

Nesting behavior of reintroduced Bornean Orangutan in Bukit Batikap Conservation Forest, Central Kalimantan, Indonesia

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Manuscript received: 6 February 2020. Revision accepted: 20 April 2020.

Abstract. *Nayasilana IN, Atmoko SS, Suyoko A, Hadisusanto S. 2020. Nesting behavior of reintroduced Bornean Orangutan in Bukit Batikap Conservation Forest, Central Kalimantan, Indonesia. Biodiversitas 21: 2088-2096.* Great apes such as orangutans build a nest to rest in every night. Orangutan's nest making skills correlate with their adaptability in a new habitat. Here we analyzed the nest skill on the reintroduced orangutan. Skills process and thought training there is a back to remembers in forest school and pre-release islands in the rehabilitation center. The study aimed to observe the skill adaptation of reintroduced orangutans (semi-wild and ex-rehabilitate) for nest building and the characteristic of the tree chosen for their nests in a new habitat. The study was 16 individuals (8 semi-wild and 8 ex-rehabilitate) from February 2012 to November 2014 at the release site of Bukit Batikap Conservation Forest, Central Kalimantan. The method used in the study was instantaneous focal animal sampling, which follows the behavior of each orangutan from the morning nest to the night nest. Non-parametric statistics test (Kruskal-Wallis) was used to nesting behavior, Canonical Correspondence Analysis (CCA) is used to determine the relationship between nesting behavior and nesting tree species, and ArcMap GIS 10.3 to find out the distribution of nest trees in the research location. The result of the study revealed that reintroduced orangutan prefers to build a nest to rest at night rather than day nest. Semi-wild orangutans prefer tree species with dense canopy and branching, while ex-rehabilitation orangutans pay less attention to this. Mostly, reintroduced Bornean orangutan created new nests rather than reusing and/or repairing old nests. Species of *Syzygium* sp. *Lithocarpus* sp. and *Xanthophyllum* sp. are a preferred species of the nest tree, the nest position of 2 (nests are constructed on the main side-branch) and 3 (the crown of the tree) is dominance. Orangutan prefer height tree species between 26-30m for day nests, are selectively determined as part of the adaptation process. However, each individual will choose the nest type species of tree, positions, and height according to their characteristics of the nest tree.

Keywords: Characteristic-tree, nest, orangutan-reintroduction, species-tree

INTRODUCTION

Orangutans are arboreal animals that are sometimes difficult to detect in the forest. Orangutans build nests every night to sleep and sometimes also make nests during the day (Prasetyo et al. 2009). Nesting behavior will be carried out at the end of each activity, such behaviors include: breaking of branches, gathering branches and twigs to form as a body protector at rest. In general, the nest is made according to its completeness starting from the base, pillow, blanket or cover (roof). Orangutans will also choose tree species and tree height before making a nest. The selection of tree species is related to the selection of leaves, branches, and twigs, which are then made of foundations and nodes (Prasetyo 2006). Several parameters are needed when researching nests, namely height, diameter and type of nest tree; the height and position of the nest; nest conditions used (built, rebuilt or reused); use of feed trees as nest trees; and the time of building and use of nests (van Schaik et al. 1995; Buij et al. 2003). Whereas the position of the nest is divided into four positions, namely the nest which is at the base of the main branch and attached to the main stem; nest of the middle or end

position of a tree branch; the nest is at the top (top) of the main tree; and nests built of two or more trees (van Schaik 2006; Prasetyo et al. 2009). Orangutans will like the nest with a position not far from the canopy, but not in a position that is too open. This is to avoid attacks by night predators (Sugardjito 1986; Ancrenaz et al. 2004).

Young orangutans use their afternoon nests repeatedly (Rijksen 1978; Maple 1980), while the orangutans that have been independent will make new nests and are generally around the last feed tree or in certain cases in the last feed tree (Sugardjito 1986, Prasetyo 2006). These orangutans generally built new nests, especially when building night nests (Rijksen 1978; Galdikas 1986; van Schaik 2006). MacKinnon (1978) and van Schaik (2006) added that the selection of new nest tree species was believed to be strong and comfortable, especially those with many branches and had broad and soft leaves. The ability and skills of nesting will develop with age. In general, at the age of 3 (three) years orangutans can do these skills. Their skills will continue to grow with age (van Schaik 2006; van Noordwijk 2009). Nest-making skills are also inseparable from the presence of tree branches as a foundation, and the twigs needed by young

orangutans will be less than that of adult females (Galdikas 1986; van Schaik 2006, Prasetyo et al. 2009; Rayadin 2009). However, up to date the establishment of nest behavior of reintroduced orangutan is considered to be insufficient and very limited. The development of nesting skills from the rehabilitation center continues to be carried out along with the introduction of natural habitats to assess their success such as nest building (Riedler et al. 2010). Learning skills in making nests is re-learned and re-developed while at the Nyaru Menteng Rehabilitation Center, BOSF at Central Kalimantan. The learning process is carried out at the forest school stage, socialization enclosure and or pre-release island. More than 131 formerly individuals from Nyaru Menteng rehabilitation center, Borneo Orangutan Survival Foundation (BOSF) who had been reintroduced to the Bukit Batikap Conservation Forest, Central Kalimantan between February 2012 until November 2014. The orangutans that previously had a history of rescue (semi-wild orangutans) and confiscation (ex-rehabilitates). Semiwild orangutan that only carries out the learning stage to the forest school, but ex-rehabilitate orangutan are not finished on forest school and learning process until the pre-release stage on the islands around the rehabilitation site.

