Analysis of vegetation diversity at Salib Kasih tourism area of Simorangkir Julu Village, North Tapanuli Regency

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Abstract. Salib Kasih tourism area is a prime religious tourism area in North Sumatra which is located in the forest area of Simorangkir Julu Village, North Tapanuli Regency. Structure and composition of vegetation in this area are not widely known, while Salagundi (*Roudholia teysmanii*) only found on this area. Generally, people only see pine as the main component of its plant. Studying the dynamics of a forest and its characteristics is an essential prerequisite for managing forests sustainability, especially for the sustainability of Salagundi which is native species of this area. This study aimed to obtain the information about the structure, composition, and diversity of plant in this area and as based data to maintain the existence of its species. The sampling technique was carried out by a combination method between the path method and the plot line. Vegetation analysis was carried out to gather information about the number and type of species at each growth level, Important Value Index (IVI) and Shannon Wiener Diversity Index. The results of the study found that there were seventeen species in this area. The number of each growth level was 691 at seedling levels, 671 at sapling levels, 209 at pole levels, and 224 at tree levels. The highest IVI at seedling, pole and tree level was *Pinus merkusii* (60.55; 87.58; 113.58), while at sapling level was *Syzygium racemosum* (50.00). The diversity index at seedling and tree level was low (1.95 and 1.76), while at sapling and pole level, it was classified as medium (2.07 and 2.08). According to the result, the existence of Salagundi needs to be preserved.

1. Introduction

One of the religious tourism areas known in North Sumatra is Salib Kasih. It was built to commemorate the services of a Christian missionary named DR. Ingwer Ludwig Nommensen. This location is the place to look towards Rura Silindung. Salib Kasih is located in the hilly area of Siatas Barita District, North Tapanuli Regency, which belongs to type B of Schmidt and Fergusson climate classification with an average of annual rainfall of 2000-4000 mm [1]. Its location is in the height range of 1261-1328 m above sea level; this area has a fresh air temperature ranging from 21-26 °C with an average of 23.28 °C and humidity 85-94% [2].

There are two things we need to know in understanding the dynamics of a forest, stand structure and species composition. Both are characteristics of stand data that must be identified in connection with the policy steps that must be taken in the operation of forest management activities. Studying the dynamics of a forest and its characteristics is an essential prerequisite for managing forests sustainably. A better understanding of the ecology of tree species will encourage forest management and the application of better silvicultural techniques [3].
This area is generally dominated by pine trees as the result of reforestation activities in 1976, but in 1995 the community also began planting Salagundi. It is necessary to periodically observe and see the dynamics of the ecosystem in this area, and describe the changes that occur. Research in 2016 [4] stated that Pine and Salagundi are the main species and have the highest IVI in this area. Based on this description, the purpose of this study was to obtain information about the structure, composition, and diversity of vegetation in the area of Salib Kasih.

2. Materials and methods
This research was carried out in the forest area of Salib Kasih, Siatas Barita District, North Tapanuli Regency. The location is designated as a population of 23 ha. The sampling technique was carried out by a combination method between the path method and the plot line [5, 6]. Each sampling unit was made of four observation lines that cut contours. Observation plots were measured 20 m x 20 m on the left side of the stub direction and a plot of 20 m x 20 m on the right side of the stub direction and 1 m pilot line width, with 10% SI (Sampling Intensity). The sample area of 2.3 ha would be divided into four lanes, and each observation path consisted of fifteen plots. Observations were made on a 20 m x 20 m plot to measure tree level vegetation (diameter ≥20 cm), 10 m x 10 m observation plot to measure pole level vegetation (diameter ≥10 - <20 cm), 5 m x 5 m observation subplot to measure sapling level vegetation (diameter <10 cm), and 2 m x 2 m observation sub-plot to measure seedling level vegetation that was placed systematically with a distance of 50 m between the lines.

Data collection included the number and type/species (seedlings and saplings), species, height, diameter, the height to branches and diameter (poles and trees). Then the data would be processed to get Density (K), Relative Density (RK), Frequency (F), Relative Frequency (RF), Dominance (D) and Relative Dominance (DR). The calculations obtained would be used to determine the Important Value Index (IVI). The value of species diversity was calculated using the Shannon-Wiener Diversity Index [5, 6].

