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Analysis of the tapanuli orangutan (*Pongo tapanuliensis*) population in other land use areas, Arse Sub-District, South Tapanuli Regency

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ABSTRACT
Tapanuli Orangutan (*Pongo tapanuliensis*) is a globally critical species (critically endangered) due to the decreasing area of natural habitat. Orangutans can reach out of their natural habitat outside the forest and into community fields for feeding. Orangutans make the other land use not only a place to stopover but also a home range and living area marked by nests. The study aims to obtain information on the characteristics of nests and the estimated population of the Tapanuli orangutan (TO) in the other land-use area. This research method uses line transects placed by systematic sampling with a distance between lines of 3 km and population data analysis using calculations from the van Schaik formula. From the results of the 11 research lines, 14 nests were obtained consisting of 3 class B nests, 5 class C nests, 3 class D nests, and 3 class E nests. The characteristics of the most dominant nests were class C with the most preferred positions II and III and nest finding highest in *Quercus maingayi* tree. The research found that the density of the TO was eight individuals/1000 ha.
Keyword: Batang Toru, Human Conflict, Mixed Garden, Nest

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1. Introduction

Tapanuli Orangutan (*Pongo tapanuliensis*) in the Batang Toru landscape (BTL) is categorized as critically endangered [1]. Orangutans can be found from lowland forests (300 m above sea level) to montane forests (1,500 m above sea level [2]. The remaining orangutan population in its natural habitat continues to be threatened due to increasing forest conversion, encroachment, and forest clearing for plantations, agriculture, settlements, and other infrastructure. The current population of TO is estimated to be only 577 – 760 individuals [3].

Orangutan, or another name is mawas is a type of great ape with long arms and reddish or brown hair. Orangutan is the only great ape that lives in Asia. About 20,000 years ago, orangutans could be found throughout Southeast Asia, from Java in the far south to the northern tip of the Himalayas and southern China. However, this type of great ape is currently only found on the island of Sumatra and the island of Kalimantan. Orangutan habitat continues to decline. Habitat loss on the island of Kalimantan reaches 1.5-2% per year, higher than the habitat of orangutans on the island of Sumatra [4].

Tapanuli Orangutan species is orangutan only found in the BTL i.e. in Dolok Sipirok Natural Reserve. The the existence status of this animal is also decreasing along with the decreasing forest ecosystems balance [5]. If this condition is not immediately prevented and seriously corrected by conservation, the TO, an endemic

animal of North Sumatra, will be increasingly endangered. According to the International Union for Conservation of Nature (IUCN), orangutans are critically endangered.

BTL administratively covers three districts: Tapanuli Utara, Tapanuli Tengah, and South Tapanuli. The forest area in the BTL is estimated to be around 249,169 ha, which includes protected forests (51.5%), nature reserves (6.2%), production forests (5.3%), other use areas/areas (36.8%), and waters (0.2%). The TO has a minimal habitat of around 138,435 ha, and in the South Tapanuli Region of 50,523 ha [6].

Human and orangutan conflict in the Arse Sub-district continues to increase because policies, spatial planning, and conservation programs with related institutions have often not been integrated. Conservation forest management in South Tapanuli Regency, such as Dolok Sibual-buali Nature Reserve and Dolok Sipirok Nature Reserve, still tends to be centralized and has not been combined with developing buffer areas including areas [7]. Data and information on the number of orangutan populations in Arse District as a buffer area for the Dolok Sipirok Nature Reserve are needed to prevent conflicts between orangutans and humans and support conservation efforts. For this reason, information on the whereabouts of orangutans in other land use (OLU) in Arse District is needed. OLU are forest areas determined based on the decree of the minister of forestry regarding the designation of provincial forest and water areas or based on forest allocation agreements (FAA) to be non-forest areas. This information is important as a reference for future management of the TO habitat outside conservation forests. The research aims to (1) obtain information on the characteristics of the TO nest, and (2) obtain an estimate of the TO population in the OLU of Arse District, South Tapanuli Regency.

