*Macaca fascicularis*), also fed by tourists, were very aggressive and did not hesitate to jump on and bite tourists to obtain food items (Small, 1995). These previous examples demonstrated that interactions with ecotourists mainly affect the daily time budget of primates, without showing if they were behaviourally affected *per se*. Also in the genus *Macaca*, Kinnaird and O’Brien (1996) recorded different categories of fear, including scream and flight behaviours, to measure the impact of ecotourism on the behaviour of Sulawesi crested black macaques (*Macaca nigra*) (thereafter referred as SCBM). They recognised that the level of fear experienced was different according to sex-age class of the individual, and occurred regardless of the tourists’ group size (Kinnaird and O’Brien, 1996). Other examples of deleterious impacts include: habituated mountain gorillas (*Gorilla gorilla*) which contracted zoonotic diseases (Niyezi *et al.*, 1999); chimpanzees (*Pan troglodytes*), although habituated to humans, still showed behavioural changes such that males and females reacted differently to observers with males performing more charge behaviours than females (*p*<0.001); on the other hand, females fled and hide more than males (*p*<0.02); their rate of soft vocalizations was also amplified (Grieser Johns, 1996). Like gorillas, chimpanzees can also be infected with zoonotic parasites brought by ecotourists (Goldberg *et al.*, 2007). Other primate species have been seen to be affected by the presence of ecotourists, such as the spectral tarsiers (*Tarsius spectrum*) (thereafter referred as
ST), nocturnal small primates, which were observed to delay their departure from their nesting tree and/or abandon them (Kinnaird and O'Brien, 1996). In addition, pygmy marmosets (*Cebuella pygmaea*) showed decreased reproduction levels, vocalisations rates and long-term behavioural modifications (De La Torre *et al*., 2000). Finally black howler monkeys (*Alouatta caraya*) males showed more aggression towards humans than both females and juveniles, which moved up higher into the canopy; the monkeys’ roaring rates were increased too and in some other cases, black howler monkeys deserted tourists’ areas (Grossberg *et al*., 2003).

Even though ecotourism is apparently more detrimental to wildlife than its conservation, it would still appear to be and is increasingly presented as a ‘panacea’ for sustainable development (Roe *et al*, 1997). However, it also has the potential to be more environmentally damaging than mass tourism, which is a large-scale tourism classically linked with ‘sea and sun’ resorts, (TIES Global Ecotourism Fact Sheet), since it typically occurs in fragile environments, and opens up previously undiscovered destinations to the mass market (Weaver, 1999). Indeed, “ecotourism should be coherent with the notion of sustainable tourism by adhering to the carrying capacity of the destination” (Weaver, 1999). Consequently, it can be imprudent to support ecotourism unless there is an evident procedure of control to limit harmful activities (Sutherland, 2000).

Standardised methods are used in welfare science in order to obtain objective data on the well-being of animals. This attempts to avoid any bias based on human perception of the animal’s state (Hosey *et al*., 2009). In captivity, these standardised methods have been used to measure stress and anxiety in primates,
and can include self-directed displacement behaviours (SDBs). An individual can be considered to be displaced when it experiences stress and is unable to cope or cannot get away from a stressful stimulus, leading to poor welfare and possibly to stereotypical behaviours. This is a common problem in captivity when both environmental and visitor pressure are sources of stress. Maestripieri et al. (1992) validated SDBs as a way to measure welfare as they correlate with other indices of poor welfare including physiological measures: cortisol levels, immunosuppression, impaired growth and reproduction, etc (Broom, 1991). SDBs can include scratch, autogroom, yawn (threat behaviour), body shake, comfort behaviours and agonistic behaviours such as aggression, chase, scream, etc (Aureli and De Waal, 1997; Plowman et al., 2005). Some SDBs are also performed outside of the stress/anxiety context, and have another function among the group such as hierarchy maintenance. Also, in the author’s personal judgment, retreat can be interpreted as an indicator of fear and anxiety, as the animal goes away from the source of stress. SDBs were studied in the population management of captive Hamadryas baboons (Papio hamadryas) and the impact of crowding. Crowding can be stressful to captive primates and in this study by Plowman et al. (2005), SDBs were increased in time of close proximity, hence proving moments of stress and decreased welfare in captive Hamadryas baboons (Plowman et al., 2005). Consequently, in the current research project, SDBs including scratch, retreat (evidence of experiencing fear), yawn and aggression events as well as vocalisation rates were used to evaluate the level of stress and anxiety experienced by wild SCBM in the Tangkoko-Batuangus Nature Reserve.

