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Movements of Semi-captive elephants during Skidding Season in Myanmar

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Abstract

Semi–captive Asian elephants (*Elephus maximus*) engaged in forestry activities in Myanmar are important for both forestry and the conservation of Asian elephant populations. In this study, we studied the movements of elephants during the skidding season. Three elephants were fitted with handheld global navigation satellite systems to collect data on their movements. The elephants were generally located between 0.534 and 0.875 km from the camp with temporary housing of the elephant handler when time therey were not working skidding (i.e., free time) and between 1.365 and 1.372 km when skidding (i.e., work time). The hourly moving distance during free time is about 0.622–0.655 km and 1.522 and 1.629 km during working time did not differ greatly from the hourly moving distance of wild Asian elephants (0.010–1.500 km). The elephants remained within 0.875 km of the camp of the elephant handler, and some variation in movements among individuals was observed during free time. Thus, the conservation of forest in areas near the camp is important for the well–being of these elephants.

Keywords: behavior, *Elephus maximus*, Myanmar Selection System, semi–captive elephant

အလှည့်ကျလွှတ်ကျောင်းစနစ်ဖြင့် မွေးမြူထားရှိသော သစ်ထုတ်လုပ်ငန်းသုံး ဆင်များ၏ သစ်ဆွဲရာသီချိန်အတွင်း လူပ်ရှားသွားလာမှု အလေ့အထများ

ဦးစည်သူမင်း၊ လက်ထောက်မန်နေဂျာ
မြန်မာ့သစ်လုပ်ငန်း

စာတမ်းအကျဉ်း

မြန်မာ့သစ်လုပ်ငန်းလက်အောက်တွင် အလှည့်ကျ လွှတ်ကျောင်းစနစ်ဖြင့် စောင့်ရှောက်ထားသောအာရှဆင်များ (*Elephus maximus*) သည် သစ်တောကဏ္ဍတွင်သာမကအာရှဆင်များကောင်ရေထိန်းသိမ်းရေးအတွက်ပါ အရေးပါသော အခြေအနေတစ်ရပ်အဖြစ် ရပ်တည်လျက်ရှိပါသည်။ ယခုစာတမ်းသည် အဆိုပါ သစ်ဆွဲဆင်များ၏ သစ်ဆွဲရာသီချိန် အတွင်း လူပ်ရှားသွားလာမှုများကို ဆန်းစစ်လေ့လာထားခြင်း ဖြစ်ပါသည်။ သစ်ဆွဲဆင်များ စုစည်းအလုပ်လုပ်ကိုင်နေသည့် တောတွင်းသစ်ဆွဲစခန်းရှိ ဆင်များထဲမှ ဆင် ၃ ကောင်ကို ရွေးချယ်၍ ဂြိုလ်တုစနစ် အသုံးပြုထားသော လက်ကိုင်ခြေရာခံစက်များ တပ်ဆင်ကာပုံမှန်လွှတ်ကျောင်းချိန်များနှင့် သစ်ဆွဲချိန်များအတွင်း သွားလာလှုပ်ရှားမှုများကို ခြေရာခံ ထောက်လှမ်းခဲ့ပါသည်။ ယေဘုယျအားဖြင့် ဆင်များသည်သစ်ဆွဲနားပြီး လွှတ်ကျောင်းချိန်များတွင် သစ်ဆွဲစခန်းအနီးဝန်းကျင် ၀.၅၃၄ ကီလိုမီတာမှ ၀.၈၇၅ ကီလိုမီတာအတွင်း နေထိုင် ကျက်စားလေ့ရှိပြီး သစ်ဆွဲ လုပ်ငန်းခွင်ဝင်သည့်နေ့ရက်များတွင်မူ ၁.၃၆၅ ကီလိုမီတာမှ ၁.၃၇၂ ကီလိုမီတာအတွင်း သွားလာလှုပ်ရှားလေ့ရှိပါသည်။ အဆိုပါ အချက်များမှတဆင့် ခန့်မှန်းရယူထားသော အချက်အလက်များအရ နာရီအလိုက် သွားလာမှုနှုန်းမှာ လွှတ်ကျောင်းချိန်အတွင်း ၀.၆၂၂ ကီလိုမီတာမှ ၀.၆၅၅ ကီလိုမီတာ အတွင်းဖြစ်ပြီး သစ်ဆွဲလုပ်ငန်းခွင်ဝင်သည့် နေ့ရက်များတွင်မူ ၁.၅၂၂ ကီလိုမီတာမှ ၁.၆၂၉ ကီလိုမီတာ အသီးသီးတို့ဖြစ်ပါသည်။ အဆိုပါ နာရီအလိုက် လူပ်ရှားသွားလာမှုနှုန်းမှာ အာရုတိုက်နေ တောဆင်များ၏ နာရီအလိုက် လူပ်ရှားသွားလာမှုနှုန်းဖြစ်သည့် ၀.၀၁၀ ကီလိုမီတာမှ ၁.၅၀၀ကီလိုမီတာများနှင့် သိသာ ခြားနားစွာ ကွာခြားမှုမရှိသည်ကို တွေ့ရှိရပါသည်။ တောတွင်းသစ်ဆွဲစခန်းတွင် အခြေချစဉ်ကာလအတွင်း ဆင်များသည် အနီးဝန်းကျင် ၀.၈၇၅ ကီလိုမီတာအဝန်းအဝိုင်းအတွင်းသာ အများအားဖြင့် နေထိုင်ကြသည်ကိုတွေ့ရှိရပြီး ယင်းအချက်အလက်သည် တောတွင်း သစ်ဆွဲစခန်းချရာ ပတ်ဝန်းကျင်ရှိ တောအခြေအနေကို ထိန်းသိမ်းခြင်းသည် အရေးကြီးလုပ်ငန်းစဉ်တစ်ရပ် ဖြစ်ကြောင်း ညွှန်ပြနေပါသည်။

