

BEHAVIOR AND ECOLOGY OF *Macaca leonina* (MAMMALIA: PRIMATES) AT HANOI ZOO, VIETNAM

Nguyen Vinh Thanh^{1*}, Tong Thi Nhai²

¹VNU-University of Science, Vietnam

²Hanoi National University of Education, Vietnam

ABSTRACT

Northern Pigtailed Macaque (*Macaca leonina*) naturally distributes in southern Vietnam, where it adapts to high daily temperature. In Ha Noi Zoo, northern Vietnam, time budget and diet of a 10-individual group of *Macaca leonina* and some ecological factors (temperature, humidity, human impact) were studied to determine its adaptation to the weather in the northern region of the country. Methods for the present study comprise focal time sampling and *ad libitum*. The study results showed that the species activities are not influenced by temperature and humidity, but strongly impacted by humans. There were linear regressions between the human impact and several activities of the species.

Keywords: *Macaca leonina*, behavior, human impact, primates.

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*Corresponding author email: nguyenvinhthanh@hus.edu.vn

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INTRODUCTION

Primate time budget reflects their adaptive adjustment under the combined effects of ecological and social factors (Isbell Young, 1993). Apart from age/sex class and individual needs, two of the reasons, which mostly affect on primate behaviors, are food availability and weather condition (José-Dominguez et al., 2015). *Macaca leonina* is known from a wide range of Asia, including the southern region of Vietnam (Brandon-Jones et al., 2004). The individuals of *Macaca leonina* of the Ha Noi Zoo (Northern Vietnam) came from southern Vietnam. There are significant difference in climate conditions between the southern (generally hot, rarely below 20°C, rainy and dry seasons) and northern (four seasons, a winter with temperature usually below 20°C) regions of the country (Nguyen Khanh Van et al., 2000). Behaviors of primates in captivity are different from those in natural habitats (Duncan and Fraser, 1997). Jaman and Huffman (2013) also report the difference in feeding time of urban-

living and rural-living rhesus macaque (*Macaca mulatta*) due to provisioned food. Visitors appear at Ha Noi Zoo from 7h00 to 17h00, and often tease or throw food at the animals. For these reasons, our study describe behavior of *Macaca leonina* in captivity under the impacts of climate conditions in the northern region of Vietnam other actions by human.

MATERIALS AND METHODS

Southern Pigtailed Macaque cage is located at Ha Noi Zoo, (21°02'N; 105°48'E). This is a lakeside area affected by tropical monsoon with four distinct seasons. The cage is ca. 24 square meters, divided into 2 sub-chambers and surrounded by metal net.

From October 2013 to January 2014, we observed the species behaviors over a total of 24 days. Focal time sampling with 15-minute interval (Paterson, 2004) was employed to collect daily data (from 7h00 to 17h00) following 9 behavioral categories: Feeding, traveling, resting, sleeping, playing, vigilance, autogroom-

ing, intraspecific interacting, and interacting with humans. There were 10 individuals belong to 4 age/sex classes have been recognized: 2 adult males, 4 adult females, 2 juveniles, and 2 infants. All of individuals have been identified as *Macaca leonina* (Colin P. Groves, per.comm) based on their morphological characteristics: triangle-shaped patches between the crown patch and the eyes, and red streaks from the external rim of the eyes point up to the direction of the ears, and the ischial callosities are oval-shaped (Malaivijitnond et al., 2012). Human impact was scored on a scale from 1 to 10. Data on temperature and humidity were also collected simultaneously, using a Nakata NJ-2099TH electric thermo-humid meter (Accuracy: temperature +/-1°C and humidity +/-5%). Statistical analysis (Nguyen Van Lieu et al., 2004) was carried out by using Excel 2007 (activity budget) and SPSS 19.0 (correlation and regression).

In general, *Macaca leonina* spent most time for resting and travelling on day time. Interacting with humans is the third most spent activity. Vigilance is almost zero, which indicates that the species is seriously influenced by humans

and probably teased so much that they are familiar with the threat (Fig. 1).

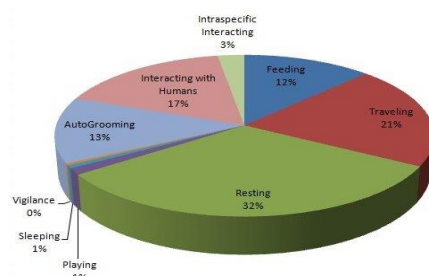


Figure 1. Activity budget of *Macaca leonina* (n = 1376 activities)

Each age/sex group has time for different activities (Fig. 2). In which, adult males gave priority to resting and vigilance over other individuals. Meanwhile, adult females spent more time on autogrooming than other individuals. Juveniles were most active as it spent most of the time for traveling, playing and intraspecific interacting.