3. Results and discussion
This study found that there were seventeen species in the study site, with the composition of seedlings of fifteen species (691 individuals), saplings of seventeen species (671 individuals), poles of fourteen species (209 individuals) and trees of twelve species (224 individuals). The species were Salagundi (Roudholia teysmanii), Pine (Pinus merkusii), Atarasa (Castanopsis itermis), Haudolok (Syzygium racemosum), Monis-monis (Ganophyllum falcatum), Tinggiran (Carallia bradiata), Nongkar-nangkir (Parastemon urophyllum), Tabbicu (Xylophia curtusii), Hapas-hapas (Exbucklandia popunea), Simarapi-api (Deplanchea bancana), Silom (Myrica esculenta), Situlan (Weinmannia fraxinea), Boji-boji (Stachytarpheta indica), Cemara (Casuarina sumatrana), Anti api (Adinandra dumasa), Atahasi (Weinmannia blumei), and Tunjang (Schefflera sp.).

In plain view, the forest in this area is dominated by pine. To understanding the structure and composition in this area, species data found were then analyzed for all vegetation on each growth rate. At the seedling level, pine is a species that has the highest IVI. The highest IVI indicates that this species has high adaptability to environmental conditions in Salib Kasih. Besides, pine regeneration ability is also good. Of the total regeneration found, Pinus occupies almost half of the area. Abundant pine fruit can be found around July-November, but the availability of viable seeds is practically available throughout the year [7]. The availability of the seed answers the existence of Pine seedlings which are quite common. The presence of pine which is active in the reproductive phase is also frequent in this area. Pine was started to plant around 1976, so currently the average age of pine stands has reached 42 years [7]. At around the age of 20, Pine begins to reproduce generatively [7].

Haudolok gets the highest IVI in the sapling phase, followed by Pinus and Salagundi. Haudolok can grow well, in right forest conditions, up to the disturbed and open forest condition [8]. The tolerance range is quite broad, thus making Haudolok able to have high adaptability in its growth phase. The sapling phase is a crucial phase, to be ready to go into the maturation phase.
Table 1. Results of calculation of seedling level vegetation analysis.

| No | Local name  | K   | F   | RK  | RF  | IVI  |
|----|-------------|-----|-----|-----|-----|------|
| 1  | Pinus       | 10667 | 0.72 | 37.05 | 23.50 | 60.55 |
| 2  | Haudolok    | 6292 | 0.65 | 21.85 | 21.31 | 43.16 |
| 3  | Salagundi   | 3208 | 0.35 | 11.14 | 11.48 | 22.62 |
| 4  | Boji-Boji   | 2750 | 0.38 | 9.55  | 12.57 | 22.12 |
| 5  | Situlan     | 1167 | 0.18 | 4.05  | 6.01  | 10.06 |
| 6  | Tinggiran   | 792  | 0.15 | 2.75  | 4.92  | 7.67  |
| 7  | Monis-Monis | 750  | 0.10 | 2.60  | 3.28  | 5.88  |
| 8  | Atarasa     | 542  | 0.08 | 1.88  | 2.73  | 4.61  |
| 9  | Nongkar-Nangkir | 583 | 0.07 | 2.03  | 2.19  | 4.21  |
| 10 | Atahasi     | 417  | 0.08 | 1.45  | 2.73  | 4.18  |
| 11 | Hapas-Hapas | 542  | 0.07 | 1.88  | 2.19  | 4.07  |
| 12 | Tabbicu     | 375  | 0.07 | 1.30  | 2.19  | 3.49  |
| 13 | Anti Api    | 333  | 0.07 | 1.66  | 2.19  | 3.43  |
| 14 | Simarapi-api | 333  | 0.07 | 1.16  | 2.19  | 3.43  |
| 15 | Silom       | 42   | 0.02 | 0.14  | 0.55  | 0.69  |
|    | Total       | 28792 | 3.05 | 100.00 | 100.00 | 200.00 |

Table 2. Results of the calculation of sapling level vegetation analysis.