Movements of Semi-captive elephants during Skidding Season in Myanmar

1. Introduction

1.1 The role of elephants in Myanmar Forestry

Selective logging is a common logging practice, especially in tropical natural forests (Bicknell et al. 2014). Because only trees satisfying particular criteria are removed during selective logging, well-planned and carefully controlled selective logging has a small negative impact on biodiversity (Gibson et al. 2011; Burivalova et al. 2015). However, selective logging can result in forest degradation or intensive ground disturbance (Pereira et al. 2002) if conducted without careful planning (Pereira et al. 2002). There is thus a need for more studies of selective logging practices to aid the sustainable management of tropical forests.

Myanmar is a country in Southeast Asia with a long history of selective logging under the Myanmar Selection System (MSS). Selective logging under the MSS results in considerably lower ground disturbance compared with selective logging in other countries (Khai et al. 2020), which is mainly associated with the use of Asian elephants (*Elephus maximus*) for skidding (Khai et al. 2020). The elephants used for skidding are semi-captive, which means that they are partially free-ranging when off duty. Elephant care and management are critically important given that semi-captive elephants are essential for the MSS. An understanding of the behavior of semi-captive elephants is necessary for optimizing elephant management.

An understanding of the behavior of semi-captive elephants used in the MSS is also important for the conservation of Asian elephants. The Asian elephant is listed as an endangered species in the IUCN Red List (Choudhury et al. 2008). Although the exact population size of the Asian elephant is not known, the estimated total population is approximately 63,000–67,000 (Menon and Tiwari 2019). Captive and semi-captive Asian elephants account for approximately 15,000 (23%) of the total estimated population of Asian elephants. Because captive elephants in zoos only number ca. 1,000 and rarely breed (Sukumar 2006), appropriate management of semi-captive Asian elephants is critically important for the conservation of Asian elephants. The number of semi-captive elephants used in the MSS is nearly 3,000 (Ministry of Natural Resources and Environmental Conservation 2018), which represents 20% of the captive and semi-captive Asian elephants in the world. Therefore, appropriate management of semi-captive elephants used in the MSS is important for the conservation of Asian elephants.