Information concerning nest build for reintroduced orangutan is currently important for their ability and skills adaptation in new habitat after making the nest stopped

when the individual became a victim of habitat degradation (conversion of land functions) and confiscation (pets). It is a kind of effort to support the management of the orangutan in a sustainable way, especially successful processes of reintroduced. Therefore, this study aim to know its memory of nesting behavior (before resting or before ending activity) with the data taken is to follow from nest to nest, e.g making a nest, the height position of the nest, map location and characteristics of tree species selection, association relative to those of wild Borneo orangutan populations.

MATERIALS AND METHODS

Time and location

The study was carried out in the Bukit Batikap Conservation Forest, Nyaru Menteng Central Kalimantan (Indonesia) Orangutan Reintroduction Program (PROKT-NM), BOS Foundation. Coordinate point $S00^{\circ}24' - N00^{\circ}40'LU$; $113^{\circ}12' - 114^{\circ}13'BT$ (Figure 1). The release area covers 35,267 ha (8,000 ha including the research area), lowland peat swamp forest habitat with Dipterocarpaceae forest condition. Research Data from February 2012 to November 2014.

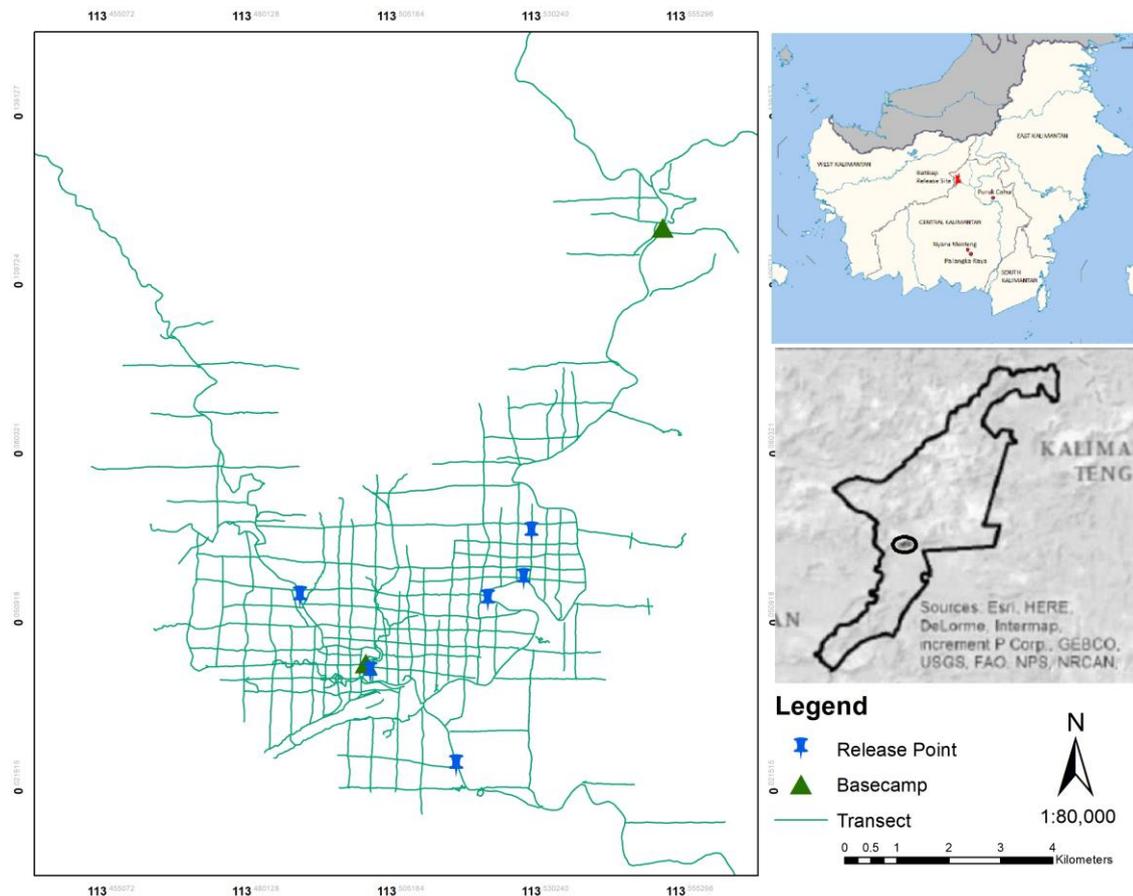


Figure 1. Map location in Bukit Batikap Conservation Forest, Central Kalimantan, Indonesia

Table 1. Data of orangutan reintroduction in Bukit Batikap Conservation Forest, Central Kalimantan, Indonesia

