

# Nest characteristics and populations of Tapanuli orangutans in Batangtoru Landscape, South Tapanuli District, Indonesia

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**Abstract.** Kuswanda W, Harahap RH, Alikodra JS, Sibarani R. 2020. Nest characteristics and populations of Tapanuli orangutans in Batangtoru Landscape, South Tapanuli District, Indonesia. *Biodiversitas* 21: 3398-3406. Tapanuli orangutan (*Pongo tapanuliensis*) has been threatened to extinction due to conflicts with humans. Information on the orangutan characteristics in conflict areas at the Batangtoru Landscape is needed. Our research aimed to analyze the characteristics of nests, nest trees, and estimation of orangutan populations in conservation forests and buffer zones to develop conflict mitigation strategies in the Batangtoru Landscape, South Tapanuli District. A line transect method was used to count orangutan nests on 49 transects, starting from June 2019 to January 2020. Data were analyzed with descriptive statistics, frequency tables, Spearman correlation ( $\rho$ ), and the equation by (van Schaick et al. 1995). Tapanuli orangutans make nests at the height of 14.01 meters (90% CI = 13.37-14.67 meters), and most use the main stem as nest support. Tree nests of 35 species (17 families) were identified, with the highest frequency in (*Durio zibethinus* Murray), especially in the buffer zone. Correlation between nest tree diameter, tree height, and canopy area was significant ( $p < 0.01$ ,  $n = 83$ ). The estimated orangutan populations in conflict areas were 155 individuals (95% CI = 121-187), and the highest was found in Dolok Sibualbuali Nature Reserve buffer zones. Mitigation strategy of human-orangutan conflict that needs to be realized is the non-cash compensation guaranteeing the community does not disturb orangutans on their land. The compensation forms can be the provision of seedlings and fertilizer for plants, agricultural machinery, knowledge to land management, and orangutan ecotourism development. Nest and feed trees enrichment can be carried out in production forests bordering with conservation area.

**Keywords:** Batangtoru, conflict, nest, population, Tapanuli orangutan

## INTRODUCTION

Forest status in Indonesia is divided into production, protection, and conservation forests. The conservation forest has certain characteristics, such as preserving the plants' and animals' diversity and their ecosystems. The surrounding area has been designated as a buffer zone by the Indonesian Government. It is an area outside the conservation forest, either as another forest area, community lands, or the other use areas (Ministry of Forestry 1999). The buffer zone designation provides additional protection and optimizes economic resources to support the living standard improvement of local communities (Ahmad et al. 2016; Schou et al. 2019). Habitat of Tapanuli orangutans (*Pongo tapanuliensis*) has spread in conservation forests and buffer zones, including in the South Tapanuli District (Djojoasmoro et al. 2004; Kuswanda 2014; Wich et al. 2014). The Ministry of Environment and Forestry (2019) designs Tapanuli orangutans (*Pongo tapanuliensis*) as a new species different from *Pongo abelii* Lesson and *Pongo pygmaeus* Linnaeus. Tapanuli orangutans have different DNA clusters with other Sumatran orangutans and are closer to Kalimantan orangutans (Nater et al. 2017). The International Union for Conservation of Nature's/IUCN

Red List has categorized Tapanuli orangutans as critically endangered animals (IUCN 2019).

Orangutans were threatened to extinction due to fragmentation and poaching difficult to stop (Wich et al. 2016; Meijaard, 2018) and hunted for illegal trading and making pets (Wich et al. 2014). Their population will decline if there is no serious conservation effort (Kuswanda 2014). Tapanuli orangutan was estimated remaining 577-760 individuals and only found in the Batangtoru Landscape (Ministry of Environment and Forestry 2019; Wich et al. 2016). Batangtoru landscaped administratively covers three regencies, namely are North, Central, and South Tapanuli. The forest is estimated around 140,535 ha, which includes protected forests (51.5%), nature reserves (6.2%), production forests (5.3%), the other use areas (36.8%), and water area of 0.2% (Haryanto et al. 2019).

Tapanuli communities use Batangtoru Landscape as agricultural land and settlement. People's growth causes expanding land clearing and increasing harvesting forest products, such as rattan, latex, and fruit (Kuswanda 2014). Human and orangutan conflicts cannot be avoided because people come to forest, while orangutans damage and consume plants, such as durian (*Durio zibethinus* Murray), petai (*Parkia speciosa* Hassk), and sugar palm (*Arenga*

*pinnata* Merr) (Atmoko, 2014; Kuswanda 2014). Orangutans were considered to be pests, and thus hunted by humans (Hockings and Humel 2010; Davis et al. 2013; Soulsbury and White 2015). In some villages at the Batangtoru Landscape, orangutans entering community fields were driven out and killed due to conflicts with humans (Wich et al. 2014; Nater et al. 2017).