Another common source of stress in captivity are the visitors. Many studies showed that humans had negative impacts on the behaviour of primates
zoo tourists – tourists visiting zoological parks – and ecotourists are likely to have the same impacts on the behaviour of primates as both, as humans, can behave inadequately (screaming, camera flashing, banging on windows in parks, decreasing proximity, etc.) when facing animals, captive or free-ranging.

The current study was conducted in the Tangkoko-Batuangus Nature Reserve (hereafter referred to as Tangkoko), North Sulawesi, Indonesia, between July and August 2009. The reserve was established in 1919 by the Dutch colonial authority and retained as a nature reserve by the newly independent Indonesian government in 1945, making it one of the oldest protected nature reserves in Indonesia (O’Brien and Kinnaird, 2000). Tangkoko is a small reserve of 8,867 ha and is generally classified as lowland rain forest by the International Union for Conservation of Nature (IUCN, 1991) (Figure 1). An unusual high density of animals within the reserve, including numerous species of kingfishers, hornbills and primates, offers great opportunities for tourists to view exceptional wildlife. Moreover, the reserve contains one of the highest numbers of endemic species of any protected area in Sulawesi (MacKinnon and MacKinnon, 1980), which makes it a high biodiversity hotspot.

More than a decade ago, Kinnaird and O’Brien (1996) clearly showed that ecotourism had deleterious impacts on the behaviour of SCBM, one of the seven species endemic to Sulawesi (Fooden, 1969), and ST. The groups of SCBM have been followed by researchers for years and are now very human-habituated primates, and it was often that some individuals were within 2 meters from a human. Consequently, the current project investigated whether these deleterious
effects had evolved positively or if they had exacerbated. A study was also carried out to study the impact of ecotourism on ST at nest trees. Hence, the two main hypotheses were that ecotourism still had negative impacts on both *Macaca nigra* and *Tarsius spectrum*’s behaviour. Finally, as mentioned previously, a tourist’s survey was carried out at the same time about experience and expectations in Tangkoko.

Figure 1: Map of the Tangkoko-Batuangus Nature Reserve and surrounding villages. (adapted from Kinnaid and O’Brien, 1996 and Rosenbaum et al., 1998).
Methods

Tourist demographics and questionnaires
The number and nationalities of tourists entering the reserve were recorded and stored as monthly totals by the park’s authority. Some of these data were available from 2004 onwards from the entrance of the park. However, the data given to the author were written on one sheet of paper and were the total numbers of Indonesian tourists and international tourists, excluding the detailed demographics.

During July 2009 and August 2009, 52 tourists were opportunistically surveyed both in homestays and directly on guided tours. A standardized method was used to ask tourists 12 questions (table 2); the author did all questionnaires.

SCBM behaviour
Study animals
There are several groups of *Macaca nigra* in Tangkoko, and only 3 are studied everyday by researchers: Rambo 1 (R1), Rambo 2 (R2) and PB. Rambo 1 and Rambo 2 are the groups used for ecotourism purposes, as they are very habituated to humans, hence they were the author’s study groups. They used to be one group “Rambo” which had split earlier in the year. Rambo 1 is a group of 73 individuals, including 16 males, the remaining of females, babies and juveniles. Rambo 2 is a group of 72 individuals, including 4 males, the remaining of females, babies and juveniles. The case of Rambo 2 is slightly dissimilar from Rambo 1’s as only this group used to be fed by tourists, guides and researchers (Kerhoas, pers. Communication), which is not the case of Rambo 1.
Data collection