Name of individual	Sex	History	Age		Rehabilitation			Days followed (N-N)	Observation times-N (h:m)
			Intake	Released	Cages	Forest school	Pre-release (Island)		
Semi-wild									
Astrid	F	R	± 9	14	Y	Y	N	50(24)	313.7
Monic	F	R	4,5-5	8	Y	Y	N	57(25)	430.4
Ika	F	R	4-4,5	10	Y	Y	N	43(10)	281
Ebol	F	R	± 2	8	Y	Y	N	59(17)	418.1
Tarzan	M	R	18	25	Y	Y	N	55(18)	339.9
Heldy	M	R	4-4,5	9	Y	Y	N	33(9)	222.7
Jojo	M	R	4-4,5	8	Y	Y	N	10(3)	46.2
Edwan	M	R	4-4,5	9	Y	Y	N	21(3)	124.9
Ex-rehabilitate									
Emen	F	C	4-4,5	17	Y	Y	Y	42(3)	252.5
Gadis	F	C	2,5-3	15	Y	Y	Y	31(4)	186.7
Leonora	F	C	3-3,5	16	Y	Y	Y	36(5)	224.9
Manggo	F	C	0	7	N	N	Y	22(3)	119.5
Markisa	F	C	4-4,5	17	Y	Y	Y	27(3)	161.1
Mita	F	C	3,5-4	17	Y	Y	Y	11(3)	45.9
Danur	M	C	4-4,5	17	Y	Y	Y	25(4)	128
Mogok	M	C	2-2,5	13	Y	Y	Y	14(2)	63.8

Note: N-N: Nest to Nest; N: Total; h:m: hours: minutes; F: Female; M: Male; R: Rescue; C: Confiscation; Y: Yes; N: No

Object of the study

The study focused on 16 reintroduced Bornean orangutans (*Pongo pygmaeus wurmbii*): 8 semi-wilds (4 males and 4 females) and 8 ex-rehabilitates (2 males and 6 females), age ranged between 8 to 25 years, following a time of the semi-wild orangutans was 328 days (NN: 107 and 221 non NN days); 2176.9 hours and 200 days for the ex-rehabilitate (N-N: 26); 1182.4 hours (Table 1). Different of reintroduced orangutan: semi-wild orangutans are those how at the time of rescue have previously encountered humans yet have retained sufficient nature behaviors and vital skills to survive alone in the wild, ex-rehabilitate orangutans are those individuals rescue at a young age and/or confiscated from people who have kept them in captivity. Similarly, confiscated immature orangutans were usually born in the wild and forcibly separated from their mothers during infancy, which can influence the expertise of handling forest problems. Thus must go through an intensive rehabilitation process (forest school and pre-release stage on the island) which can take up to 7 years on average (Nayasilana et al. 2017). A lengthy process of rehabilitation starting from quarantine, rehabilitation process (forest school and/or pre-release) and comprehensive health screening prior to release. In general, all orangutans (rescue and confiscated) will be brought to quarantine of the rehabilitation center and given full medical check-up on arrival, then later on will go the rehabilitate process one of them is having a forest school, after forest school before release to semi-wild they when back to cages and ex-rehabilitate they go to the island (pre-release). All orangutans had stayed at the rehabilitation center for a variable amount of time and skill development (nesting behavior).

The reintroduced orangutan in Bukit Batikap, Conservation forest was implanted with a radio transmitter that emits a unique individual radio signal which can be

detected through a handheld radio tracking device, active period of transmitter 3-5 years, 70-100% found the individual with greater ease, and 400 m for the distance between radio transmitter with an individual (Nayasilana et al. 2017). The use of transmitters on orangutans is easy in orangutan monitoring activity, especially to follow orangutan. Once a focal individual was located, the individual was followed for the entire day until they built their night nest or/until the individual was lost. Data were recorded using a standardized set of orangutan data collection protocol methods (<http://www.aim.uzh.ch/de/research/orangutannetwork/sfm.html>) with instantaneous focal animal sampling (once every 5 minutes) to record general behavior (Altman 1974). All data collected followed pre-established standards (Morrogh-Bernard and Harisson 2007; van Schaik and van Noordwijk 2003) which activities included nest creation time (start and end), type of nest (day/night; new, rebuilt or reuse), nest tree species, and nest height. GPS position and nest diameter (dbh) were also recorded during each follow. Were the GPS point taken at every nest location (built, rebuilt or reuse).

Data analysis

Statistical analyses were conducted using the program IBM SPSS v20. to test nest behaviors, we used both Mann-Whitney and Kruskal-Wallis to the overall difference in the number of day nest to night nests and between the semi-wild and ex-rehabilitate orangutan, to ascertain time to build a nest and also the number of new, rebuilt and reused nests. Canonical Correspondence Analysis (CCA) was used to determine the relationship between nesting behavior with individuals and nesting tree species. All GPS data points were transferred to ArcMap GIS 10.3 to establish the distribution of nest trees across the research location.