2. Method

2.1. Time and location

This research was carried out in August - September 2022 in the OLU area of Arse Sub-District, South Tapanuli Regency. Data processing and analysis were conducted at the Integrated Forest Management Laboratory, Department of Forest Management, Faculty of Forestry, Universitas Sumatera Utara. The map of the research location can be seen in Fig. 1.

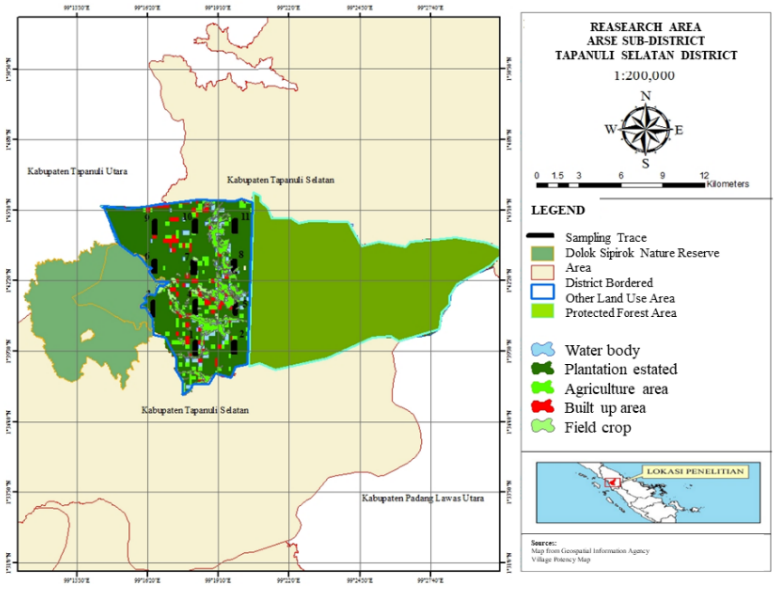

Figure 1. Map of research line location and placement

2.2. Tools and Materials

The tools used in this study are Software in the form of ArcGIS 10.3, Erdas Imagine Hardware in the form of a set of personal computers (PCs), Global Positioning System (GPS), cameras, haga meters, plastics ropes, phi-bands, and stationery. The materials used in this study are tally sheets and field data or primary data (Ground check) and secondary data, namely maps of the research area and Landsat Images of the 2021 area.

2.3. Data collecting

This research was conducted in several stages, including preparing tools and materials, field surveys, data collection, and data analysis. In collecting data, traces of orangutan presence were identified, which were marked by the discovery of orangutan nests [8]. Making paths was carried out using the line transect method, which systematically samples [9] with a distance between paths along 3 km. This method was very effective for estimating orangutan population density. Nest findings or other signs of existence were subsequently recorded and marked in their location coordinates. The intensity of observational sampling was set at 10% of the entire OLU area (96.57 km^2) so that ArcGIS obtained 11 observation paths with a transect length of 1km. The assumption of the width of the observation distance in the field was about 40-50 meters

This study was conducted using a combination of the line transect method with nest count. The path was placed systematically, with the initial transect placed on land cover, which allows for orangutan habitat because it was an OLU area. The distance between transects was 3,000 m (east-west) and 2,000 m (north-south), so it was expected to represent the entire research area. Each transect was made along 1 km with 11 research transects.

2.4. Nest characterization

The nests found in the research line identified age class, nest position, and type of nest tree. Other nest characteristics observed were nest height, nest diameter, the nest tree circumference, nest tree height, and nest tree header. Age and nest position analysis were classified in Table 1, while nest position classes were classified in Table 2 [10].

Table 1. Observation Criteria for the age class of orangutan nests

Nest age	Criterion
A	New, fresh, all leaves were green
B	Not so long ago, all the leaves were still there, the color of the leaves began to brown
C	Old (old), some leaves were gone, others were still attached, the nest was still sturdy and intact
D	Very long, there were holes in the nest building
E	Almost gone, only a few branches and wooden branches, shape The original nest was gone

Table 2. Orangutan nest position class

Nest Position	Criterion
I	The nest was near the main trunk
II	The nest was in the middle / on the edge of branching without the use of trees or branching from other trees
III	The nest was in the treetops
IV	The nest was between two different trees

The following was an example of the age class of an Orangutan nest.