Tourist activities and SCBM (R1 and R2) reactions were monitored as follows: Broad state behaviours (table 1) were recorded using scan instantaneous sampling, on visible animals, every 30 seconds, during a 5min observation session when tourists were present (with; N_{R1} = 27; N_{R2} = 18) and then a match-control observation, carried out at the same time on the next available day, when there were no tourists present (control; N_{R1} = 27; N_{R2} = 18). Event behaviours (table 1) were noted using scan continuous sampling; for events that occurred at high frequencies, they were considered to be a new event if they were separated by 10 seconds i.e. for scratch and retreat. Behavioural data were collected on the visible individuals of the different sex-age classes of the SCBM group, including adult males, adult females, adult females with infant, big and small juveniles (less than 24 months old).
<table>
<thead>
<tr>
<th>SCBM Behaviour</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>State</strong></td>
<td></td>
</tr>
<tr>
<td>Social (SO)</td>
<td></td>
</tr>
<tr>
<td>- allo-grooming</td>
<td>Picking through hair or at skin, removing debris with hand or mouth, including groom another, receiving grooming, and mutual groom</td>
</tr>
<tr>
<td>- non-copulatory mounting</td>
<td>One individual mounts another but thrusting does not occur.</td>
</tr>
<tr>
<td>- copulation</td>
<td>A male mounts and thrusts a female.</td>
</tr>
<tr>
<td>Play (PL)</td>
<td>Includes wrestling, tickling and chasing. May be accompanied by a play face « smiling »</td>
</tr>
<tr>
<td>Resting (RE)</td>
<td>sit, lie down alone or within a group. Head up or down</td>
</tr>
<tr>
<td>Consumatory (CO)</td>
<td></td>
</tr>
<tr>
<td>- foraging</td>
<td>look for food through materials on the ground, in trees consumption of food items – including drinking</td>
</tr>
<tr>
<td>- feeding</td>
<td></td>
</tr>
<tr>
<td>Locomotion (LO)</td>
<td>Can be horizontal and vertical; individual changes location by walking, running, crawling, climbing etc. The change in location must be greater than one body length.</td>
</tr>
<tr>
<td>Others (OT)</td>
<td>behaviours not mentioned in the above</td>
</tr>
<tr>
<td><strong>Event</strong></td>
<td></td>
</tr>
<tr>
<td>Yawn (YA)</td>
<td>The mouth opens widely, head tips back, lips are pulled back so that the teeth are exposed. Looks like exaggerated form of a yawn.</td>
</tr>
<tr>
<td>Scratch (SC)</td>
<td>Individual scrapes/grazes itself or the floor; raking of fingernails over skin; may be smaller movements of hand, or larger sweeping scratching involving arm movement.</td>
</tr>
<tr>
<td>Retreat (RT)</td>
<td>individual flees away from tourists either on the ground or up into the adjacent trees; include group splitting</td>
</tr>
<tr>
<td>Aggression (AG)</td>
<td>charging and chasing, demonstration (species typical postural and facial displays); may include pilo-erection</td>
</tr>
<tr>
<td>Vocalisations (VO)</td>
<td>sound emitted by the individual. Not sub-categorised</td>
</tr>
</tbody>
</table>

Table 1: Ethogram of state and event behaviours studied for SCBM

Health and safety (thereafter referred as HS) were also studied during the project.

Data regarding HS guidelines, given or not by the guides, were established thanks to the cooperation of tourists.
ST behaviour

In Tangkoko, there are about 3,000 ST forming hundreds of families. However, only one family of 3 is the target of ecotourism and were the study animals in the current project. This family was living in a big Ficus tree at the western boundary of the Ecotourism Park of Tangkoko, 600 meters deep into the forest.

The time was recorded when the first ST emerged from the sleeping tree, and then the time recorded when the first and second ST leapt from the tree. Tourist numbers and the number of camera flashes, which occurred after the emergence of the first ST, were also noted. Emergence was defined as the time when the ST was entirely visible outside the tree crevice, i.e. not only visible when still within the tree crevice.

Results

Tourists number trend and seasonality

Figure 2: Tourists number including locals, foreigners and total.
The number of foreigners visiting Tangkoko reached nearly 2,100 foreigners in 2006 to then decrease abruptly by almost a half, down to 1,274 in 2007 (Figure 2). It increased again in 2008 to about 1,600 foreign tourists. On the other hand, domestic tourism (Figure 2), which was stable at about 3,000 visitors in 1993, has by now decreased down to 2,334 in 2008 going through a peak at 3,500 in 2005. The number of local tourists is fairly regular and stable.