Recently, an increasing number of studies have focused on the semi-captive elephants. However, the behavior of elephants when off duty has not yet been examined. Most studies of semi-captive elephants have focused on topics related to elephant populations, such as mortality rate (Mar et al. 2012), reproduction (Robinson et al. 2012), and population dynamics (Jackson et al. 2019). Other studies have focused on the personality of elephants (Seltmann et al. 2018, 2019) and their diet (Campos-Arceiz et al. 2008). Crawley et al. (2019) investigated the attitude and experience of elephant handlers and their relationships to recent political and economic changes in Myanmar. Similarly, Mar (2007) summarized the life history of semi-captive elephants for the MSS and the traditional system of elephant management; however, the main focus of this study was on the demographic characteristics of wild-caught elephants captured since 1994. No studies to date have investigated the behavior of the semi-captive elephants used in the MSS.

Here, we studied the behavior of semi-captive elephants used in the MSS when they were being used for skidding and when off-duty. We tracked the movements of three semi-captive elephants using a global navigation satellite system (GNSS) and determined the moving speed and moving distance of the elephants. We expect that this quantitative information on their movements will facilitate the management and conservation of semi-captive elephants.

1.2 Ordinary daily schedule of semi-captive elephants in the skidding season

During the skidding season, elephant handlers stay at a camp with temporary housing near the skidding site and a stream. The camp is also where the semi-captive elephants spend much of their time when off duty.

Before skidding, the elephant handler locates the semi-captive elephants that were released the previous night and escorts them to the camp. The elephants are then washed in a stream and fed a light meal including tamarinds and salts. The health status of the elephants is also examined when they are being washed. After that, semi-captive elephants and the handlers leave the camp for skidding. After skidding, the semi-captive elephants and handlers return to the camp, the health status of the elephants is assessed, and elephants are fed a light meal. Semi-captive elephants are generally released to forests to rest and forage. Sometimes, the elephants are not free to roam but instead tied to a place where food is ample near the camp depending on their health. This is a procedure that is occasionally employed when necessary. When elephants are at the camp, they are provided with food, bathed, and subjected to health assessments.

2. Objectives

In this study, the objective is to track the movements of elephants (1) during skidding and (2) when semi-captive elephants were free to roam, which are hereafter referred to as work time and free time, respectively.

3. Study area

The study site was located in compartment 18 of Pyinde Reserved Forest in Katha and Kawlin, Myanmar (23°57′–58′N, 95°55′–57′E). The site is mountainous with an altitudinal range from 196 to 350 m above sea level. The forests are dominated by hardwood species such as teak (*Tectona grandis*), tauk-kyant (*Terminalia tomentosa*), and bamboo (*Thyrsostachys oliveri*).

4. Materials and methods

4.1 GNSS tracking and time records

Three semi-captive elephants were fitted with handheld GNSSs (GPSmap 62SJ, Garmin Ltd., Schaffhausen, Switzerland) by hitching a collar around their necks and were tracked from 11:15 on December 23th to 16:30 on December 27th in 2019.

We focused on the behavior of semi-captive elephants during their free time and work time. Work time was defined as the period between the time when the elephants left the camp for skidding and the time when the elephants returned to the camp. Free time was defined as the period between the time when the elephants were released from the camp and the time when the elephants returned to the camp. The elephants were equipped with the handheld GNSS just before their work time and free time, and it was removed when they returned to

the camp. The start and end time of the work time and free time for each elephant was also recorded. The GNSS data were acquired approximately every 30 s during the tracking period.

The elephants were 19–35 years old. Two elephants were male, and the other was female. Table 1 summarized the features of the elephants fitted with GNSSs. The GNSS fell off an elephant during free time one time. We found this GNSS in the field and could estimate the time when the GNSS fell off the elephant because the GNSS tracking data showed the time when the GNSS arrived at the point where it fell off. We thus removed data acquired after the GNSS fell off the elephant in our analysis.