Nest A class age

Nest B class age

Nest C class age

Nest D class age

Nest E class age

Figure 2. Orangutan nest class (Source: BKSDA Section V Sipirok)

3. Result and Discussion

3.1. Nest characteristics

Based on the analysis results, the number of TO nests found was 14 Orangutan nests from 11 observation paths. The highest number found in transect 3; the other nests are four nests in transect 9, two in transect 7, and one nest in transect 6. While for transects 1, 2, 4, 5, 8, 10, and 11, no orangutan nests were found, as shown in Figure 3. Orangutan nests are more commonly found in transect 3, because in transect 3 there are many types of feed tree i.e. *Eugenia grandis*, *Cryptocarya nitens*, *Litsea Firma* etc.

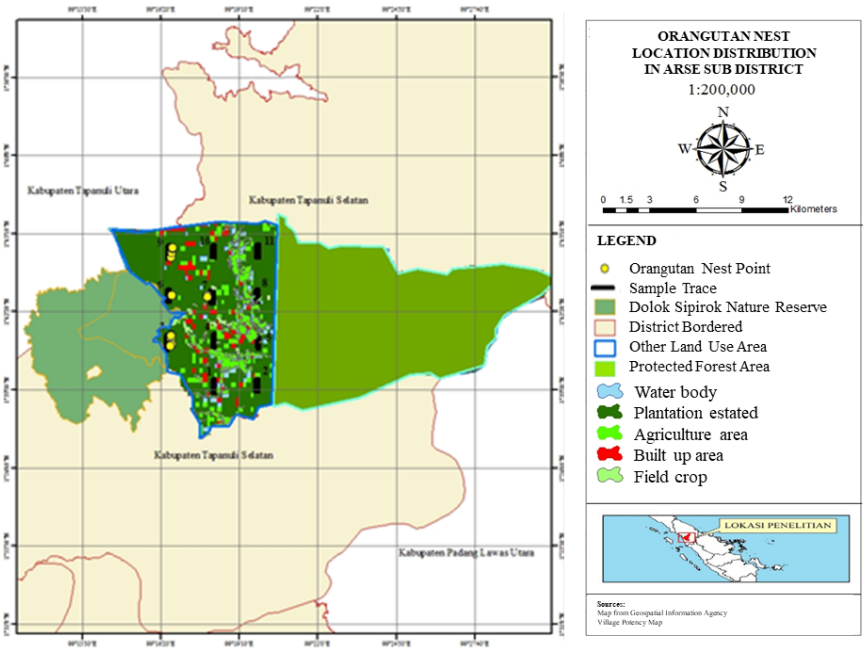

Figure 3. Nest point spread

In Fig. 3, we can see that the werea bordering or close to the Dolok Sipirok Nature Reserve was an Orangutan nest-finding werea. States [11] that the characteristics of orangutan nests were visible broken branches or branches on the side of the nest foundation. Orangutans only use nest-making materials from tree branches around the nest site. In identifying the nest of the TO (*Pongo tapanuliensis*) several things need to be observed, namely:

3.2. Age class of orangutan nest

Based on the findings of the nest age class, the most common was class C as many as five Orangutan nests, while class A nests were not found at the location of the research line. The absence of new nest class characteristics was thought to be due to weather factors, orangutans not being active around the observation path, the amount of human activity, and the feed trees had finished bearing fruit. Nest class was a parameter that can be used to see the movement of orangutans, and this was because orangutans always move and make nests every day, so the nests found do not always have the same class. For this reason, the class divisions used were classes A, B, C, D, and E to distinguish class A to class D can be seen from the color of leaves and twigs that can be seen in orangutan nests found.

Figure 4 showed the division of nests by nest age class, which showed that class A was an undiscovered nest, whereas the class was a relatively new and fresh nest characterized by all green leaves. Class A nests were not found in observation transects because orangutans were constantly moving around in making nests in the sense that orangutans would make nests every day in different places. The absence of class, A nests, was also influenced by various factors, including the wide range of orangutans, so most likely, orangutans do not always make new nests on the observation path [12].