In mitigating human-orangutan conflicts, the characteristics of populations are essential to identify as a basis for developing mitigation action plans and their conservation strategies (Hockings and Humel 2010; Alikodra 2019). Information on the Tapanuli orangutan characteristics is limited because previous research focused on Aceh Province (Kuswanda 2014). Research results based on sites or forest status are limited, such as the research results from (Djojoasmoro et al. 2004; Simorangkir 2009; Nasution et al. 2018). Information on the characteristics of orangutans, especially in conflict areas, must be reviewed, so there is a reference to develop a more comprehensive conflict mitigation policy. This study aimed to analyze the characteristics of nests, nest trees, and orangutan populations in conservation forests and buffer zones. The research results are expected to be used as policy material for mitigating human-orangutan conflicts in the Batangtoru Landscape, South Tapanuli District, North Sumatra Province, Indonesia.

## MATERIALS AND METHODS

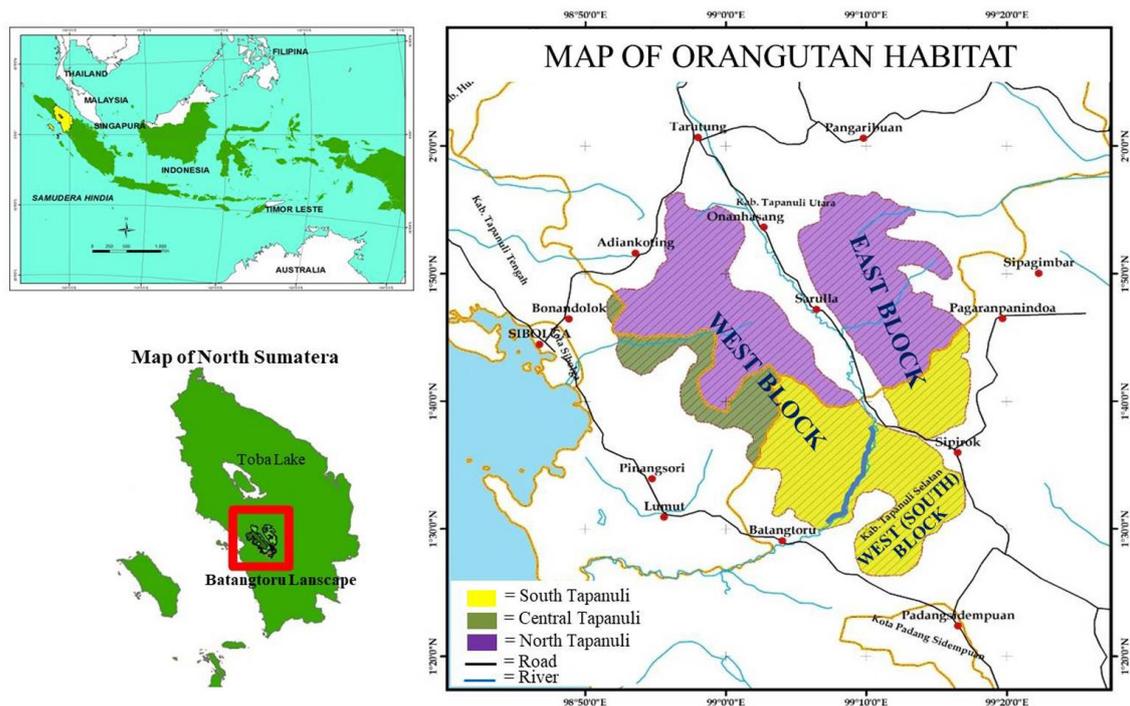
### Study area

The Batangtoru landscape covering an area of 249,169 ha is not entirely as orangutan habitat. Orangutans are only found in small locations of fragmented forests (Nater et al.

2017; Wich et al. 2016; Kuswanda 2014; Simorangkir 2009). The remaining orangutan areas are 138,435 ha and 50,523 ha, including South Tapanuli District (Figure 1). We divide those areas into three blocks, namely the West Block (21,331 ha), the West (South) Block (20,267 ha), and the Eastern Block (8,925 ha), separated by roads, Batangtoru river, gardens, and settlements. The research site was focused on the West (South) Block and the Eastern Block because human-orangutan conflicts have been found at those locations (Kuswanda 2014; Wich et al. 2016; Nater et al. 2017). We reclassified each block in the conservation forests (nature reserves/NR) and the buffer zones (production forests and other areas). We conducted research for eight months, from June 2019 to January 2020.