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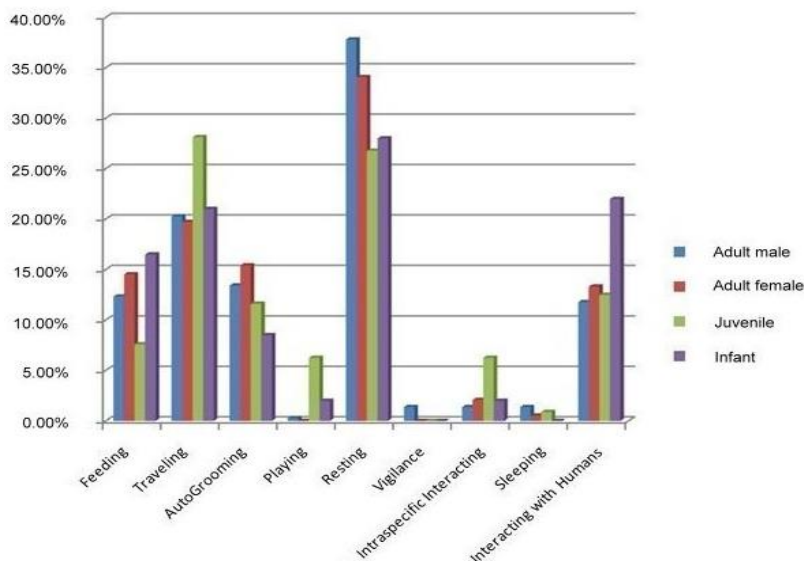


Figure 2. Behavioral difference between age/sex classes

Statistically analysis of the correlation between frequencies of defined behaviors and weather factors (temperature, humidity) and human impact indicates that:

No correlation between defined behaviors and weather factor ($p > 0.05$).

There was correlation between feeding and human impact ($R = 0.755$, $p = 0.007$). Testing for linear regression model for the two variables showed that it existed (ANOVA, $F = 5.793$, $p = 0.039$), and the equation has been estimated as $y = 6.018x - 14.273$ (Fig. 3).

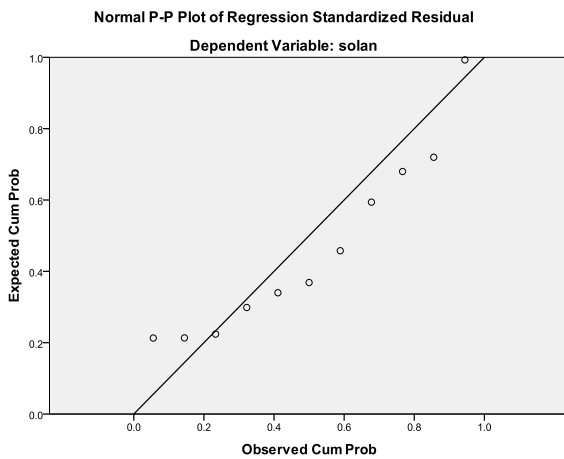


Figure 3. Correlation between Feeding and Human impact

A correlation between the behavior Interacting with humans and human impact also existed ($R = 0.70$; $p = 0.016$). An linear equation was found between the two variables as well

(ANOVA, $F = 5.619$; $p = 0.042$) and the equation that describes this relationship was $y = 6.173x - 12,318$ (Fig. 4).

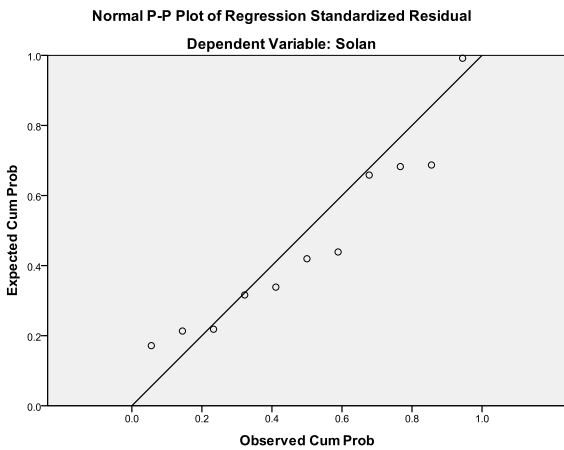


Figure 4. Correlation between Interacting with humans and human impact

A strong correlation also occurs between the behavior intraspecific interacting and human impact ($R = -0.941$, $p = 0.005$). The best equation for this relationship would be a non-linear function (ANOVA, $F = 2.933$, $p = 0.162$), however.