The results of data analysis obtained from observing orangutan nests based on nest class consist of new to old nests, and in general, new nests were very rare. This was influenced by several factors, including the orangutan's vast range, weather, wind speed, and header openness. Fruit trees found at the observation site were scattered unevenly. It was also why new nests were found little in the observation transect. At least class, A and B were found in observation transects because orangutans always move around in making nests.

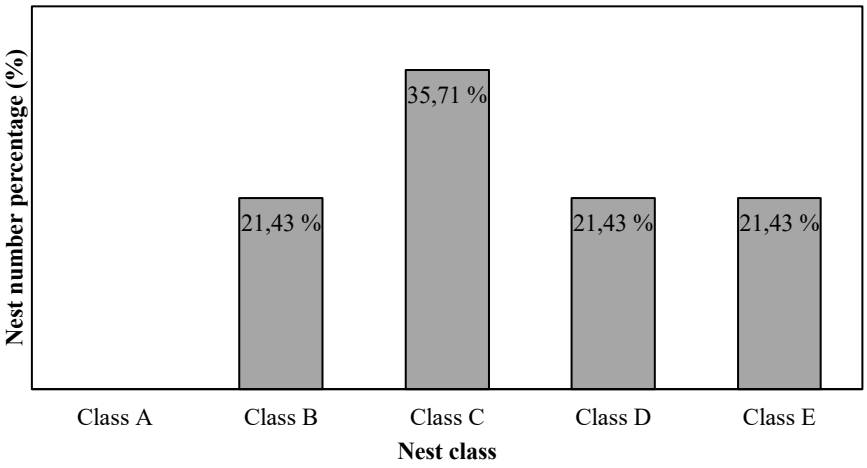

Figure 4. Nest age class

3.3. Orangutan Nest Position Class

In the observation transect, five nests were obtained in position II, five in position III and four in position I. Figure 5 showed the percentage of position II and position III more commonly found at the study site. The position of the nest in this tree was thought to be related to the Orangutan age, the Orangutan weight and the ease of obtaining materials for making the nest. According to [13], the branch end position (position II) was usually used by juvenile orangutans or those who were not too heavy. Orangutans chose the tree top position (position III) to make it easier to observe outside disturbances. Positions II and III were also often used by juvenile orangutans to make nests and for places to play and rest.

The position "I" was usually preferred by adult orangutans because can be supporting the Orangutan body weight. This was also related to the trees suitability to build nests and the comfort of orangutans. This observation was following [14] statement that orangutans like places to build nests on position “I”. In general, this position had abundant nest material. The branches that cluster in this section vertically or horizontally facilitate the formation of nest circles, nest bowls, and nest supports that can support the Orangutan body weight.

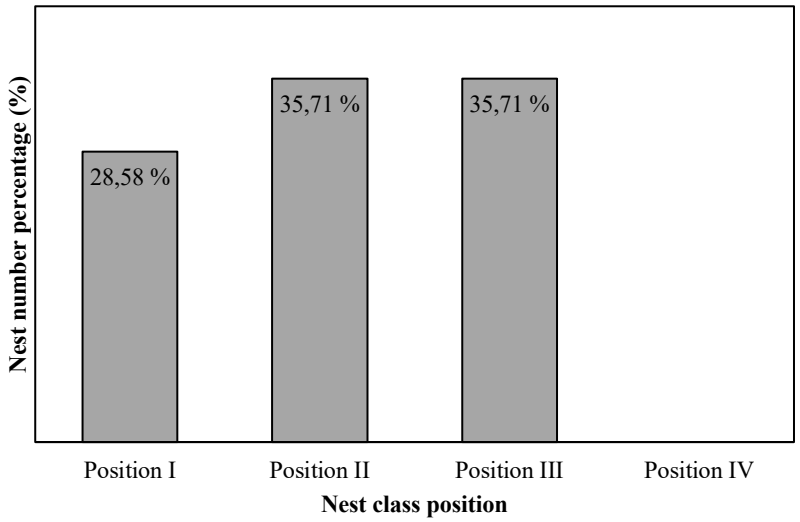

Figure 5. Orangutan nest position class

3.4. Nest height

The research site bordered the Dolok Sipirok Nature Reserve with a hilly and steep topography. The high-class division of nests was based on the frequency distribution. Data showed that TO makes dominant nests at altitudes between 10-19 m, as shown in the table below.

