Habitat Selection and Activity Pattern of GPS Collared Sumateran Tigers

Dolly Priatna1, Yanto Santosa1, Lilik Budi Prasetyo1, Agus Priyono Kartono2

1Graduate School of Bogor Agricultural University, Dramaga Main Road, Campus IPB Dramaga, Bogor 16680, Indonesia
2Department of Forest Resources Conservation & Ecotourism, Faculty of Forestry, Bogor Agricultural University, Academic Ring Road, Campus IPB Dramaga, PO Box 168, Bogor 16680, Indonesia

Abstract

Although translocation has been used in mitigating human-carnivore conflict for decades, few studies have been conducted on the behavioral ecology of released animals. Such information is necessary in the context of sustainable forest management. In this study we determine the type of land cover used as main habitat and examine the activity pattern of translocated tigers. Between 2008 and 2010 we captured six conflict tigers and translocated them 74–1,350 km from their capture sites in Sumatera. All tigers were fitted with global positioning system (GPS) collars. The collars were set to fix 24–48 location coordinates per day. All translocated tigers showed a preference for a certain habitat type within their new home range, and tended to select the majority of natural land cover type within the landscape as their main habitat, but the availability of natural forest habitat within the landscape remains essential for their survival. The activity of male translocated tigers differed significantly between the six time intervals of 24 hours, and their most active periods were in the afternoon (14:00–18:00 hours) and in the evening (18:00–22:00 hours). Despite being preliminary, the findings of this study—which was the first such study conducted in Sumatera—highlight the conservation value of tiger translocation and provide valuable information for improving future management of conflict tigers.

Keywords: activity pattern, GPS collars, habitat selection, sumateran tiger, translocation

*Correspondence author, email: dolly.priatna@gmail.com, telp. +62-813-8900-1566

Introduction

The sumateran tiger (Panthera tigris sumatrae Pocock, 1929) is the only subspecies of tiger still remaining in Indonesia, after 2 of its relatives, the bali tiger (P. t. balica) and the javan tiger (P. t. sondaica) were declared extinct in the 1940s and 1980s, respectively (Seidensticker et al. 1999). Sumateran tigers are distributed all over the island of Sumatera, but they live in isolated populations (Wibisono & Pusparini 2010). Most of them inhabit 12 Tiger Conservation Landscapes (TCL) whose total area is around 88,000 km² (Sanderson et al. 2010). At present, sumateran tigers face many threats originating from human activities (Seidensticker 1986; Seidensticker et al. 1999), which causes conflict between humans and tigers (Nugraha & Sugardjito 2009). In Sumatera, conflict between humans and tigers has become a major problem in tiger conservation, due to its effect in the form of loss of property and human life, which will ultimately decrease people’s support for tiger conservation efforts. Such conflict is also one of the factors which triggers people to hunt and even kill tigers (Nugraha & Sugardjito 2009).

In the last several decades, translocation has been one of the methods used for mitigating conflict between humans and wild animals, such as in the case of brown bears (Ursus arctos) and black bears (U. americana) (Armistead et al. 1994; Blanchard & Knight 1995), wolves (Fritts et al. 1984; Bangs et al. 1999), and large cats (Rabinowitz 1986; Stander 1990; Ruth et al. 1998), including tigers (Seidensticker et al. 1976; Nowell & Jackson 1996; Goodrich & Miquelle 2005; Priatna et al. 2012). However, there is still little research being conducted on the ecology and behavior of wild animals after they are released again to the wild or after being translocated. Understanding the ecological requirements or prerequisites for this rare carnivorous wild animal is very important for implementing an effective management and conservation strategy (Grassman et al. 2005). Santosa & Rahman (2012) explained that protection of wild animals which are umbrella species, such as the sumateran tiger, occupies a very important position in sustainable forest management, due to its implications for other species and its role in maintaining ecosystem stability.

Global positioning system collars (GPS device fitted around a wild animal’s neck) are frequently used for the study of habitat selection and movement of wild animals (Edwards et al. 2001; Coelho et al. 2008) because the device is able to provide accurate information on a wild animal’s location in various conditions (Hebblewhite et al. 2007). Habitat selection is a process whereby individual wild animals, in preferential manner, utilize the available habitats in a
landscape (Morris 2003). Wild animal movement, besides being affected by environmental conditions, is also affected by the distribution of resources needed by the animal to grow, reproduce, and survive (Begon et al. 1986). Meanwhile, Valeix et al. (2010) explained that the spatial ecology and movement of a predator animal are very much affected by habitat characteristics which determine the distribution of its prey animals.

Studies related to the use of habitat and activity patterns of Felidae species have been conducted on snow leopards (Jackson 1996; Xu et al. 2012), as well as on clouded leopards, golden cats, marble cats (Grassman et al. 2005), and on asian leopards (Simcharoen et al. 2008). Similar research on wild tigers has been conducted in Nepal (Sunquist 1981) and in Sumatera (Sunarto et al. 2012). However, such studies have never been conducted on sumateran tigers which have been translocated, so the success rate of tiger translocation in Sumatera is difficult to measure. The objective of this research was to determine the vegetation cover type which was chosen as the main habitat by the tiger and to study the activity pattern of tranlocated sumateran tigers.