RESULTS AND DISCUSSION

Orangutans perform nesting behaviors on both day and night time. Recognition of nesting tree species and the use of tree height influences the reintroduced orangutans' adaptation process. During the adaptation, not all individuals can build a perfect nest every day. They will choose nests selectively until it is built perfectly with the nest tree, height and nest position, and species of tree. Reintroduced orangutans at Bukit Batikap Conservation Forest prefer nesting behavior at night compared to in the daytime (Figure 2). This research recorded nesting behavior intensity for each individual, such as Jojo (semi-wild orangutan) which prefers to spend his midday break with other activities instead of building a nest, compared to Ika, Ebol dan Tarzan (semi-wild) which prefer to build day nest instead. This is also the case for Emen, Gadis, Manggo, Markisa, Mita, Danur dan Mogok (ex-rehabilitate) which also prefer to make day nest. In general, reintroduced orangutans maximize their daytime activity by reducing their day nest behavior, and this adaptation is done while they are reintroduced to a natural habitat.

There is no difference in the number of day and night nests built between the 16 orangutans ($H=15$; $P\text{-value}=0.451$) but there is between semi-wild and ex-rehabilitates ($Z=-1.946$ with $P\text{-value}=0.026$). Ex-rehabilitate orangutans were observed to have a higher day

nest use pattern, compared to semi-wild orangutans, while the semi-wild orangutans had a higher night nest use. Semi-wild orangutans prefer to maximize their time for other activities besides nesting, by resting without a nest (Figure 2). Nest building behavior is influenced by some factors, such as choosing nesting locations, e.g. species of tree, nest position or height trees. In general, semi-wild orangutans choose their nesting locations, while ex-rehabilitate orangutans did not pay attention to their surroundings.

Reintroduced orangutans need 1-17 minutes to build a nest, with 6.5 minutes average for semi-wild and 5.1 minutes average for ex-rehabilitates. The time it takes to build a complete nest may be affected by the adaptation process, comfort, and shape of the nest. Longer nest-building time means the adaptation process and development of thinking patterns to build a comfortable nest is working in each individual in their new habitat. This is evidenced in the semi-wilds which consider comfort factors in nest building (such as position, nest height, or nest tree choice) as opposed to the ex-rehabilitates. Reintroduced orangutans also chose certain times of the day to build both day and night nests (Figure 4). A similar pattern in nest building time can be observed in semi-wilds and ex-rehabilitates. During the day, reintroduced orangutans built their nests before noon (12 am) and between 3-4 pm, while night nests are built at 3-5 pm (Figure 3).

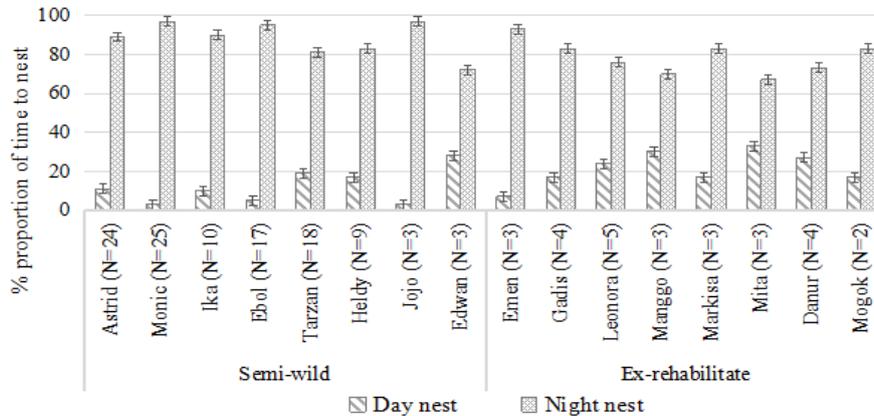


Figure 2. Nesting behaviors time on reintroduction orangutans

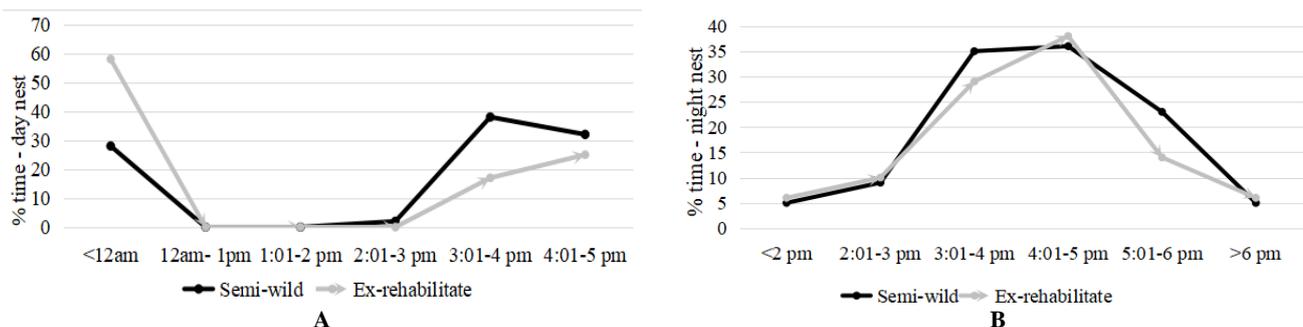


Figure 3. Nest behavior during the day (A); Nest behavior during the night (B)