Table 3. Nest height position found

No	Nest height position	Number of nests
1	5-9 m	2
2	10-14 m	4
3	15-19 m	4
4	20-24 m	2
5	25-29 m	2

From research (Tabel 3), it was known that the height of dominant nest at a height between 10 to 19 meters from ground level. Generally, orangutans made nests at an altitude of 5 to 20 meters [15]. Overall, in various areas, the highest nest height, at an altitude of 10 to 20 meters, was to avoid predators, namely the Sumatran tiger (*Panthera tigris* Sumatrae). The nest position was also influenced by factors such as the presence of feed and avoiding other feed competitor animals.

3.5. Nest length

The length of an Orangutan nest varies depending on the age and size of the Orangutan body. The class division of nest length was based on the frequency distribution (Figure 6). Field data found nest length classes 70 to 89 cm as many as three nests, 90 to 109 cm as many as two nests, 110 to 129 cm as many as five nests, and 130 to 150 cm as many as four nests. The 110 to 129 cm nest length class was the most dominant, with as many as five nests. The length of the smallest orangutan nest was 70 cm, and the largest was 150 cm. According to [16], the nest length built by orangutans ranges from 68 to 170 cm. It was related to the length or width of the orangutan's body so that he would make a comfortable nest when resting. Nest-making was based on Orangutan ability to make nests and the ease of obtaining nest-making materials.

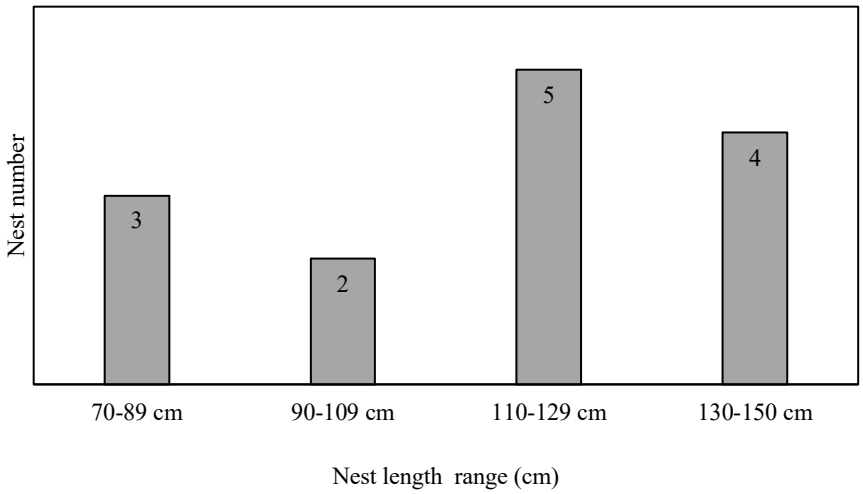

Figure 6. Orangutan nest length

3.6. Nest tree species

The study found as many as seven species of nesting trees from 14 nests found on 11 observation tracks. Most Orangutan made nests in hoteng tree species with the family Fagaceae. The distribution of Orangutan nests and nesting trees is illustrated graphically in Fig. 7. The most common type of nest tree found was the stone hoteng tree (*Quercus mangiayi*). Orangutans chose nesting trees, usually that the tree were near the bearing fruit tree. According to [17], the trees that were most commonly found in nests were feed trees. The feed trees used as nesting sites allowed orangutans to save energy.

Quercus maingayi (Hoteng batu) was the most preferred tree species for orangutans as nesting trees at observation sites. Research by Pujiyani [18] states that hoteng trees were more widely chosen as a place to build nests and were included in the family Fagaceae, which was a relatively strong and hardwood tree species. In addition, hoteng trees had horizontal branching that was relatively dense, with hairless and non-gummy

leaves that were evenly distributed throughout the tree branches. The branching nature and composition of hoteng leaves would make it easier for Orangutans to build solid and comfortable nests.