Methods

This research was conducted from July 2008 through August 2011 in four locations of tiger translocation in Sumatera, i.e. Bukit Barisan Selatan National Park (BBSNP) in the Province of Lampung, southern Sumatera; Gunung Leuser National Park (GLNP) and Ulu Masen Ecosystem (UME) in the Province of Aceh, northern Sumatera; and Kerinci Seblat National Park (TNKS) in the Province of West Sumatera (Figure 1).

Between July 2008 and December 2010, we collaborated with the Directorate General of Forest Protection and Nature Conservation (PHKA), Ministry of Forestry, in handling human-tiger conflicts. After undergoing a recovery period of between 16 and 225 days in quarantine facilities, 6 sumateran tigers (5 males and 1 female) which conflicted with humans (entering villages and killing livestocks) were translocated to 4 different locations at distances of between 74 and 1,350 km from the places where each of them were captured. After all programmed to determine the duration of active period and the number of position data readings which would be fixed every day, GPS collars (Televilt, Lindesberg, Sweden; Argos/Sirtrack Ltd, Hawkes Bay, New Zealand) were fitted on the 6 tigers before they were released back to the wild. With the aid of satellite, tiger position data from the GPS collars were periodically transmitted to a server every day and were subsequently sent to an appointed email address.

In analysis of habitat utilization, all collected data from each GPS collar were screened to obtain tiger position data with high accuracy, i.e. those data which were fixed using 4 or

Figure 1 Location of tiger translocation in 4 forest areas in Sumatera (JD-1 & 2 in BBSNP, JD-3 in GLNP, JD-4 & 5 in KSNP and BD-1 in UME).
Table 1  Most preferred habitat types by translocated tigers in each release sites, with the values of chi-square test and Neu index (W)

<table>
<thead>
<tr>
<th>Tiger</th>
<th>Location</th>
<th>Results of chi-square test</th>
<th>Most preferred habitat (value of Neu index/W)</th>
</tr>
</thead>
<tbody>
<tr>
<td>JD-1</td>
<td>BBSNP</td>
<td>$\chi^2_{calculated} = 304.04 &gt; \chi^2_{table}$ (0.05;5) = 11.07</td>
<td>Plantation/regrowth (bush/young secondary forest) (W = 1.18)</td>
</tr>
<tr>
<td>JD-2</td>
<td>BBSNP</td>
<td>$\chi^2_{calculated} = 2,840.72 &gt; \chi^2_{table}$ (0.05;5) = 11.07</td>
<td>Plantation/regrowth (bush/young secondary forest) (W = 1.21)</td>
</tr>
<tr>
<td>JD-3</td>
<td>GLNP</td>
<td>$\chi^2_{calculated} = 306.96 &gt; \chi^2_{table}$ (0.05;8) = 15.51</td>
<td>Lower montane forest (W = 1.41)</td>
</tr>
<tr>
<td>JD-5</td>
<td>KSNP</td>
<td>$\chi^2_{calculated} = 3,551.99 &gt; \chi^2_{table}$ (0.05;9) = 1692</td>
<td>Lowland forest (W = 1.98)</td>
</tr>
<tr>
<td>BD-1</td>
<td>UME</td>
<td>$\chi^2_{calculated} = 3,234.16 &gt; \chi^2_{table}$ (0.05;6) = 1259</td>
<td>Plantation/regrowth (bush/young secondary forest) (W = 2.17)</td>
</tr>
</tbody>
</table>
Figure 2 Percentage of vegetation cover types availability in each study sites and within the tiger home ranges as well as their utilization by each individual translocated tiger (A= tiger JD-1, B= tiger JD-2, C= tiger JD-3, D= tiger JD-5, E= tiger BD-1). (ustralian % size within study area, (our % size within home range, (ility frequency (N), N tiger JD-2 = 1.228, N tiger JD-3 = 1.281, N tiger JD-5 = 5.996, N tiger BD-1 = 6.116.
Table 2  Percentage of habitat type/vegetation cover utilization by tigers in the day time (D) and night time (N) in each translocation sites

<table>
<thead>
<tr>
<th>Habitat type/vegetation cover</th>
<th>Percentage of utilization frequency (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tiger JD-1</td>
</tr>
<tr>
<td>D</td>
<td>N</td>
</tr>
<tr>
<td>Water</td>
<td>0.0</td>
</tr>
<tr>
<td>Mangrove</td>
<td>0.1</td>
</tr>
<tr>
<td>Lowland forest</td>
<td></td>
</tr>
<tr>
<td>Plantation/regrowth (bush/young secondary forest)</td>
<td>93.6</td>
</tr>
<tr>
<td>Lower montane forest</td>
<td></td>
</tr>
<tr>
<td>Upper montane forest</td>
<td></td>
</tr>
<tr>
<td>Lowland mosaic</td>
<td>0.0</td>
</tr>
<tr>
<td>Montane mosaic</td>
<td>0.0</td>
</tr>
<tr>
<td>Lowland open</td>
<td>0.0</td>
</tr>
<tr>
<td>Montane open</td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td></td>
</tr>
<tr>
<td>Large-scale plantation</td>
<td>0.0</td>
</tr>
<tr>
<td>Total (%)</td>
<td>100</td>
</tr>
</tbody>
</table>