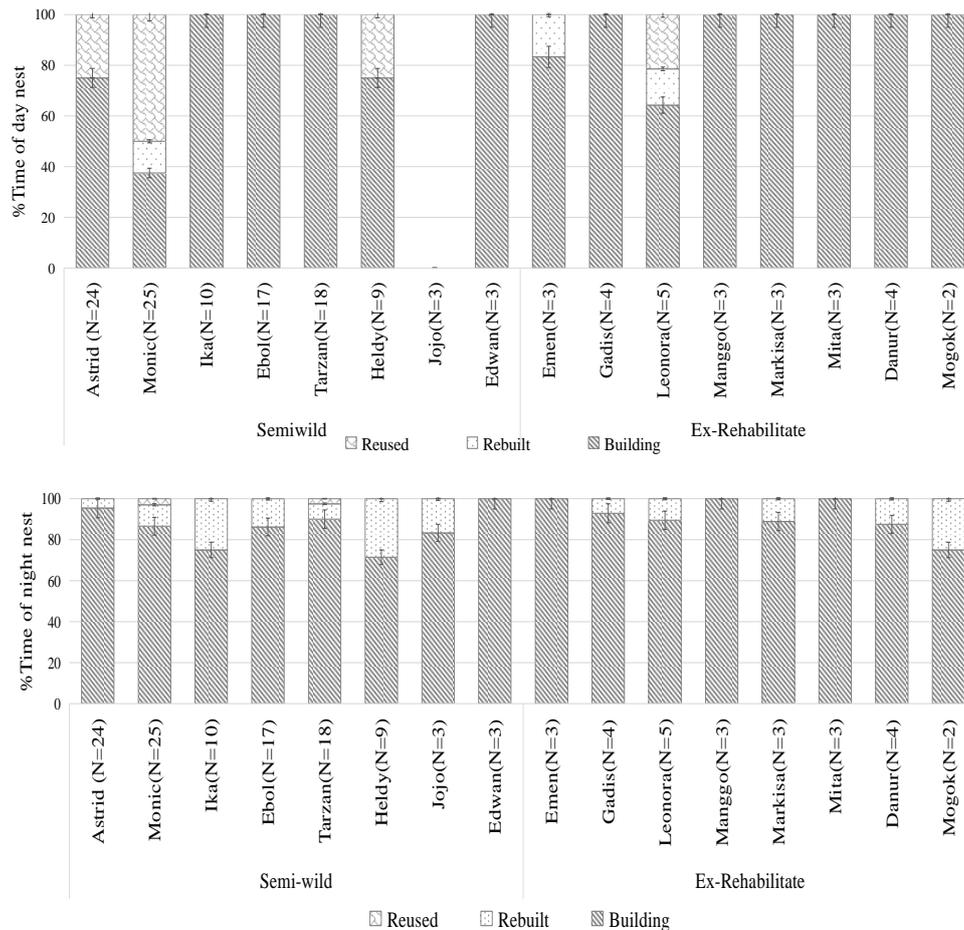


Figure 4. Reintroduced orangutans' day (*above*) and night (*below*) nest behavior in Bukit Batikap Conservation Forest, Indonesia

Results show that during nest behavior, each individual will choose and use various kinds of the nest, such as new, repaired old nest, or reused old nest (Figure 4). All individuals are recorded using a new nest: Ika, Ebol, Tarzan and Edwan (semi-wilds) as well as Gadis, Manggo, Markisa, Mita, Danur, and Mogok (ex-rehabilitates). Kruskal-Wallis analysis for day nest type between each semi-wild and ex-rehabilitate individuals show a significant value (p -value=0.451), further analysis is conducted in each group (semi-wild and ex-rehabilitate) with new nest p -value=0.113, repaired nest p -value= 0.225 and reused old nest p -value=0.945. For orangutans, night nests are a need, thus the main priority before finishing its daily activity to rest. In general, night nests are newly built every night. However, there are cases of reusing old nest (Galdikas 1986). The nest's main purposes are for resting and protecting itself (Matsuzawa 2001). Reintroduced orangutans in Bukit Batikap most commonly built new nests for their night nest. Nest building skill is performed by every individual before their night activity. Mann-Whitney test between semi-wilds and ex-rehabilitates shows a significant value on built (p -value=0.084), rebuilt (p -value=0.1445) and reuse (p -value=0.0715). Kruskal-Wallis test on each individuals' nest type usage shows a significant value (p -value=0.451). Night nest type usage is

shown in Figure 4. Building a new nest has a 70-100% occurrence rate, while the rebuilt nest has a range of 0-29%, and 0-3% range for reusing old nest. Manggo, Edwan, Gadis, Tarzan, Markisa, Danur, Ebol.

Canonical Correspondent Analysis (CCA) describes each orangutan in their choice in tree species and height when building day and night nests. Straight-line in CCA analysis is shown by individual Ika, which means Ika chose trees of *Syzygium* sp., *Lithocarpus* sp. and *Xanthophyllum* sp. with heights of 26-30m as her day nest tree. The analysis also shows that *Syzygium* sp. as the tree most favored by every individual. Besides as a nest tree, *Syzygium* sp. may also be used as the last feeding tree. This is as opposed to Astrid dan Monic which chose their nest tree from *Shorea* sp. and *Sterculia* spp. with heights between 21-25m. Individual Heldy also chose nest trees higher than 30m regardless of tree species. *Ficus* sp. remains as a favorite tree to build a nest on, as the fruit can be consumed, the height also gave comfort while nesting, especially during the day. Similar research was done on Ketambe research station, Sumatra. Orangutans like to build their day nests on *Ficus* sp. when the tree is their last feeding tree before resting (private data).