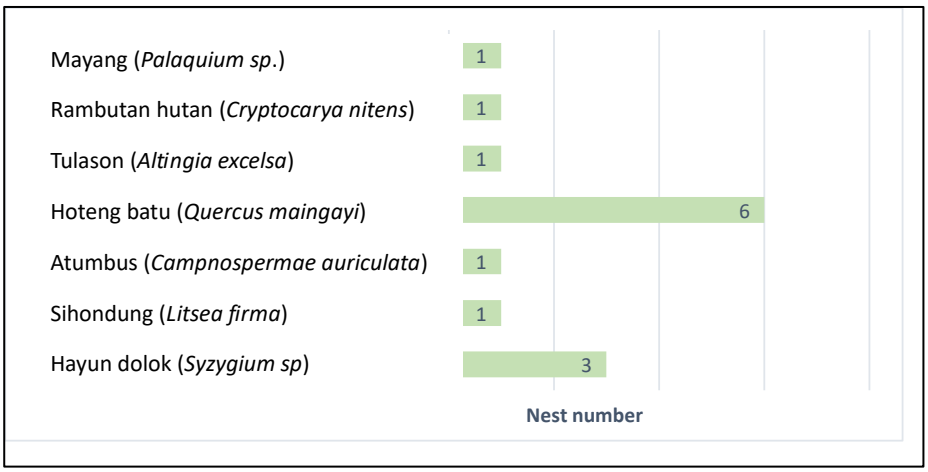

Figure 7. Species of nest trees

3.7. Tree diameter

The dominant nest tree diameter at the study site was between 118 to 136 cm as many as five nests (Fig. 8). The tree diameter where orangutans nest was predominantly a relatively large tree on the observation path. This happens because the tree condition in some observation lines was a garden left by the community so the condition of trees with a large diameter was quite a lot, such as Hoteng and Petai. Orangutans can more easily build nests on trees that have fairly tight and strong branches. According to [19], tree diameter did not influence Orangutans in choosing trees to be used as nesting sites. The role of the diameter factor is more supportive of the number of feed type in influencing the presence of nests in certain trees.

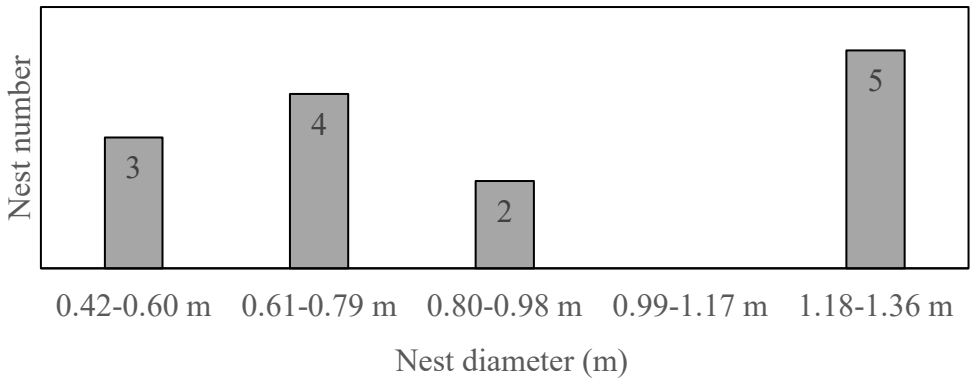

Figure 8. Nest tree diameter distribution

3.8. Tree height

The nest tree height favored by Orangutans ranges from 12 to 15 m (Fig. 9). The division of high classes of nest trees was based on the frequency distribution. In high classes 12 to 15 m, there were six nests (43%), classes 16 to 19 m were not found; in classes 20 to 23 m, as many as four nests (29%); classes 24 to 27 m, as many as two nests (14%), classes 28 to 31 m found as many as one nest (7 %) and in classes 32 to 35 m found as many as one nest (7%). According to [10], the choice of the height of Orangutan nest trees can be caused because orangutans like a wide view from their nest but not too open so that they can be protected from wind exposure. This also caused TO to prefer to live hanging from trees.