Table 1 Summary of the features of elephants fitted with GNSSs

Elephant	Sex	Age (years)	MTE classification
1	Male	19	Full growth
2	Male	29	Full growth
3	Female	35	Full growth

4.2 Data analysis

Before analyzing the data, we categorized the GNSS data into two classes: free time and work time. We then removed outlier points based on the moving speed and turning angle following previous studies of animal movement using GNSS data (Bjørneraas et al. 2010). Points exceeding the pre-defined moving speed were defined as outliers. Points were also classified as outliers when the turning angle was smaller than the pre-defined threshold. In this study, we defined the pre-defined moving speed threshold and the turning angle threshold as 5.18 km/hour and 1.72 degrees, respectively. Outliers corresponded to the 1 percentile of all data points. If a given point (outlier) was removed, the moving speed and turning angle were updated using the new data set without the outlier. Because the updated moving speed and turning angle may still exceed the pre-defined threshold, we recursively removed the outliers until the updated moving speed and turning angle satisfied the criteria.

After filtering the GNSS data, we calculated the distance from the camp and the moving distance. The distance from the camp was defined as the horizontal distance between the center of the camp and each GNSS data point. The center location of the camp was recorded using a handheld GNSS (GPS map 62SJ). The distances were summarized for every elephant by discriminating free time and work time (i.e., the time for skidding).

The moving distance was also calculated horizontally. Based on the GNSS data classified into work time and free time, we calculated the total moving distance and hourly moving distance of each elephant by dividing the total moving distance by the free time and work time.

The analysis was conducted in R ver. 4.0.3 (R Core Team 2021).

5. Results and discussion

All three elephants spent approximately the same amount of time skidding (ca. 13% of the study period), but the amount of free time varied (ranging from 63% to 80%) (Fig. 1). The reason for the variation in the amount of free time is that some elephants were tied down for long periods because of their health status, as described in section 2.

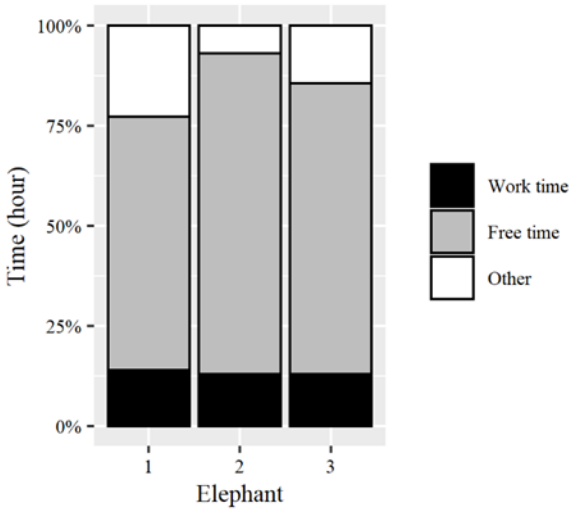

Fig. 1 Free and work time ratio of each elephant

The tracks varied among elephants during free time but were concentrated around the camp, which was in contrast to their tracks during work time (Fig. 2). The mean distances from the camp for each elephant were between 0.172 and 0.364 km for free time (Fig. 3) and significantly varied among elephants ($P < 0.05$) (Games-Howell test). The maximum distance that elephants moved from the camp was 0.875 km. The mean and maximum distances suggested that the elephants were located near the camp where elephant handlers could find them. The tracks of the three elephants during work time were similar (Fig. 2). The mean distances from the camp for each were between 1.365 and 1.396 km (Fig. 3) and did not significantly differ among elephants ($P > 0.05$) (Games-Howell test). This is not surprising because all three elephants went to the same logging sites and worked as a group during the study period.

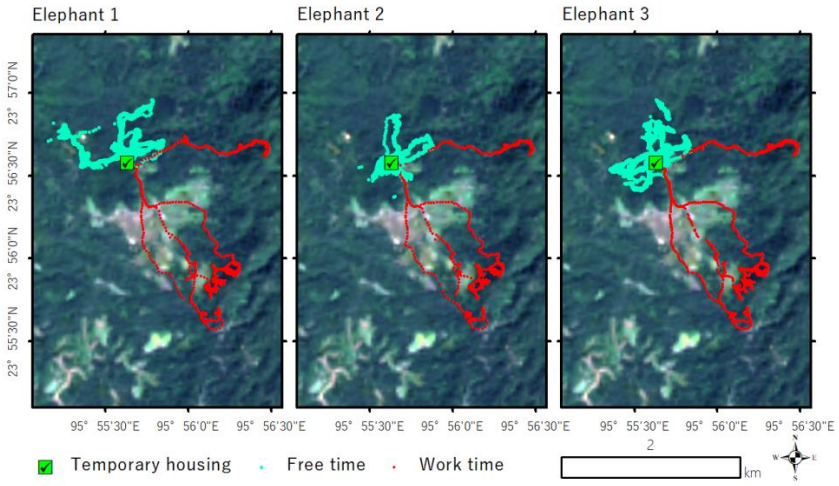

Fig. 2 Movement trajectories of elephants and the location of the camp of elephant handlers. The background image is the true-color image derived from Landsat 8 (acquired November 18, 2019).