As observed by Kinnaird and O’Brien (1996), tourism in Tangkoko is seasonal with high activities during the dry season from July to November and peaks in July and August. August is the most active month of the year with an average of 360,4 total tourists (Figure 3).

Nationalities of foreign tourists coming to Tangkoko were not accurately recorded but the author noticed that it was a majority of German/Dutch, French and Australians who stayed in the homestays of Batu Putih Village.

**Tourist questionnaire: type of tourists and experience**

The majority of tourists surveyed (table 2) suggested they were in Sulawesi for diving (20.3%) (the two dive sites mentioned were Bunaken Marine National Park and Lembe islands) and for wildlife (22.8%). Visitors’ wildlife expectations in
Tangkoko were to see the ST (27.8%) and the red-knobbed hornbill (23.9%). A lower number of tourists (17.2%) expected to see SCBM and even fewer were aware of the population-declining trend when questioned by the author. Most of the visitors' expectations, of wildlife they'd like to see, were satisfied except few saw the bear cuscus (5.3%). Most tourists were satisfied by the quality of guiding (80.8%), despite not being able to choose their guide (46.3%), but they highly disapproved with the entrance fee which they considered to be too high (78.4%). Most tourists declared they would be unwilling to come back to Tangkoko (72.1%) as this nature reserve was “ticked” on the “to do list”. Ecotourism was defined by tourists as visiting a nature reserve (30.8%) and having a low impact on the environment (13.5%). The great majority of tourists visiting the reserve were not given any kind of HS guidelines (70.59%); nearly 24% were given proactive guidelines and researchers had to intervene in almost 3% of the situations.
Characteristics and % tourists answers

Main reason for coming to Sulawesi
Travel 38%; Wildlife 22.8%; Diving 20.3%; Culture 15.2%; Other 3.8%

Wildlife expectations
ST 27.8%; Red-knobbed Hornbill 23.9%; SCBM 17.2%; Other 15%;
Kingfishers 8.3%; Bear Cuscus 7.8%

Species seen
SCBM 20.8%; ST 20.8%; Red-knobbed Hornbill 19.2%; Other 18.4%;
Kingfishers 15.5%; Bear Cuscus 5.3%

Average number of trips 2.5%

Time spent into the forest
>6-8hours 34%; 4-6hours 32%; >8hours 28%; <4hours 6%

Quality of guiding
Yes 80.8%; No 19.2%

Perception of entrance fees
Not Good 78.4 % (too high); Good 21.6%

Guide Tipping
No 80.4%; Yes 19.6%

Choice of guide
Language skill 50%; No choice 46.3%; Speciality 3.8%

Other activities done in Batu Putih
Relax 64.9%; Snorkelling 33.8%; Other 1.3%

Come again to Tangkoko
No 72.1%; Yes 27.9%

Ecotourism perception
Visit nature reserve 30.8%; Low environment impact 13.5%;
Bring money to communities 1.9%; Conservation 1.9%; Education 1.9%

Table 2: Tourist experience and attitude in percentage (N=52 tourists questioned)
Study Animals

Any results were obtained thanks to statistical analysis was done thanks to Minitab v. 14.10, Minitab Inc. Pennsylvania. It was to investigate if there were any significant differences between the 2 conditions i.e. with and without tourists (independent variables) for SCBM behaviours (dependent variables), and if the number of tourists and subsequent camera flashes (independent variables) had an impact on the emergence and leaping (dependent variables) of ST.