This research also shows that Ebol and Mogok did not choose tree species or height for their nest tree. Mita

prefers trees with heights of 11-15m, as well as other semi-wilds that chose nest trees with heights of 11-15m, followed by heights of 16-20m and 21-25m. This is compared to ex-rehabilitate orangutans which in general chose trees with heights of 11-15m, followed by 16-20m and 6-10m. Day nest tree choice in reintroduced orangutans are dominated by *Syzygium* sp., *Mallotus* sp., *Sterculia* spp., *Xanthophyllum* sp., *Lithocarpus* sp., *Planchonia* sp., *Shorea* sp., *Dracontomelon* sp., *Diospyros* sp., and *Beilschmiedia* sp. (Figure 5)

Orangutans chose trees with heights of 11-15m, followed by 16-20m up to >30m for their night nest tree. Trees with heights of >30 m are usually utilized by semi-wild females and subadult males (Astrid, Monic, Ika, Ebol, Jojo) as well as ex-rehabilitate females (Emen and Leonora). In general, reintroduced orangutans chose *Dracontomelon* sp., *Elaeocarpus* sp., *Sapindaceae* sp., dan *Baccaurea* sp., followed by *Sterculia* spp., *Xanthophyllum*

sp., *Ficus* sp., *Artocarpus* sp., *Canarium* sp., *Diospyros* sp., *Eusydroxillan* sp., *Shorea* spp., dan *Syzygium* sp as their nest tree choice. *Dillenia* sp., *Horsfieldia* sp. and *Lithocarpus* sp. were trees rarely used by reintroduced orangutans (Figure 5).

CCA in Figure 5. shows that the total *inertia* for the day nests value as 1.416. The first axis (species) explains 69.4% of the total variance. The first and second axes explain 82% of the total *inertia*, indicated a high correlation between species and environment. CCA shows a value of total *inertia* 0.619 for tree usage for the night nest. The first axis (species) explained 63.1% of the total variance, while the first and second axes explain 80% of the total *inertia*, indicating a correlation between species and environment. Each individual chose the nest tree based on their characteristics. Besides tree species, semi-wild and ex-rehabilitate orangutans are also selective in choosing their nest position.

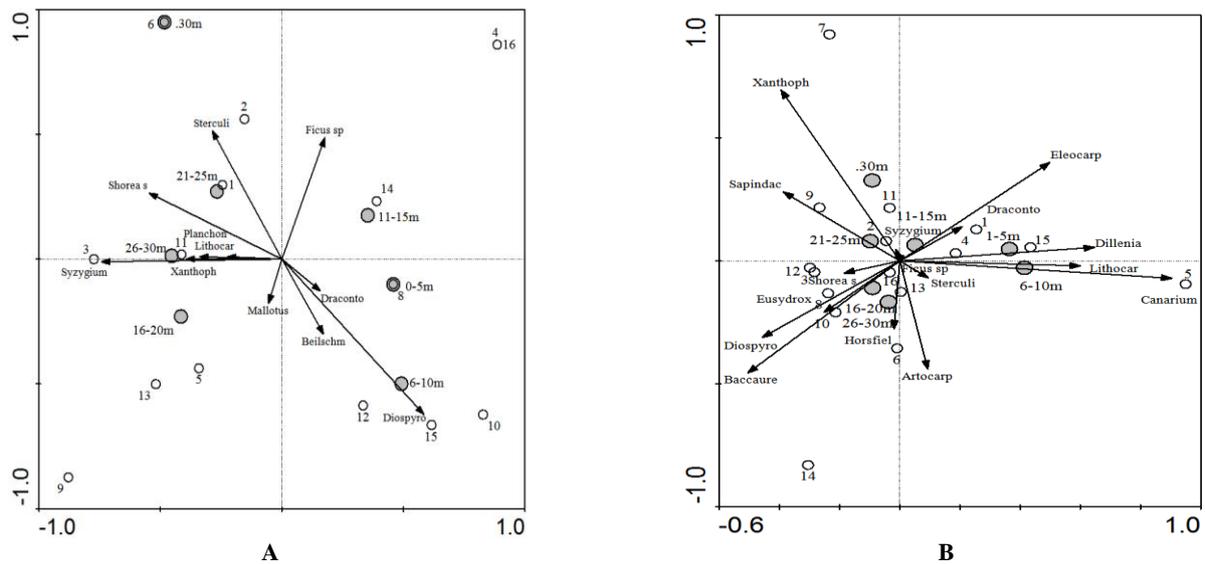


Figure 5. A. CCA between vegetation and orangutan presence based on nest tree (for day nest). B. CCA for night nest