The selection of nest tree height at the study site depended on the needs of orangutans and the safety obtained. At the research site, the Orangutan feed was not too far from the Orangutan nest itself, so the nest height was not relatively different from the feed height. This was also found in the research of [17], that orangutans make nests depending on the structure of the forest where the orangutan was located. Usually, orangutans will make low nests for day rest nests and high nests for night rest to avoid predators, including the Sumatran tiger (*Panthera tigris* sumatrae).

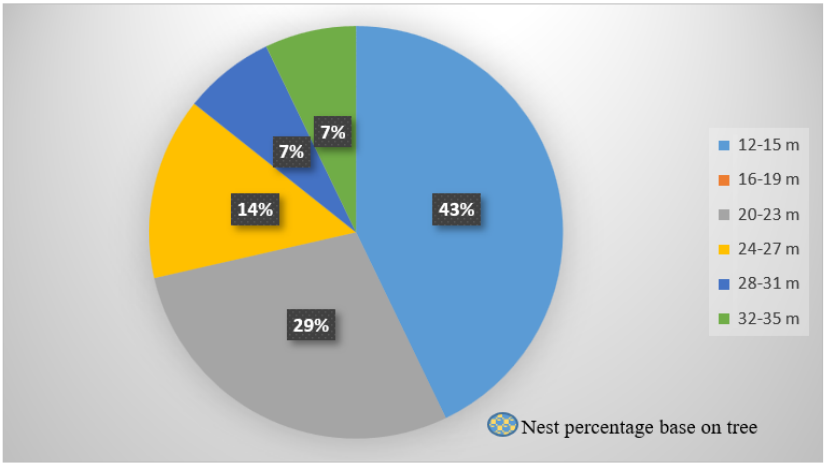

Figure 9. Nest percentage base on tree height

3.9. Orangutan Population Density

According to [20], to produce accurate population estimates based on nests, it was necessary to consider various parameters such as the estimated proportion of nest builders (p), estimated production rate/number of nests created per day per individual (r), and estimated average life span of a nest in days/nest age (t). These parameters in this study cannot be observed because it requires a long observation time and must be done periodically at no small cost. Therefore, the p, r, and t values used in data analysis were the results of a review of previous studies.

From the previous analysis in the Dolok Sipirok Nature Reserve contained in [6], the value of p (0.9), the value of r (1.7), and the value of t (289) where this value was the provision of an area (Dolok Sipirok Nature Reserve), the results were obtained in the following table.

Table 4. Prediction of TO population

Line	nest	Nest density (nest/km^2)	Population density (individual/1000ha)	Population (individual)
1	0	0	0	0
2	0	0	0	0
3	7	158.08	40.0	38.32
4	0	0	0	0
5	0	0	0	0
6	1	25.00	6.00	6.05
7	2	66.67	17.0	16.16
8	0	0	0	0
9	4	61.53	15.0	14.91
10	0	0	0	0
11	0	0	0	0
Total		311.29	78.0	75.45
Average		28.30	7.80	6.86

From the results of research in OLU Arse District, the results of estimating the average density of Orangutans in OLU Arse District of 7.80 individuals /1000 ha with the highest density found in line three of 40.0 individuals /1000ha or with an estimated population of six to seven individuals in an area of 96.57 km^2. With the estimated number of this population, it was very prone to conflict with humans because it was in OLU, which should be a place for humans to carry out activities.

4. Conclusion

The most dominant nest characteristic was class C with the most positions in positions II and III on the stone hoteng tree (*Quercus maingayi*). The population of TOs in OLU Arse District was 6-7 individuals, with a

population density of 8 individuals/1000 ha. The Other Use Area (OLU) of Arse District, South Tapanuli Regency, should get more attention from related parties for the preservation of TO habitat and can even be of economic value, such as being used as a natural tourism arena that was beneficial for the surrounding community and for the local government.

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