### Procedures

The nests were observed using the line transect method refers to (van Schaick et al. 1995; Ancrenaz et al. 2004; Kuswanda 2013). Transects are made systematic with random starting points, distances between 1,000 m (east-west), and 1,500-2,000 m (north-south) to represent the research area. We used a sampling intensity of 7-8% for nest observation (Fowler et al. 1998), so the study area reached 245 ha. The length of the transect was made at 500 meters, with a total of 49 transects. Based on the proportional area, the distribution of transects was as follows: 17 transects were in East Block (Dolak Sipirok NR = 9 and buffer zone = 8), and 32 transects were in the West (South) (Dolak Sibual-buali NR=9 and buffer zone =23), as demonstrated in Figure 2. The recorded data of nest characteristics were the height, position, and class of the nests. We also observed characteristics of nest tree, i.e. the species, height, diameter, canopy cover, and the distance of the nest trees from the transect.



**Figure 1.** Distribution of orangutan habitat in the Batangtoru Landscape, North Sumatra, Indonesia

**Data analysis**

We analyzed the characteristics of the nests and the nest trees using a frequency table described in the histogram and non-parametric Spearman rank ( $\rho$ ). The position and nest class classifications referred to (van Schaik et al. 1995; Anrenaz et al. 2004). The position of the nest was grouped as follows: 1) the nest attached to the main branch or tree stem, 2) the nest on a branch that does not use the main stem as nest support, 3) the nest at the top of the canopy, or at the end of the branching, 4) the nest located in more than one tree, at a meeting point of two branches or the treetops. The class nest criteria are class A: fresh, new nest, having green leaves; class B: older, the leaves may still be attached, the original shape is conserved, and no holes visible in the nest; class C: old, most leaves remove, and the holes are visible in the nest; class D: very old, the leaves are removed, and the holes are found in the nest, and class E: twigs and branches are still present but no longer in the nest original shape.

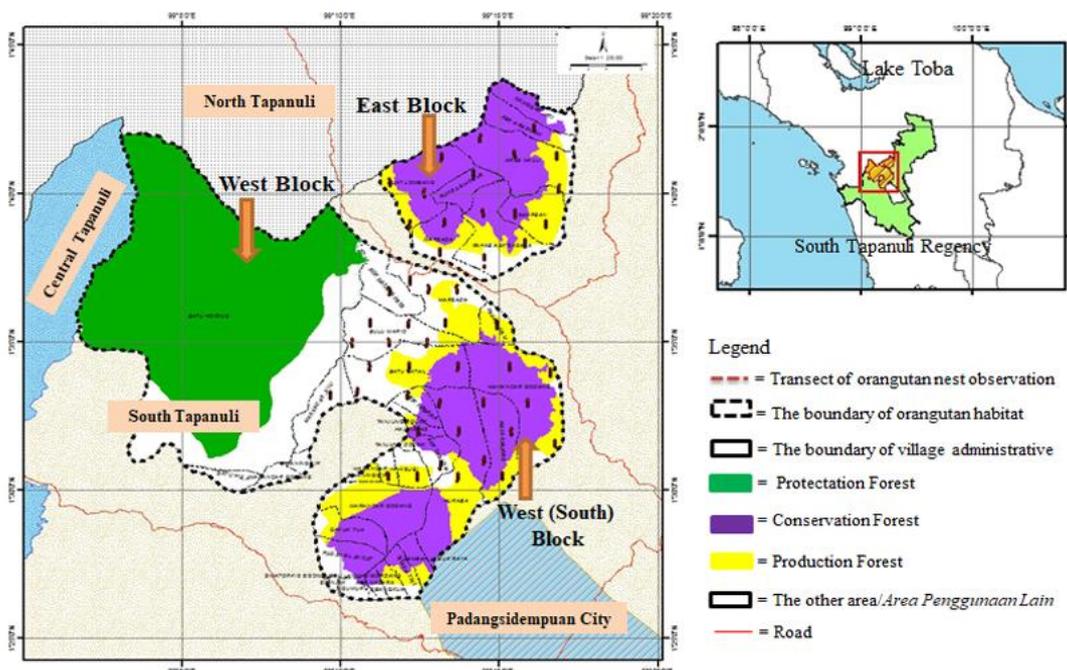
Orangutan densities could be estimated using the following equation of van Schaik et al. (1995):  $D_j = N / (L \times 2 \times w \times p \times r \times t)$ , where  $D_j$  = orangutan density (individuals/km<sup>2</sup>); N = number of nests observed in each transect; L = length of the transect covered (km); w = estimated width of the strip of transect; p = proportion of nest builders in the population; r = rate at which nests are produced (n/day/individual); and t = decay rate of nests or time during which a nest remains visible (in days). We estimated average density using the equation,  $D_k = \sum D_j /$

