Jurnal Biotik. P-ISSN: 2337-9812, E-ISSN: 2549-1768
Vol. 10, No.1 Ed. April 2022, P. 1-12

DIVERSITY OF TREE SPECIES IN SYIAH KUALA UNIVERSITY

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DOI: 10.22373/biotik.v10i1.13030

ABSTRACT

This research was conducted from April 2020 to October 2020 entitled "Diversity of Tree Species at Syiah Kuala University". The data collection technique was performed through a survey of 21 observation plots including faculties, office units, worship facilities, health facilities and other supporting facilities. The data analysis includes the Important Value (NP) and Species Diversity Index (H'). The results showed that the species composition of trees growing on the campus of Syiah Kuala University were 46 species belonging to 27 families. Six tree species that had relatively high importance value compared to others, namely *Pterocarpus indicus* (19.61%), *Swietenia mahagon*i (19.56%), *Polyathia longifolia* (12.76%), *Mimusops elengi* (12.48%), *Roystonia regia* (12.27%), and *Samanea saman* (10.176%). The Diversity Index (H') of those tree species ranged from 1.549 to 2.634. The conclusion is that the tree species composition was relatively limited when compared to the Cronquist classification, and the tree species diversity index was in the medium category.

Keywords: Species Diversity Index, Important Value, Flora.

INTRODUCTION

The threat of global warming currently has implications for increasing the needs of the community, especially in urban areas for green open space (GOS) with a various composition of flora, herbs, shrubs, and trees. The current development of urban area shows a tendency for unbalanced development activities [1]. The current development is more oriented to the fulfillment of spaces with facilities and infrastructure in the form of physical buildings [2]. Thus, it is necessary to accelerate the urban development towards a green city, including universities, so that it can equilibrate the acceleration of environmental degradation in various places. The remaining lands are directed to build green open space as an approach and application of one or several forest functions in the form of

vegetations in urban area to achieve the goals of protection, recreation, aesthetics, and the use of other functions for the benefit of urban communities [3]. Green open space is crucial for reducing carbon dioxide (CO_2) content through fixation by vegetation to supply the needs of oxygen (O_2) for respiration, especially for humans. The management of the urban environment in Indonesia has been set out in Law no. 26 of 2007 concerning Spatial Planning which requires the existence of green open space as much as 30% of the total area [4].

A Green Open Space (GOS) is part of the open spaces of an urban area filled with plants (flora) to support the direct and indirect benefits produced by green open space in the city, such as security, comfort, welfare, and the beauty of the urban area [5]. GOS can be found in hospitals, offices, schools, universities, and other places.

Syiah Kuala University (USK) is one of the public universities in Banda Aceh which has an area about 9,437,209 m^2 [6]. To support the terms of university green space as a part of urban GOS which ideally has a function in assisting campus academic activities including students, lecturers, and employees, therefore USK infrastructure development must be balanced with the availability of adequate green space. The results of observations made in the USK campus, the area that have GOS overgrown with various plant species, but the composition of the existing flora is not yet known, both from taxonomic and ecological aspects.

Furthermore, the flora in such area is an important data that must be owned by every institution, including USK. As USK is now known one of the Universities with the status of a Public Service Agency (PT-BLU), thus it is important to conduct research that might provide comprehensive information on taxonomy and ecology of flora in this area.

This research aims to investigate: (a) the trees species that making up the vegetation of GOS in USK; (b) vegetation analysis including Important Value (NP) and Diversity Index of species (H').

RESEARCH METHODOLOGY

Materials

The tools and materials used including identification book (Flora "For Schools in Indonesia/Van Steenis and Flora of Java Vol III), Flora of Java Vol. I, II, and III), digital camera (DSLR D100), meter (50 m), surgical lattice label paper (dissecting kit), magnifying glass (loupe), microscope, ruler and book containing tribal taxon (Familia) and clan (genus).

Data Collection

The research was conducted at 21 (twenty-one) research stations: Faculty of Teacher Training and Education (FKIP), Faculty of Mathematics and Natural Sciences (FMIPA), Faculty of Medicine (FK), Faculty of Veterinary (FKH), Faculty of Nursing (FKep), Faculty of Economics and Business (FEB), Faculty of Social and Political Science (FISIP), Faculty of Engineering (FT), Faculty of Dentistry (FKG), Faculty of Law (FH), Faculty of Agriculture (FP), Faculty of Maritime and Fisheries (FKP), Language Center of USK, administrative center office (KPA), Student Sport Hall, The Main Library of USK, Jamik mosque of USK, student dormitories, postgraduates, public lecture halls (RKU), Prince Nayef hospital, mini stadium and monument field, PGSD Lampeunereut campus, Goheng campus and Syiah Kuala University football field (Figure-1). Prior to sampling, observations were carried out and the determination of observation stations (segmentation) was performed. The total area of USK campus is around 9,437,209 m^2. From this total area, 21 plots/sampling unit was selected. The quadratic method (10 m X 10 m) was used as sampling technique. Then, at each plot, five replication sampling areas (each is 5 quadrat) were set, thereby obtaining 105 squares of replication observation areas. Determination of the number of squares was done using the tree series technique [7]. Besides, the determination of the area of the sample square was based on the minimum area curve technique [8].