SCBM

First of all, for SCBM, proportions of state behaviours were calculated. Secondly, proportion of event behaviours were calculated and adjusted to obtain an average estimation of the group behaviour. Time spent performing the different event and state behaviours (table 1) with and without visitors was analysed using a parametric matched paired t test in Minitab as means (N<30) were normally distributed within the sample (figure 4).
Figure 4: Mean proportions of state and event behaviours of SCBM under the two conditions (with/without tourists). Data indicate mean ± SE (Rambo 1 N=27; Rambo 2 N=18).
From statistical calculations, shown in Table 3, it can be said that there were no statistical differences in time performing state behaviours between tourists presence and absence, apart from females with infants from R2 (d.f. = 17; p<5%). However, there were some significant differences in performing stress-related event behaviours between the 2 conditions in both R1 and R2, with a majority of changes in R1 in the 5 different sex-age classes (males: scratch and retreat d.f. = 26, p<5%; females: scratch d.f. = 26, p<5% and retreat d.f. = 26, p<0.1%; females with infant d.f. = 26 p<0.1%; big juveniles: scratch d.f. = 26 p<1% and retreat d.f. = 26 p<2%, small juveniles scratch d.f. = 26 p<2%, d.f. = 26 retreat p<1%). Only one
sex-age class from R2 (males) showed statistical differences of vocalisations levels \((d.f. = 17; p<5\%)\) with and without tourists. Overall, retreat and scratch were the 2 event behaviours performed the most with the presence of tourists in R1.

**ST**

For ST, the statistical analyses were linear regression and correlation tests also performed on Minitab. The relationship between time of emergence/leaping and number of tourists/camera flashes were compared using linear regression to predict any correlation between independent and dependent variable in Minitab.

**Figure 5:** time of emergence vs number of tourists and camera flashes for provisioned and non-provisioned ST. Data indicate number (tourists or camera flash) according to time (24h)
There was no correlation ($r > 5\%$) between the number of tourists recorded at the tarsier tree or the number of subsequent camera flashes, and the behaviour (figure 5) i.e. emergence time, leaping time and distance of leaping of ST both provisioned (table 4) and non-provisioned (table 5).

<table>
<thead>
<tr>
<th></th>
<th>Time of Emergence</th>
<th>Lag time</th>
<th>Time of Leaping</th>
<th>Distance of Leaping</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average number of tourists [7-23] on a 32-days observation</td>
<td>$r = 0,395$</td>
<td>$r = 0,099$</td>
<td>$r = 0,501$</td>
<td>$r = 0,528$</td>
</tr>
<tr>
<td>Average number of camera flashes [13-155] on a 32-days observation</td>
<td>$r = 0,538$</td>
<td>$r = 0,236$</td>
<td>$r = 0,292$</td>
<td>$r = 0,518$</td>
</tr>
<tr>
<td>Analyse of Variance</td>
<td>$r = 0,688$</td>
<td>$r = 0,248$</td>
<td>$r = 0,569$</td>
<td>$r = 0,338$</td>
</tr>
</tbody>
</table>

Table 4: $r$ values from correlation tests for provisioned tarsiers

<table>
<thead>
<tr>
<th></th>
<th>Time of Emergence</th>
<th>Lag time</th>
<th>Time of Leaping</th>
<th>Distance of Leaping</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average number of tourists [7-23] on a 32-days observation</td>
<td>$r = 0,319$</td>
<td>$r = 0,802$</td>
<td>$r = 0,350$</td>
<td>$r = 0,599$</td>
</tr>
<tr>
<td>Average number of camera flashes [21-100] on a 32-days observation</td>
<td>$r = 0,859$</td>
<td>$r = 0,318$</td>
<td>$r = 0,140$</td>
<td>$r = 0,882$</td>
</tr>
<tr>
<td>Analyse of Variance</td>
<td>$r = 0,470$</td>
<td>$r = 0,588$</td>
<td>$r = 0,320$</td>
<td>$r = 0,790$</td>
</tr>
</tbody>
</table>