$n_j$ , where  $n_j$  = the number of transect at each block, with a confidence interval (CI) at the 95% level (Kuswanda 2014). Parameter estimation used for r-value is 1.5 nests/day per individual, which is the average of 1.7 (Rijksen 1978; Buij et al. 2003) and 1.2 (Wich et al. 2016). The t-value, according to (van Schaick 1995), is 170 days, (Kuswanda 2014) is 195.5 days, and (Wich et al. 2016) is 501.5 days, so we used the t-value as an average value of 289 days. The t value could be different because of the type and forest structure, wood species, temperature, humidity, and wind speed. The p-value refers to (van Schaik et al. 1995; Buij et al. 2003) is 90% or 0.9. The average path width transect (w) was analyzed with Software Distance 6.2 (Thomas et al. 2010).

**RESULTS AND DISCUSSION**

**Characteristics of the nest**

The nest is intentionally or not built to be used as breeding, as a place for rest or sleep (Alikodra 2019). Orangutans make nests every day (Rijksen 1978; Singleton and van Schaik 2001). They use nest material from tree branches at nesting sites and create a nest at least 1-2 times each day (Meijard et al. 2001). Observation results on 49 transects had identified at least 83 nests. The percentage of the nest position is presented in Figure 3.



**Figure 2.** Map of the distribution path of orangutan nests in the conflict area

The nest positions most favored by orangutans are position 1 (56.6%) and position 2 (21.7%). These results reinforce that the Tapanuli orangutans have a level of preference in making nests in positions 1 and 2. (Pujiani 2009; Kuswanda 2014; Nasution et al. 2018) showed that Tapanuli orangutans often make nests in both positions. Nevertheless, Simorangkir (2009) stated that the position favored by orangutans is position 3. The least found position is position 4. The highest percentage of nest classes was analyzed in class C (47.0%) and class B (24.1%). The results of previous studies, such as conducted by (Djoasmoro et al. 2004; Kuswanda 2014; Nasution et al. 2018), indicated that the nests found in the Batangtoru forest were old, including the C and D classes. We have found that new nest classes (A and B classes) were higher because orangutans often stay with buffer zones during the durian season, such as around the Dolok Sibual-buali NR. In the research transect, new nests were found; this case indicated that orangutan was around the site in 1-3 days before.

We also observed the nest height, which is the vertical interval of the nest from the land to the nest position, as shown in Figure 4.

The nest height in conservation areas is lower than that in the buffer zones. The average is 14.01 meters (95% CI = 13.24-14.77, n=83), with intervals of 7.5-22.7 m. The highest average was found in the Dolok Sibual-buali buffer zone, namely 14.4 m. People often visit the buffer zone, especially processed land. The orangutans then create a higher nest to monitor the presence of predators more easily.

### Characteristics of nest trees

The trees used by orangutans to make nests are quite varied. Orangutans will choose strong and comfortable trees to nest around foraging sites (Prasetyo et al. 2009; Kuswanda 2014). The nest trees were identified in 49 transects, as shown in Figure 5.

We identified 35 nest tree species, included in 17 families. The most chosen nest tree species are the Family of Lauraceae, Fagaceae, and Dipterocarpaceae. The trees most often used to build nests are 15 nests of durian (*Durio*

*zibethinus* Murray), five nests of hayun dolok (*Syzygium* sp.), and five nests of lacat bodat (*Shorea hopeifolia* (Heim) Symington). Based on the Spearman rank ( $\rho$ ), there was a significant relationship between tree species and the number of nests in each family ( $\rho = 0.524$ ,  $p < 0.05$ ,  $n=83$ ).