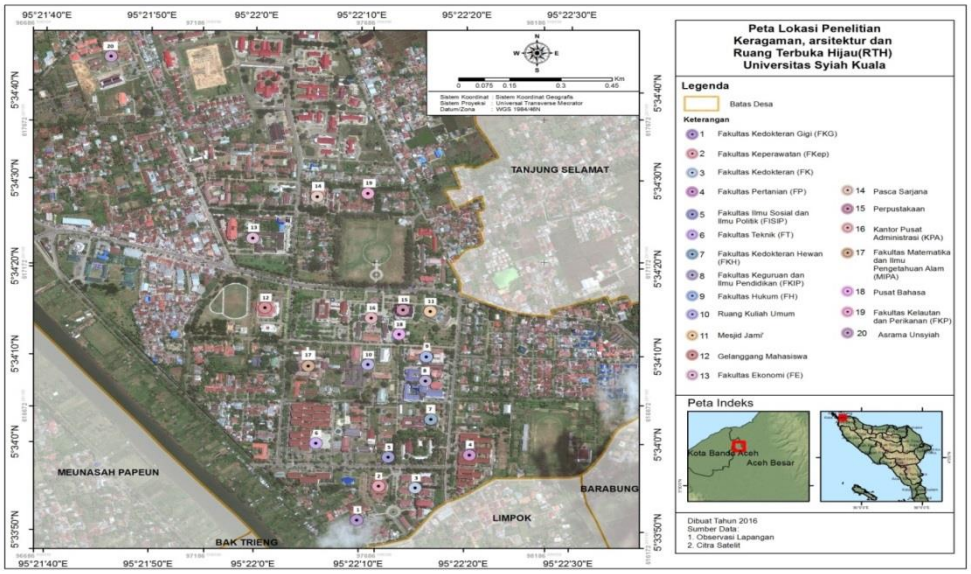

Figure 1. Sampling Location

Data Analysis Technique

Important Value (NP)

Calculate the Importance Value (NP) of each species, the following formula was used NP = Relative Frequency (FR) + Relative Density (KR) [9]. This study did not consider the Absolute Dominance (DM) and Relative Dominance (DR). The reasons were that the vegetation observed was mostly planted (not growing naturally) and the areas were non-natural habitat. The results of the NP calculation were then used as a value to determine the Species Diversity Index.

The observed variables included Absolute Density (KM) and Absolute Frequency (FM) values. To calculate KM, KR, FM and FR, the following formula is used [10].

$$\text{Absolute Density (KM)} = \frac{\text{Number of species}}{\text{Total number of observation plot}}$$

$$\text{Relative Frequency (KR)} = \frac{\text{Number of species}}{\text{Total number of species density}} \times 100\%$$

$$\text{Absolute Frequency (FM)} = \frac{\text{Species frequency}}{\text{Total number of Observation Plot}}$$

$$\text{Relative Frequency (FR)} = \frac{\text{Species frequency}}{\text{Total frequency of Species}} \times 100\%$$

Spesies Diversity Indices (H')

The variation of species composition in a study area is calculated by Diversity Index using this following formula [8]:

$H' = \sum p_i \ln p_i$

pi= ni/N

ni = Importan value of species

N = Total of important value for all species.

In= Natural logaritm (natural number)

To interpret Shanon-Wienner Species Diversity Index (H'), the following criteria are used. The value of ranges was calculated from 0-7. The Index score ≤ 1, was categorized as low category. The index score 1-2 was a low category, 2-3 was a medium category, 3-4 was a high category, and ≥ 4 wass a very high category [8].

RESULT AND DISCUSSION

Based on the results of research conducted on the composition of tree vegetation at 21 observation stations from April 2020 to October 2020, A total of 46 tree species were obtained from 27 families (Table 1).

Table-1. Vegetation Composition, Important Value, Diversity Index and Percentage (%) of Tree Species in Study Area.

No.	Local Name	Scienteific Name	Familia	NP	Ĥ'	%
1.	Angsana	*Pterocarpus indicus*	Fabaceae	19,61	0,211	8,837
2.	Mahoni	*Swietenia mahagoni*	Meliaceae	19,56	0,193	7,442
3.	Glodokan tiang	*Polyathia longifolia*	Annonaceae	12,76	0,127	4,651
4.	Tanjung	*Mimusops elengi*	Sapotaceae	12,48	0,145	6,047
5.	Palem raja	*Roystonia regia*	Arecaceae	12,27	0,127	5,116
6.	Trembesi	*Samanea saman*	Mimosaceae	10,17	0,137	6,512
7.	Asam jawa	*Tamarindus indica*	Cesalpinaceae	9,116	0,103	5,116
8.	Jati	*Tectona grandis*	Verbenaceae	7,99	0,093	3,721
9.	Kembiri	*Aleurites moluccana*	Arecaceae	7,82	0,104	4,651
10.	Cemara laut	*Casuarina equisetifolia*	Casuarinaceae	7,76	0,095	4,186
11.	Ketapang	*Terminalia catappa*	Combretaceae	5,73	0,073	2,791
12.	Kelapa	*Cocus nucifera*	Arecaceae	5,26	0,074	3,721
13.	Sawit	*Elaeis guineensis*	Arecaceae	4,07	0,045	1,860
14.	Kelor	*Moringa citrifolia*	Morangaceae	2,31	0,045	2,326
15.	Mimba	*Azadiractha indica*	Meliaceae	2,26	0,042	2,326
16.	Mangga	*Mangifera indica*	Anacardiaceae	1,94	0,045	2,791
17.	Akasia	*Acacia auriculiformis*	Mimosaceae	2,76	0,039	1,860