Utilization of day time and night time habitat
Observation results showed slight variations for each translocated tiger in the use of each main habitat type in the day time and night time. Male tiger JD-1, which was translocated to BBSNP, used plantation/regrowth (bush/young secondary forest) habitat as much as 93.6% in the day time and 93.3% in the night time. Tiger JD-5 in GLNP spent 62.2% of its day time and 58.2% of its night time in lower montane forest habitat. Tiger JD-5 spent 54.1% of its day time and 62.3% of its night time in plantation/regrowth (bush/young secondary forest) habitat. Female tiger BD-1 spent 56.7% of its day time and 55.1% of its night time roaming in plantation/regrowth (bush/young secondary forest) habitat (Table 2). However, the results of the Wilcoxon signed rank test for each tiger individual showed that there was no significant difference between day time and night time in terms of habitat utilization (JD-1: Z = -0.211; p = 0.883 > 0.05, JD-3: Z = 0.000; p = 1.000 > 0.05, JD-5: Z = -0.315; p = 0.752 > 0.05, and BD-1: Z = -0.135; p = 0.892 > 0.05). On the other hand, results by Simcharoeo et al. (2008) showed that asian leopards in Thailand used various habitat types with differing proportion between day time and night time. This phenomenon is probably due to the existence of tigers which live sympatrically with asian leopards, where the asian leopard uses one type of habitat when the tiger does not use it.

Patterns of activity
Results of data processing of tiger activity showed that signal X and signal Y gave the same results. This implies that if the tiger was moving, both signals X and Y would indicate that the tiger was active. On the other hand, if the tiger was resting, both signals X and Y would indicate that the tiger was not active. A similar phenomenon was observed for male sumateran tigers, during their activity time compared to clouded leopards. Our research results also show that male sumateran tigers, which live sympatrically with asian leopards, where the asian leopard uses one type of habitat when the tiger does not use it.

From the graphic pattern formed by signals X and Y (Figure 3), it can be seen that the 2 male tigers (JD-1 and JD-5)
conducted many movements and the most active time started at late afternoon before dark and proceeded into the night. However, male tiger JD-5 was also seen to conduct many activities at dawn before morning time, while tiger JD-1 was less active in the morning. The 2 tigers decreased their activities in the morning until noon time, and at midnight until before dawn.

Observation results show that for male tigers, the most active period was late afternoon (14:00–18:00 hours) and evening/night (18:00–22:00 hours). However, individually, there was a small difference for male tiger JD-1, which was translocated to BBSNP: its most active times were in the evening/night (18:00–22:00 hours) and in the morning (06:00–10:00 hours) (Figure 4). Through the chi-square test ($X^2_{calculated} = 91.96 > X^2_{table} (0.05; 5) = 11.07$), it can be concluded that within a period of 24 hours (one full day and night), there is significantly a most active period of time for the tiger. Neu analysis shows that the most active times, with the greatest number of movements, were the late afternoon (14:00–18:00 hours Western Indonesia Time/GMT +7) (Neu index/W = 1.17) and evening/night time (18:00–22:00 hours Western Indonesia Time/GMT+7) (Neu index/W = 1.19). This finding is rather similar to that of previous research (Fata 2011) which stated that an increase in sumateran tiger activities occurred within the time intervals before dawn until early morning time, day time before late afternoon, and dusk time until before midnight. The period of activity and movement of this sumateran tiger was rather different from that of bengal tigers in Chitwan National Park in Nepal, which were, in general, active and moving, starting at dusk, and before morning time (Sunquist 1981). Schaller (1967) reported that for bengal tigers in India, the most active time was night time, and they took rest, starting in the morning before day time, until late afternoon. However, sometimes tigers hunted during the day time if the animals failed to capture prey animals during the previous night. Sunquist (1981) proved that a tiger's active
period was closely related to air temperature, and Bengal tigers in Nepal generally take rest in areas with dense vegetation cover along rivers or streams in daytime during summer. Hamilton (1976) reported the same phenomenon, where leopards in Africa were in general not active when air temperature was high during daytime. Besides, the pattern of tiger activity is closely related to the active period of its main prey animal (Sunquist 1981; Linkie & Ridout 2011). The tiger will hunt more easily if its prey animal is highly active, which is from when the sun starts to set until before midnight, and between sunrise and morning time.

**Conclusion**

Plantation/regrowth (bush/young secondary forests), lower montane forests, and lowland forests were the vegetation cover types which served as the main habitat for tigers which were translocated to Sumatera forest. Areas which were selected as the main habitat for the tigers constituted the dominant natural vegetation cover in the local landscape, where the tigers established their home range. There were found to be no differences in terms of main habitat utilization by the translocated tigers, either in the day time or the night time. Male tigers selected times for activity and hunting of prey animals in the late afternoon until before midnight and at dawn until morning time.

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**References**