The average diameter of the nest trees in the East and West (South) Blocks was not significant. That average was 26.20 cm (95% CI = 23.62-28.77,  $n = 83$ ), with the tree being used as a nest was around 12.1-85.3 cm. Orangutans would tend to develop nests with a diameter between 18-31 cm. The average height of the tree nest in Batangtoru Forest, South Tapanuli was 18.50 m (95% CI = 17.69-19.32,  $n = 83$ ). We analyzed that the height of the nest trees in the East Block was lower than that in the West (South) Block. Orangutans selected the nest trees with a height between 8.90-27.40 m. Tapanuli orangutans preferred area of the nest tree canopy between 19.63-157.17 m<sup>2</sup>, with an average of 66.57 m<sup>2</sup> (95% CI = 59.42-73.72,  $n = 83$ ). The Dolok Sibula-buali NR generally has a wide canopy cover, such as meranti (*Shorea lefrosula* Miq), and the other Dipterocarpaceae Families.

### Estimating orangutan density

The nest finding is a method for estimating orangutan populations in an area (Singleton and van Schaik 2001, Ancrenaz 2005; Johnson et al. 2005; Kuehl et al. 2008). The analysis results of the estimated population density based on nest refer to van Schaik et al. (1995), as presented in Table 2. The nest density in the East Block was 176.16 nests/km<sup>2</sup> (95% CI = 103.29-249.04,  $n = 28$ ), or the estimated true density was 0.44 ind./km<sup>2</sup> (95% CI = 0.26-0.63,  $n = 28$ ). We found that the nest and orangutan densities in the West Block were higher than those in the Eastern Block. The analysis results showed that the nest density was about 228.55 nests/km<sup>2</sup> (95% CI = 164.91-292.20,  $n = 55$ ), or the estimated true density was 0.57 ind./km<sup>2</sup> (95% CI = 0.41-0.73). In the buffer zone, orangutan density was 0.61 ind./km<sup>2</sup> higher than the nature reserve/NR (0.49 ind./km<sup>2</sup>). These results showed that the potential of human-orangutan conflicts is very high.

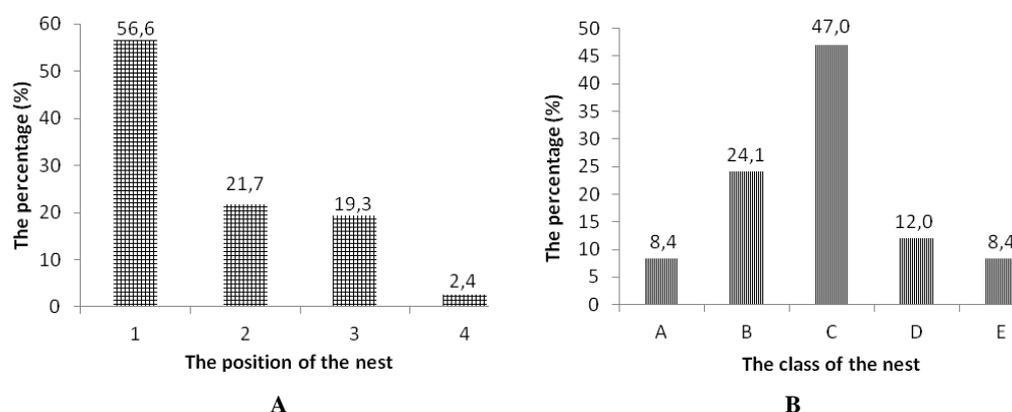


Figure 3. Percentage of orangutan nest position (A) and class (B)