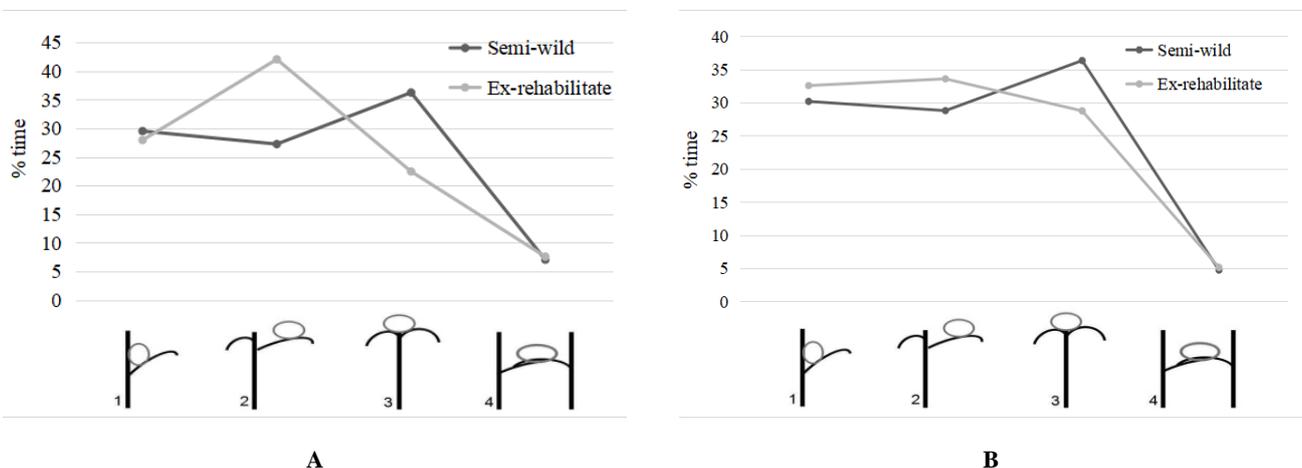


Figure 6. A. Reintroduced orangutans day nest position; B. Reintroduced orangutans night nest position

Before building their nests, reintroduced orangutans decide the nest position on the tree. Nest position gives a certain comfort to the reintroduced orangutans in Bukit Batikap Conservation Forest, Central Kalimantan. Semi-wild orangutans prefer position 2 (on the branch) and ex-rehabilitate prefer position 3 (on top of the tree) when building the day nest. However, for the night nest, it is the other way around, with position 3 (on top of the tree) for the semi-wilds and position 2 (on the branch) for the ex-rehabilitates (Figure 6). Tree species and nest position influences nest deterioration rate. Nests in the central position have a lower deterioration rate compared to nests on top which is exposed to direct sunlight (Yeager 1999).

However, reintroduced orangutans tend to choose position 3 (top).

Based on the monitoring, reintroduced orangutans nest tree distribution patterns can be mapped with ArcMap GIS analysis (Figure 7.A). Research results from the year 2012-2014, orangutan nest presence are concentrated around the camp area and release point. This indicates that the first year after reintroduction is when the orangutan still adapting to their new habitat. Camp presence is a favorite location for reintroduced orangutans during this research, and orangutans will use both new nests and rebuild or reuse old nests near human or camp presence and getting further in the following years (Figure 7.B).

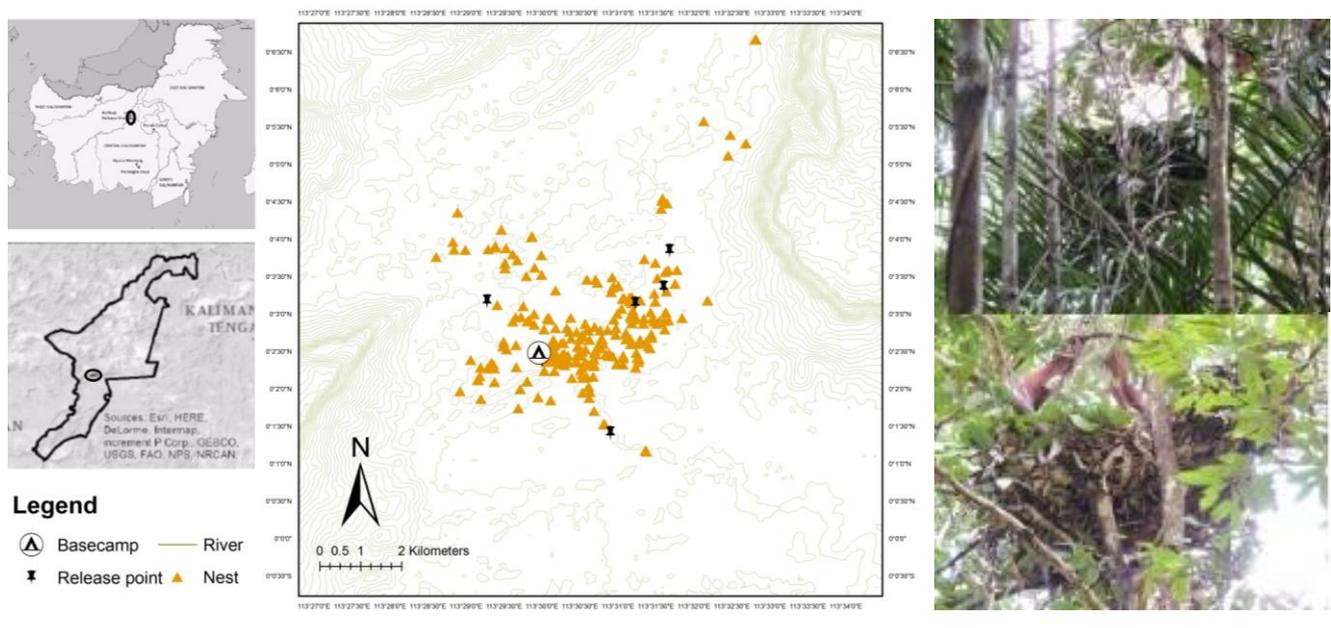


Figure 7. Reintroduced orangutan nest distribution map (A) and examples of a new nest (top) and a rebuilt old nest (bottom) (B)