| No | Local name         | K   | F   | RK  | RF  | IVI  |
|----|--------------------|-----|-----|-----|-----|------|
| 1  | Haudolok           | 1300 | 0.67 | 29.06 | 20.94 | 50.00 |
| 2  | Pinus              | 1080 | 0.62 | 24.14 | 19.37 | 43.51 |
| 3  | Salagundi          | 680  | 0.48 | 15.20 | 15.18 | 30.38 |
| 4  | Boji-Boji          | 380  | 0.38 | 8.49  | 12.04 | 20.54 |
| 5  | Tinggiran          | 200  | 0.22 | 4.47  | 6.81  | 11.28 |
| 6  | Situlan            | 220  | 0.15 | 4.92  | 4.71  | 9.63  |
| 7  | Atarasa            | 87   | 0.12 | 1.94  | 3.66  | 5.60  |
| 8  | Atahasi            | 93   | 0.08 | 2.09  | 2.62  | 4.70  |
| 9  | Hapas-Hapas        | 73   | 0.08 | 1.64  | 2.62  | 4.26  |
| 10 | Simarapi-api       | 60   | 0.08 | 1.34  | 2.62  | 3.96  |
| 11 | Tabbicu            | 80   | 0.05 | 1.79  | 1.57  | 3.36  |
| 12 | Anti Api           | 47   | 0.07 | 1.04  | 2.09  | 3.14  |
| 13 | Monis-Monis        | 60   | 0.05 | 1.34  | 1.57  | 2.91  |
| 14 | Tunjang            | 33   | 0.05 | 0.75  | 1.57  | 2.32  |
| 15 | Nongkar-Nangkir    | 47   | 0.03 | 1.04  | 1.05  | 2.09  |
| 16 | Silom              | 20   | 0.03 | 0.45  | 1.05  | 1.49  |
| 17 | Cemara             | 13   | 0.02 | 0.30  | 0.52  | 0.82  |
|    | Total              | 4473 | 3.18 | 100.00 | 100.00 | 200.00 |

Some species need full light in their growth, but some can grow under conditions of shade. Haudolok can grow well in the shaded area, but not so with Pine. Pine is a species that needs full light in its growth phase [7, 9] so that with the shade makes its growth disrupted. Intolerance of shading is likely to make Pine not have a high IVI in the sapling phase.

The pole phase usually starts to have better adaptability than the sapling phase. The crucial stage in its growth has already been exceeded and has stable growth. The better versatility causes Pine to dominate the IVI [9]. Based on the canopy strata, the pole is still able to obtain light, so the increase is not disturbed. Appropriate conditions of the height of the place, temperature, humidity, and rainfall make this species more established in this area.
Table 3. Results of calculation of pole level vegetation analysis.

| No | Local name      | K  | F   | D   | RK  | RF  | RD  | IVI |
|----|----------------|----|-----|-----|-----|-----|-----|-----|
| 1  | Pinus          | 120| 0.25| 1.49| 34.45| 16.85| 36.28| 87.58|
| 2  | Haudolok       | 62 | 0.20| 0.64| 17.70| 13.48| 15.49| 46.68|
| 3  | Salagundi      | 50 | 0.22| 0.59| 14.35| 14.61| 14.29| 43.25|
| 4  | Hapas-Hapas    | 18 | 0.13| 0.31| 5.26 | 8.99 | 7.44 | 21.69|
| 5  | Situlan        | 18 | 0.13| 0.21| 5.26 | 8.99 | 5.17 | 19.42|
| 6  | Nongkar-Nangkir| 15 | 0.10| 0.18| 4.31 | 6.74 | 4.27 | 15.32|
| 7  | Boji-Boji      | 17 | 0.08| 0.15| 4.78 | 5.62 | 3.74 | 14.14|
| 8  | Tinggiran      | 10 | 0.07| 0.14| 2.87 | 4.49 | 3.41 | 10.78|
| 9  | Atarasa        | 8  | 0.07| 0.08| 2.39 | 4.49 | 1.98 | 8.86 |
| 10 | Simarapi-api   | 8  | 0.07| 0.08| 2.39 | 4.49 | 1.96 | 8.85 |
| 11 | Monis-Monis    | 7  | 0.05| 0.06| 1.91 | 3.37 | 1.46 | 6.74 |
| 12 | Silom          | 5  | 0.05| 0.07| 1.44 | 3.37 | 1.76 | 6.57 |
| 13 | Atahasi        | 7  | 0.03| 0.07| 1.91 | 2.25 | 1.74 | 5.90 |
| 14 | Anti Api       | 3  | 0.03| 0.04| 0.96 | 2.25 | 1.02 | 4.22 |
|    | Total          | 348| 1.48| 4.11| 100.00| 100.00| 100.00| 300.00|