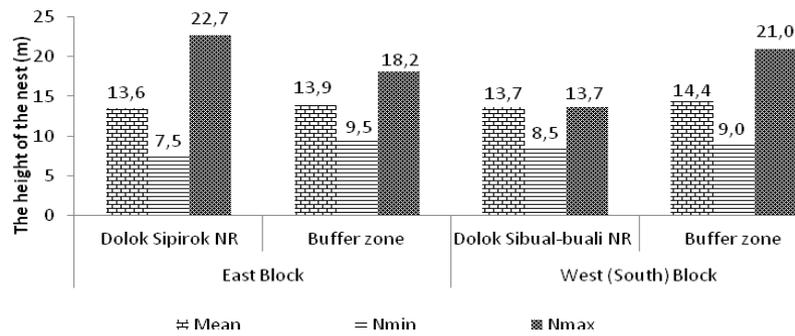


Figure 4. Percentage of orangutan nest height at the research site

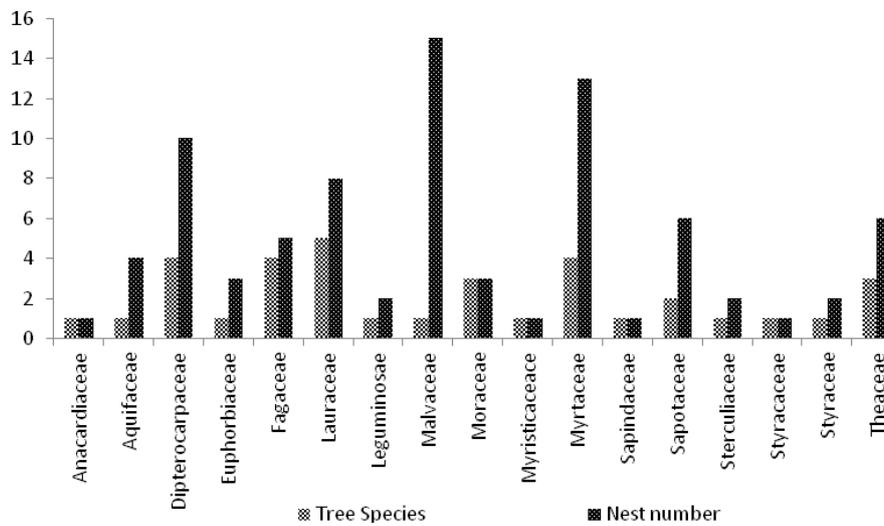


Figure 5. Tree family and the number of orangutan nests number

Table 1. Characteristics of the orangutan nest trees in conflict areas, South Tapanuli District, Indonesia

Block	Site	The no. of the nest (n)	The nest tree diameter (cm)			The nest height (m)			The canopy cover of the nest tree (m <sup>2</sup> )		
			Mean	N min	N max	Mean	N min	N max	Mean	N min	N max
East	Dolok Sapirook NR	19	23.2	14.6	32.5	17.8	8.9	25.3	47.68	19.63	129.62
	Buffer zone	9	21.4	14.0	35.6	18.2	11.8	23.7	50.76	22.05	96.72
	Total	28	22.6	14.0	35.6	17.9	8.9	25.3	48.67	19.63	129.62
West (South)	Dolok Sibual-buali NR	14	25.3	13.7	46.1	19.1	12.6	24.0	78.82	39.57	157.17
	Buffer zone	41	28.9	12.1	85.3	18.7	12.0	27.4	74.61	25.06	156.07
	Total	55	28.0	12.1	85.3	18.8	12.0	27.4	75.68	25.06	157.17

Note: NR: Natural Reserve, N: value, min: minimum, max: maximum

Table 2. Analysis results of the nest and the orangutan density

Block	Site	The no. of transects	The number of nests (n)	Estimated nest density (nest/km <sup>2</sup> )		The orangutan density (ind./km <sup>2</sup> )	
				Mean	95% CI	Mean	95% CI
East	Dolok Sapirook NR	9	19	216.44	99.11-333.78	0.54	0.25-0.84
	Buffer zone	8	9	130.85	28.86-232.84	0.33	0.07-0.59
	Total	17	28	176.16	103.29-249.04	0.44	0.26-0.63
West (South)	Dolok Sibual-buali NR	9	14	194.47	127.64-261.31	0.49	0.32-0.66
	Buffer zone	23	41	241.89	154.87-328.90	0.61	0.39-0.82
	Total	32	55	228.55	164.91-292.20	0.57	0.41-0.73
Total		49	83	210.38	162.76-258.00	0.53	0.41-0.65

Note: NR: Natural Reserve, CI: confidence interval

## Discussion

We found that the orangutans preferred positions 1 and 2. In both positions, the trees have relatively tight horizontal branches so that orangutans can easily build their nests, especially a nest bowl attached to the tree main stem (Gibson 2005). Position 1 is generally chosen by male or female adults that have a large size and weight (Kuswanda 2014). The election of the nest position was also used to monitor the surrounding area and protect themselves from predators and other disturbances at night (Prasetyo et al. 2009). Building a nest in the home range is to maintain and access food sources, thermoregulation, and protection from bad weather (Samson and Shumaker 2015; Davies et al. 2019). Building a nest done by orangutans indicates a behavior showing intelligence of great apes (Stewart and Pruetz 2013). Orangutan nests can still be seen long with different durations at each location. Orangutan nests will be destroyed and remaining only the branches for more than three months (Rijksen 1978; van Schaik et al. 1995). The nest durability nest depends on the construction technique, the weight and size of the orangutans, the location (low or high land), species and characteristics of the trees, the nest size, the weather and the presence of other animals that might damage the nests (Cheyne et al. 2013).