Table 2. Comparatino of nest trees between reintroduced orangutans in Bukit Batikap Conservation Forest, with wild orangutans in Stasiun Penelitian Tuanan and Sebangau NP, Central Kalimantan, Indonesia (Prasetyo et al. 2009)

Spesies	Bukit Batikap Conservation Forest	Tuanan Research Station	Sebangau National Park
Day nest	<i>Mallotus</i> sp. <i>Ficus</i> spp. <i>Syzygium</i> sp. <i>Diospyros</i> sp.	<i>Palaquium</i> sp. <i>Neoscortechinia kingii</i> <i>Diospyros</i> sp. <i>Elaeocarpus mastersii</i>	<i>Camposperma coriaceum</i> <i>Neoscortechinia kingii</i> <i>Xylopia fusca</i> <i>Mezzetia leptopoda parviflora</i>
Night nest	<i>Baccaurea</i> sp. Sapindaceae <i>Elaeocarpus</i> sp. <i>Dracontomelon</i> sp.	<i>Elaeocarpus mastersii</i> <i>Litsea</i> sp. <i>Tetractomia tetranda</i> <i>Camposperma coriaceum</i>	<i>Camposperma coriaceum</i> <i>Litsea</i> sp. <i>Cratoxylon</i> sp. <i>Xylopia fusca</i>

Nest type similarities between reintroduced orangutans in Bukit Batikap Conservation Forest and other research locations (Stasiun Penelitian Tuanan dan Sabangau NP.) are shown in Table 2. One example is the similar choice of *Diospyros* sp. trees for day nest and *Elaeocarpus* sp. for night nests. Favored nest tree species were *Ficus* spp., *Syzygium* sp., *Baccaurea* sp., dan *Sapindaceae* sp. Those trees (*Ficus* sp., *Syzygium* sp., *Baccaurea* sp., dan *Sapindaceae* sp.) are one of the main food sources for orangutans. When reintroduced orangutans utilized food trees, indirectly they will use it as day nest trees as well. Orangutan individuals prefer to utilized trees as maximum and effective as possible (a food source and nest location) during their daytime activity. However, those conditions differ from night nesting behavior. Individuals chose night nests with a certain level of comfort and avoid food trees as nest trees. According to van Schaik (2006), orangutans prefer strong trees with numerous branches with soft medium-sized leaves, as well as avoiding fruiting trees that attract predators. From monitoring, it is also known that individuals prefer to dominate one species of a tree when doing feeding and nesting activity (especially males with males, or females with females without tolerance or blood relation).

Nesting behavior is performed by each orangutan. Reintroduced orangutans in Bukit Batikap Conservation Forest will remember the nesting behavior (day and night nest) similar to the skill reminded and performed in the rehabilitation center. Rehabilitation center as the place to gather information and learning before the individual is ready to be reintroduced to its natural habitat. Semi-wild and ex-rehabilitate orangutans have different steps on their rehabilitation process, even though the adaptation process in the forest school will be experienced by every individual. Make nest is measuring for successfully adapting to natural habitat. Orangutan a make a nest to the protection and get comfort at rest (Prasetyo et al. 2009). The process of selecting a tree is a technique in obtaining comfort and protection (Prasetyo 2006).

In conclusion, reintroduced orangutans in Bukit Batikap Conservation Forest were able to remember their nesting behavior when reintroduced to the natural habitat. Nest building behavior on orangutans is a way to develop a forest regeneration pattern by allowing sunlight to reach the forest floor. Nesting patterns were reminded of reintroduced orangutans in the rehabilitation center. An opposing pattern was observed on day and night nest behavior between semi-wild and ex-rehabilitate orangutans. Reintroduced orangutans observe the time of the day; tree species choices, height, and position when building both day and night nest. Tree nest distribution appears to be around the camp and the release site up to the first year after release. Reintroduced orangutans still adapt in their new habitat and now those are difficult to monitor.

ACKNOWLEDGEMENTS

We thank the Ministry of forestry – BKSDA Central Kalimantan and Governor of Central Kalimantan,

especially local government (Bupati MURA and Dishut). We thank the BOS Foundation, Nyaru Menteng Orangutan Reintroduction Program in Central Kalimantan. We thank the ARCUS Foundation and UNAS Primate Research Center for providing financial support for this study and collaboration with Universitas Nasional, Jakarta. PERHAPPI, Symposium and Congress of Indonesian Primate 2019 in Yogyakarta for sponsoring. We thank Jamartin Sihite, Jacqueline S. Groves, Simon Husson, Anton Nurcahyo, Denny Kurniawan, May Sumarmae, Ulfa Hanani, Purnomo and all local assistance for their help in the field, and Christian Nicholas Pranoto and communication advice.

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