Table 5: $r$ values from correlation test for not provisioned tarsiers

**Discussion**

Ecotourism is a fast growing branch of tourism generating millions of dollars for the profit of the global tourism industry (TIES Global Ecotourism Fact Sheet). Foreign tourism became famous in 1980s with only 50 foreigners (MacKinnon and MacKinnon, 1980) visiting the reserve to reach 1,515 foreign tourists in 1993 (Kinnaird and O’Brien, 1996). 15 years later, this number appears to be stabilised at almost 1,600 foreign tourists in 2008. However, in 2007, the western and
developed world faced an economic downfall and a credit crunch, which affected
different areas of the economy including the tourism industry with a decrease in
international arrivals. Although, the number of tourists coming to Tangkoko slightly
decreased due to the economic crisis, it is still a fairly popular ecotourism
attraction in Sulawesi. Unfortunately, a vast majority of tourists coming to
Tangkoko clearly lack education and information. Balmford (1999) did
acknowledge that the lack of education was the greatest problem faced by
conservationists. Indeed, in Tangkoko, most tourists did not expect to see SCBM
as they were sometimes not aware of their existence and consequently even less
of their critically endangered IUCN status. Moreover, most of the guides the author
worked with were not informed of their status either and tended to think the
complete opposite of the reality i.e. the population was increased, which was
nonsense as their numbers keep going down with time. However, it was
interesting to discover that most guides, as well as villagers (Sampson, pers.
communication), think that their numbers had increased over the years as they are
followed everyday by researchers, legally protected within the reserve, and also
because SCBM are regularly seen around the village. To problems of education
and information gaps is added the issue of flagship species of Tangkoko, which
are the red-knobbed hornbill and the ST. These two species are the most
expected ones to be seen within Tangkoko amongst tourists as ST are “tiny and
cute” and red-knobbed hornbills “colourful and massive” where SCBM are “scary”.
Indeed, most tourists questioned by the author revealed they were fearful of
SCBM, which could get very close, not knowing how to behave around the
macaques, and also because of the group effect, signifying a lack of HS guidelines
as well. From the questionnaire it was discovered that although most tourist come
to Sulawesi for wildlife, they did not come especially for Tangkoko. Tangkoko, as a tourist attraction, has a lot of competition with others of Sulawesi and its numerous diving sites; Indonesia as a whole with Komodo Island and its dragons, Kalimantan and Orang-utans, which does not make Tangkoko a primary tourism site to visit in Indonesia. Moreover, the entrance fees were said to be inappropriate by tourists and too high compared to other prices in Indonesia, and consequently tourists did not tip their guide. Actually, to enter Tangkoko a fee of $US8 or 80,000 IDR has to be paid whereas it is $US2 to visit the Gunung Halimun Nature Reserve in West Java (Taman Nasional Gunung Halimun Salak website). However the entrance fee of the Komodo National Park in Bali costs US$15 for foreigners, and $US7.5 for locals and KITAS holders, for a stay up to 3 days and increases with the length of stay as the tourists stay within the park; tourists also have to pay a ‘Tourism Fee Conservation’ which directly contributes to the protection and conservation of the Island and its inhabitants (Komodo National Park Official Website).

The absence of guide tipping in Tangkoko decreases the financial contribution of ecotourism to local communities. On the other hand and to the contrary, some ecotourists are willing to pay very high prices to see some wildlife as observed in the Bwindi Impenetrable National Park in Uganda, where a 3 days trekking cost US$380 per person to see Mountain gorillas including $US 200 to observe the animals for a 2 hours period (Bwindi Impenetrable National Park website). The main objective of these revenues is that they should fit ecotourism principles i.e. directly support and benefit conservation (monitoring, rehabilitation, research, surveillance and enforcement), community development (alternative livelihoods, training and capacity building, micro-financing, and improvement of public services), and nature-based tourism development (construction, maintenance and
operation of visitor facilities, including information centres, souvenirs shops, restaurants, and development of new tourism products). Although these principles are very clear to ecotourism parks, they are not for ecotourists themselves. Indeed, tourists questioned in Tangkoko had a clear misconception or incomplete view of the primer functions and goals of ecotourism as they thought it was about visiting a nature reserve with limited impacts on the environment. The main cause of this misconception of ecotourism is predominantly a lack of information and education again, probably from travel agencies, the Ecotourism Park itself and the general media on the roles of Ecotourism. By fully knowing and understanding these principles, ecotourists would probably be more willing to give money to communities by staying in local homestays, rather than doing 1-day trips, or tipping the guides or by directly donating money to conservation and native people. This misapprehension of ecotourism proved that most tourists are not conscious of their impacts on the environment and associated wildlife including behaviour and diseases points of view. Zoning, due to trails, within the reserve also impacts the environment. Indeed, trails for visitors within a reserve create zones which showed to have an impact on animals which do not cross trails and avoid them (Forbes et al., 2004). However, it is important to keep in mind that most tourists coming to Tangkoko are genuinely attracted by nature and indisputably for the protection of ecosystems as a whole.