During observation, orangutans often visited buffer zones as the land managed by communities, especially in villages around CA. Dolok Sibual-bulai. As an indication, five nests (class A) and 12 nests (class B) were found. Orangutans often come to the community land during the durian season to look for food (Atmoko et al. 2010). We also identified two orangutans directly eating and making nests on durian trees in Aek Batang Paya Village. This situation would trigger human-orangutan conflicts because people saw their crops being destroyed by the orangutans.

Orangutans chose the nest height by preference, more influenced by the structure of the nest trees. They selected a specific nest height to obtain a clear direction around the forest, such as on the side and top of the tree canopy (Buij et al. 2003; Prasetyo et al. 2009). Orangutans generally make nests at high places from 10-17 m (Simorangkir 2009). The highest orangutan nests were identified in the api-api (*Gordonia excelsa* Blume) and the lowest ones were in the horsik (*Ilex pleiobrachiata* Loes). In the locations frequently visited by the community, such as around villages, roads, gardens, or agricultural land, orangutans tend to choose nest at a higher location than primary and secondary forests.

We also identified that orangutans chose only some species and families of the trees to make nests. Orangutans were selective in taking tree species for nesting (Ancrenaz et al. 2004), preferring dense branching trees (Prasetyo et al. 2009), which have straight stem and big diameters to maintain nets stability from the wind (Cheyne et al. 2013). The number of trees identified as orangutan nests in the Batangtoru area was 91 species of 27 families. The dominant families used are Fagaceae, Sapotaceae, and Dipterocarpaceae (Haryanto et al. 2019; Nasution et al. 2018; Simorangkir 2009). The Fagaceae and

Dipterocarpaceae families were selected as nests because they generally have area canopies and strong branches, that can support the bodies of orangutans. However, when species from the Fagaceae are bearing fruit, orangutans rarely use them as nests (Pujiyani 2009; van Schaik et al. 2006).

In this study, the Lauraceae has mostly used as a nest because of the species of the Fagaceae, such as the hoteng batu (*Lithocarpus maingayi* (Benth.) Rehder) and hoteng turi-turi (*Quercus lineata* Blume) had borne fruit. The species of the Lauraceae have soft branches and are easier to spell, thus speeding up nest building, such as the modang (*Litsea firma* (Bl.) Hook. Fil.) At the species level, durian is dominantly applied as a tree nest (15 nests). This case shows how they maintain the feed tree for not consumed by the other primates, such as macaque (*Macaca nemestrina*). Meijaard et al. (2001) stated that orangutans would remain for several days in the plants they liked and make nests in the trees.

Orangutans were always selective in choosing nest trees that are safe and comfortable for them (Gibson 2005; Meijaard et al. 2018; Davies et al. 2019). The correlation between diameter and height of the nest trees was very significant ( $\rho = 0.404$ ,  $p < 0.01$ ,  $n = 83$ ). The height of an orangutan's nest tree was directly proportional to its diameter (Law et al. 2008; van Casteren et al. 2012). The selection of nest diameter is influenced by the vegetation structure, safety factors, and experience of each orangutan (Ancrenaz et al. 2004; Cheyne et al. 2013). We saw the orangutans chose medium diameter trees to identify the movements and presence of predators that could threaten them, especially humans. The trees with a big diameter are usually used by adult orangutans that already have the experience to hide from predatory attacks. The highest tree used as a nest is the torop (*Artocarpus elasticus* Reinw. Ex Bl.) and the lowest one is rambutan hutan (*Cryptocarya nitens* (Bl.) Koord. & Valeton). Orangutans rarely make nests in the trees above 30 m or topmost canopy.

We found in the primary and secondary forests, the most nest tree species were laccat bodat (*Shorea hopeifolia* (Heim) Symington) and mayang (*Palaquium gutta* Burch), while in community-processed lands was durian. The choice of a wider canopy in the West (South) Block indicated that orangutans we are looking for safer nest trees. In the buffer zone of Dolok Sibual-bulai, NR, human intensities were high. They worked every day in the fields in which orangutans usually searched for food. The selection of tree canopies by orangutans depends on the forest canopy and threat to habitat (van Casteren et al. 2012). Orangutans will make more robust, complex, and last longer nests compared to African apes in primary forest (Grove 1985).