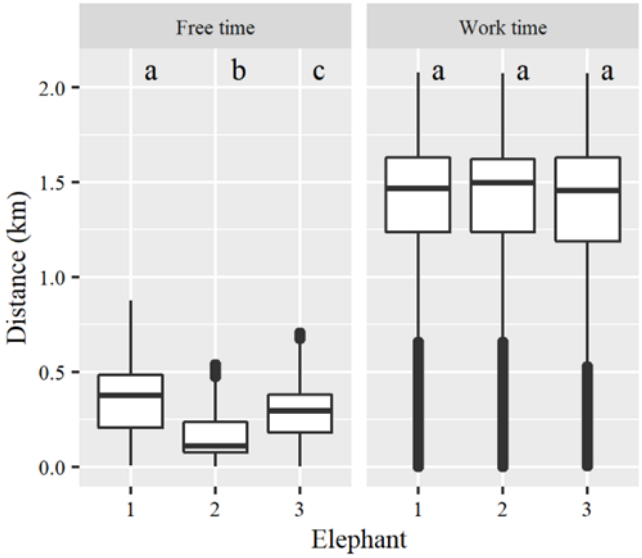

Fig. 3 Distance from the camp of elephant handlers

The total moving distances of elephants during free time were more than twice as long as the total moving distances during work time (Fig. 4). This was because the duration of free time was much longer than the duration of work time (Fig. 1). The hourly moving distance was between 0.622 and 0.655 km and between 1.522 and 1.629 km for free time and work time, respectively (Fig. 4). According to Leighty et al. (2009), the hourly distance traveled by wild Asian elephants ranged from 0.010 to 1.500 km. The hourly distance traveled by semi-captive elephants in both free time and work time was similar to that of wild Asian elephants, but the hourly distance in work time was close to the upper limit of the hourly distance traveled by wild Asian elephants.

Semi-captive elephants spent their free time within 0.875 km of the camp. Because the semi-captive elephants forage (especially bamboo) and rest during free time, sufficient supplies of food near the camp are needed. Therefore, the conservation of forest in areas used for camp is important for the MSS as well as the conservation of Asian elephants.

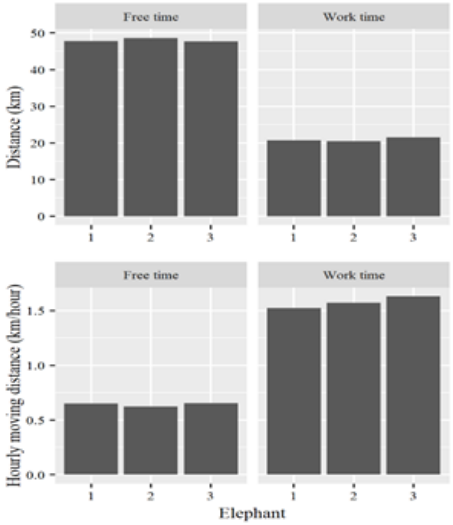

Fig. 4 Total moving distance and hourly moving distance of elephants

4. Conclusion

The semi-captive elephants mainly spent their time within 0.875 km of the camp of the elephant handler, but there was some variation among individuals when semi-captive elephants were off duty. During work time, the elephants needed to go more than 1 km away from the camp. No significant differences in the movements between elephants were observed during work time because the elephants worked as a group. The hourly moving distance of the semi-captive elephants during free time and work time in this study was similar to that of wild elephants. Additional studies are needed to explore the movement behavior of semi-captive elephants under other seasonal schedules, in resting camps, in tourism camps, and in other skidding sites.

5. Acknowledgements

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