Salagundi began to get interference in this phase. The quality of the wood is excellent which makes people use it for various purposes so that the logging of this species begins to bloom. Fortunately, this species has good vegetative and generative regeneration capabilities, so that it is still able to survive in this forest area [10]. Community disruption for Pine relatively lacks because people can use the sap rather than cut down the wood. Tapping of fluid is done and can improve the economy of the community [7, 9].

Table 4. Results of tree-level vegetation analysis calculations.

| No | Local name      | K  | F   | D   | RK  | RF  | RD  | IVI |
|----|----------------|----|-----|-----|-----|-----|-----|-----|
| 1  | Pinus          | 42 | 0.25| 1.85| 44.64| 20.83| 48.10| 113.58|
| 2  | Salagundi      | 16 | 0.18| 0.62| 16.96| 15.28| 16.16| 48.40|
| 3  | Haudolok       | 14 | 0.20| 0.56| 15.18| 16.67| 14.41| 46.26|
| 4  | Hapas-Hapas    | 5  | 0.10| 0.23| 5.80 | 8.33 | 5.93 | 20.07|
| 5  | Situlan        | 3  | 0.10| 0.14| 3.57 | 8.33 | 3.65 | 15.56|
| 6  | Atarasa        | 3  | 0.10| 0.11| 3.13 | 8.33 | 2.75 | 14.21|
| 7  | Tinggiran      | 2  | 0.08| 0.07| 2.23 | 6.94 | 1.91 | 11.09|
| 8  | Atahasi        | 3  | 0.05| 0.09| 2.68 | 4.17 | 2.23 | 9.08 |
| 9  | Silom          | 2  | 0.05| 0.06| 1.79 | 4.17 | 1.48 | 7.44 |
| 10 | Boji-Boji      | 2  | 0.03| 0.07| 2.23 | 2.78 | 1.87 | 6.88 |
| 11 | Monis-Monis    | 1  | 0.03| 0.04| 1.34 | 2.78 | 1.09 | 5.21 |
| 12 | Tunjang        | 0  | 0.02| 0.01| 0.45 | 1.39 | 0.39 | 2.22 |
|    | Total          | 93 | 1.20| 3.85| 100.00| 100.00| 100.00| 300.00|

Tree phase is a condition that shows established growth. Pine seems to be a species that has high adaptability to the ecological requirements of this area and can create environmental conditions that are suitable for the growth of other species in the area [9]. Pine occupies the uppermost strata in the tree phase because its greediness is light, followed by Salagundi and Haudolok. As with the pole phase, the community also uses pine resin, which indirectly maintains the presence of this species in the area.

Species diversity was measured using the Shannon Wiener diversity index. The index for each growth rate can be seen in figure 1.
Figure 1. Shannon Wiener's Diversity Index at various levels of growth.

The range of Shannon Wiener Index values in between 1.76-2.08 is classified as low-medium [11]. This result is not much different from 2016 [4], in which the Shannon Wiener Diversity Index was 1.6-1.71. At first, this area was an area that began to be green around 1976 with the planting of pine in the west of Salib Kasih and around 1995 the cultivation of Salagundi to the east of Salib Kasih by the local community. A long-time journey, this ecosystem can develop well and be stable. Several other species have begun to appear, so that the diversity is increasing, even though it is still at moderate criteria.

4. Conclusion
The results of the study found that there were seventeen species in this area. The number of each growth level was 691 at seedling levels, 671 at sapling levels, 209 at pole levels, and 224 at tree levels. The highest IVI at seedling, pole and tree level was Pinus merkusii (60.55; 87.58; 113.58), while at sapling level was Syzygium racemosum (50.00). The diversity index at seedling and tree level was low (1.95 and 1.76), while at sapling and pole level, it was classified as medium (2.07 and 2.08). According to the result, the existence of Salagundi needs to be preserved.

5. References
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