The correlation between diameter, height, and canopy cover of the trees was very significant ( $\rho = 0.628$  and  $\rho = 0.5528$ ,  $p < 0.01$ ,  $n = 83$ ). It means that orangutans have selected certain tree characteristics to build nests. Orangutans are genius primates so that they will find nest trees suitable and comfortable for them (Meijaard et al. 2001). However, as forest damage increases, orangutans

will be more difficult to find nest trees because they will face conflict with or be hunted by humans. During the observations on buffer zones, production forests, and APL, these areas experienced a decrease in habitat quantity in the last three years. The communities, such as Luat Lombang and Rambassiasur Villages have cleared land to the extent of nature reserves. This phenomenon caused orangutans moved to safer habitats to avoid from hunting and conflict, such as nature reserves, even though they should compete for territory with other orangutans (Meijaard et al. 2001; Wich et al. 2011)

Based on Table 2, the density on the human-orangutan conflict areas in South Tapanuli District was 0.53 individuals (ind.)/km<sup>2</sup> (95% CI = 0.41-0.65, n = 83). The previous research resulted in density of 0.47 ind./km<sup>2</sup> in the Dolok Sibual-buali NR (Kuswanda, 2014), 0.4 ind/ km<sup>2</sup> in the Hopong Forest (East Block) (Nasution 2018), 0.23 ind/km<sup>2</sup> in lowland forest, around the Batangtoru River (Santosa et al. 2018), and 0.82-1.02 ind./km<sup>2</sup> in highland forests (Kuswanda 2014). Orangutan density in the Batangtoru landscape grows with the increasing altitude (Simorangkir 2009). The function of lowland forest has changed to become a residential area, agriculture, and community garden. Habitat destruction has occurred massively until the availability of home range, feed source, and nesting trees in lowland forests were limited (Kuswanda 2014). Orangutans will migrate to better habitats with sufficient food and nesting sites on highland (Haryanto et al. 2019).

If the total area is 29,192 ha, we estimated orangutans around 155 individuals (95% CI = 121-187, n = 83). In the Eastern Block, there were 49 individuals (95% CI = 27-71), including Dolok Sipiok NR = 38 individuals and buffer zone = 11 individuals. In the West (South) Block, there were around 116 individuals (95% CI = 89-144), i.e Dolok Sibuali NR = 24 individuals, buffer zone = 74 individuals, and Lubuk Raya Preserve = eight individuals (Report of the survey of Institute for Conservation of Natural Resources of North Sumatra 2017, unpublished). The total population at the conflict areas in South Tapanuli District was 20.4-26.9% of the orangutans in Batangtoru Landscape, referring to the Ministry of Environment and Forestry (2019) between 577-760 individuals.

The frequency of Tapanuli orangutan conflicts has increased in buffer zones or outside the conservation forests (Wich et al. 2016). We have also met orangutans directly as well as found new nests on community lands between October to January. The eviction activities were found in several villages, such as Aek Batang Paya and Bulu Mario using fires, shouting while throwing sticks and gunshots. Orangutans then respond to a perceived threat, especially mothers in defense of infants (Hockings and Humel 2010). Some people consider them as pests like other animals, such as *Macaca nemestrina*, long-tailed monkeys, and pigs.

Orangutans in the buffer zones were around 85 individuals. This number potentially causes conflicts endangering humans and orangutans. Conflict mitigation must be carried out quickly, both for the long- and short-terms. Blackwell et al. (2016), there is no single solution in

mitigating human-wildlife conflict, successful management must begin with identifying the population and animals' behavior, how animals respond to disturbances, assessing conflict risks, and community/farmer responses to conflicts (Megaze et al. 2017).

We recommend long-term strategies to mitigate human-orangutan conflict, such as habitat restoration, creating barriers, protecting plants, building corridors, law enforcement, and village economic development (Hockings and Humel 2010; Hill and Wallace 2012; Ango et al. 2017). In the short term, the needed program is the provision of compensation (Bandara and Tisdell 2003) with the guarantee from the community to give up their plants as food and nest trees for orangutans (Ranjan 2017). The compensation is not cash but other forms that can increase yields in agroforestry systems.

The compensation provided to community can be: (i) plant seeds that are not consumed by orangutans, such as coffee, cocoa, and zalacca, (ii) fertilizer plants to increase crops productivity, (iii) machines for plowing rice fields and agricultural land, (iv) knowledge and extension to optimize yield harvest, and (v) development of other alternative economic sources, such as village ecotourism and fisheries. On the other side, enrichment of nest trees and natural foods in production forests bordering with conservation forests continues to be enhanced by the Forest Management Unit (*Kesatuan Pengelolaan Hutan/KPH*) at Tapanuli South District.

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