The high proportion of time the macaques spend for interact with humans and these strong correlations has proven the intensity of the relationship.

DISCUSSION

Our study also supports Maruhashi (1981) that juvenile and adult females were more active than males; juvenile spent more time playing and moving while females spent more time grooming and feeding.

Feeding accounted for 12% of the Northern Pigtailed Macaques budget indicates that full provision made them save time for other activities. Free-ranging macaques often consume more effort and time for foraging (18.78% at *M. fascicularis*, Hambali et al., 2012; approximately the same at *M. sylvanus* Alami et al., 2012)

As we have not found similar studies for *Macaca leonina* for comparison, we compared the results with the 12 months period of activity of the *Macaca fuscata* (Jaman Huffman, 2008), and activity budget of urban-living Rhesus Macaque *Macaca mulatta* (Jaman Huffman, 2013) because they both have more interaction with humans. In addition, the results of Jaman Huffman (2008) suggest that resting and moving time, feeding, resting and grooming are significantly different between "semi-naturally" nonvegetated and vegetated groups. Jaman Huffman (2008) suggested that factors such as shading provision (to avoid hot temperature) also affected time spent feeding and resting. It can be explained that Jaman and Huffman (2008) and Jaman and Huffman (2013) are full-year studies, while *Macaque leonina* at Ha Noi Zoo is fully provisioned and has not been studied in the summer. Thus, the effect of temperature and humidity is not so clear.

Alami et al. (2011) compared the behavior of *M. sylvanus* in a semi-provisioned group and a wild-feeding group showed a significant difference between time spent on Resting, Forag-

ing, Moving, especially Aggressive display, The time spent on Feeding is not much different. The same thing with feeding behavior was reported by Unwin Smith (2010), in which although the time spent on foraging in the unprovisioned group was high compared to the provisioned group, the feeding time did not increase. In our study, because it was difficult to determine the purpose of moving for food or for something else, Foraging was not placed separately in the Moving behavior. Therefore, comparisons with Unwin Smith (2010) are unfavorable.

In our study, Intraspecific interaction was larger but similarly similar to aggressive display. Juveniles spent 6.25% of their total time engaged in this activity, while adult males, adult females and infants spent 1.37%, 2.08%, and 2% for intraspecific interaction, respectively. Average time spent for intraspecific interaction in our study was high (ca. 3%) was significantly higher than 0.4 - 0.5% for *M. fuscata* (Jaman Huffman, 2008) and *M. mulatta* (Jaman Huffman, 2013), the objects were in captive conditions. It is likely that the cage square is only 24 m², and contains 2 males and 2 male juveniles. Therefore, these individuals are often close to each other and would be affected by the collision, although it is not currently intensive due to the hierarchy and an adult male looked old. This issue is not surprising because social tension and some other activities show a "monotonic" increase with group size (Van Schaik et al., 1983). Although the time spent on the aggressive display of captive macaques (this study; and Jaman and Huffman 2013) is usually lower than free-ranging macaques (for example 2.45–9.7% in Md-Zaid et al. (2010)). This poses an imperative need for Ha Noi Zoo. The zoo must either expand the cage or build an enclosed land for them to live.

Despite of human food provision influence on primate behavior (Albert et al., 2012), sometimes captive primates can perform wild-like activity budget (Melfi Feistner, 2002). However, if the situation is continued, capability for them and their offsprings' reintroduction will be minimized. The percentage of Vigilance in this study was too low in compare with 3.0–3.3% at *M. fuscata* (Jaman Huffman, 2008) made them more difficulty in the reintroduction

process. Human appearance might bring toxic substances, potential disease transmission (Scientific Committee of the Food Safety Authority of Ireland, 2015), or only reduce the independence of animals (Hosey, 2004).

CONCLUSION

These results suggest that weather condition might not a constraint factor for *Macaca leonina* behaviors, meanwhile visitors' influence would be a challenge for primate welfare at Ha Noi Zoo. Visitor impact inhibition should be strongly recommended.

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