Kinnaird and O’Brien (1996) plainly recognized the deleterious impacts of ecotourism on the behaviour of SCBM, which had been habituated to humans a year prior to their study. They shaped a code of conducts specific to this site on the number of tourists to be brought around the different SCBM groups (no more
than 6 individuals at a time). More than 15 years later, from this present study, it was shown that daily time budgets, often impacted by ecotourism, of both groups were not affected by the presence of tourists but that individuals from all sex-age classes of R1 still experienced stress and anxiety. The use of SDBs has proved to be a good way to measure stress and anxiety in primates with the use of specific event behaviours. Overall it can be said that the behavioural impacts have positively evolved over the years for the two study groups (R1 and R2) as behavioural impacts are minimal regardless of the number of tourists, and this especially if tourists behave appropriately and avoid decreasing proximity. Habituation in primates is a common phenomena (Zhao, 1991; O’Leary, 1993; O’Leary and Fa, 1993; Small, 1995; Grieser Johns, 1996; Niyazi et al., 1999) and although, Kinnaird and O’Brien (1996) said that ecotourist activities were creating long-term behavioural modifications in SCBM, this study may prove them wrong as ecotourism may have detrimental impacts only in the short-term and not in the long-term. This could be explained by the fact that R1 and R2 are highly habituated to humans as they are daily followed from dawn to dusk by at least 3 researchers and that SCBM are in contact with tourists’ groups less than 5 times a day and this during a short period of time (less than 10 minutes). This does not mean that SCBM are different animals from what they were, but that they have adapted to their environment and its challenges such as the presence of tourists; unlike in other ecotourism situations where there are high levels of aggression and interaction (wildlife feeding mainly), behaviour remains unchanged with the presence of tourists. This does not suggest that the level of stress experienced by the animals of R1 does not have an impact on their physiology including reproductive and immune systems. More particularly the immune system is
crucially important, as zoonotic parasitological risks are high in primates with direct or indirect contacts with humans, which are elevated in zoological and ecotourism parks (Niyezi et al., 1999; Goldberg et al. 2007). It was established by Yamashita (1963) that there is an ecological relationship between primates and parasites as well as other diseases (Wolfe et al., 1998). Most interactions between humans and wild nonhuman primates occur in a “high-risk interface”, which has recently increased because of expanded ecotourism and forest encroachment (Wolfe et al., 1998) thus enhancing the risk of diseases and parasites transmission.

The study on ST showed that the number of tourists and subsequent number of camera flashes did not affect both time of emergence and leaping from the nesting tree. However, to really estimate if there is an impact on emergence and leaping times, a match-control method should be used and a comparison between the two should be lead. Again, Kinnaird and O'Brien (1996) found out that ST departure from their tree was very delayed and that the camera flashes momentarily stunned them. Although the variables considered here in the present project, do not tell whether or not departure is delayed, they do show that the family of ST studied here is highly habituated to humans. In fact, at the end of the project, one individual – probably the grown up offspring - left the nest and was quickly replaced by a new infant. The parents are very habituated to human’s presence and camera flashes as are probably their offspring and this from an early age, which could explain the absence of delay in the departure. One more time, the project may demonstrate that deleterious effects of ecotourism are less damaging on the long-term than on the short-term. On the other hand, even if impacts are not behaviourally negative, they might be physiologically. As seen in SCBM, ST probably experiences stress and non-invasive methods could be used
to estimate stress levels notably thanks to faecal cortisol. On the other hand, as nocturnal animals, flashlights from tourists’ cameras may damage their vision, and to tell if their vision is impaired, more invasive methods would have to be used. As said previously for SCBM, stress also impact on the immune functions and as some individuals are hand-fed by guides, parasites burden and associate morbidity may be increased.

In conclusion, further projects could study the similarities in parasite burdens between SCBM and ST and local populations to establish whether or not a link exists between Tangkoko primates and close humans.

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