No.	Local Name	Scienteific Name	Familia	NP	Ĥ'	%
18.	Sukun	*Artocarpus altilis*	Moraceae	1,84	0,028	0,930
19.	Kedondong laut	*Polycias fruticosa*	Aralaiaceae	0,83	0,022	0,930
20.	Ki acret	*Spathodea campanulata*	Bignoniaceae	1,53	0,034	1,860
21.	Kenanga	*Cananga orodata*	Annonaceae	1,45	0,024	0,930
22.	Kayu putih	*E. camaldulensis*	Myrtaceae	1,41	0,030	1,395
23.	Anona	*Annona muricata*	Annonacae	1,40	0,037	2,326
24.	Ceri/kersen	*Muntingia calabura*	Elaeocarpaceae	1,28	0,030	1,395
25.	Karet kebo	*Ficus elastica*	Moraceae	1,03	0,028	1,395
26.	Jambu air	*Eugenia aquea*	Myrtaceae	0,63	0,020	0,930
27.	Mengkudu	*Morinda citrifolia*	Rubiaceae	0,59	0,024	1,395
28.	Gebang	*Corypha utan*	Arecaceae	0,53	0,020	0,930
29.	Flamboyan	Delonix regia	Mimosaceae	0,18	0,013	0,465
30.	Beringin	*Ficus* sp.	Moraceae	0,18	0,020	1,395
31.	Sirsak	*Annona muricata*	Anacardiaceae	0,17	0,018	0,930
32.	Sirsak	*Annona muricata* Linn	Annonaceae	0,92	0,016	1,395
33.	Ficus kuning	*Ficus* sp.	Moraceae	0,92	0,012	0,465
34.	Ki sabun	*Filicium decipiens*	Sapindaceae	0,84	0,014	0,930
35.	Jeruk bali	*Citrus maxima*	Rutaceae	0,83	0,014	0,930
36.	Nyamplung	*Colaphylum inophyllum*	Clusiaceae	0,62	0,010	0,465
37.	Kapuk randu	*Ceiba pentandra*	Malvaceae	0,57	0,009	0,465
38.	Kamboja	*Plumeria acuminata*	Apocynaceae	0,46	0,008	0,465
39.	Melinjo	*Gnetum gnemon*	Gnetaceae	0,41	0,008	0,465
40.	Jamblang	*Syzygium cumini*	Myrtaceae	0,39	0,008	0,465
41.	Cempaka	*Michelia campaca*	Magnoliaceae	0,29	0,007	0,465
42.	Petai cina	*Leucaena leucocephala*	Mimosaceae	0,29	0,007	0,465
43.	Cermai	*Phyllantus acidus*	Phyllantaceae	0,26	0,006	0,465
44.	Jambu klutuk	*Psidium guajava*	Myrtaceae	0,22	0,006	0,465
45.	Belimbing wuluh	*Averhoa carambola*	Oxalidaceae	0,16	0,005	0,465
46.	Belimbing buah	*Averrhoa bilimbi*	Oxalidaceae	0,16	0,005	0,465
		Total		**200**	**2,179**	**100**

Note : NP = Important Value, H' = Species Diversity Index

Based Table-1, there were 46 tree species which belongs to 27 families that were found in the study site. In addition, it is found that the vegetation composition was dominated by Arecaceae with five species, namely *Roystonia regia, Veitchia merillii, Cocus nucifera, Elaeis guineensis* and *Corypha utan*. Thus, it can be stated that those five species were the most adaptable species to this environment, beside the fact of human intervention in planting these species.

Arecaceae (palm) is one of the most important families for humans. This families are widely used in daily life, for example as materials for crafts, food and beverages, traditional medicines, decorations, building materials and also economical value.

Based on Table-1, it is known that none of the families had conspicuous species representation because each familia was only represented by a few species. The families represented by 3-5 species including Myrtaceae, Annonaceae, Fabaceae, Mimosaceae, Moraceae and Arecaceae. These family groups had a relatively better tolerance for life than others. From all research stations, there were six species that had presence percentage >50%, namely *Pterocarpus indicus* (8.837%), *Swietenia mahagoni* (7.442%), *Samanea saman* (6.512%), *Mimusops elengi* (6.047%), *Tamarindus indica* (5.115%), and *Roystonia regia* (5.115%). Ecologically it can be said that the species mentioned above are groups that have relatively better adaptability and tolerance than other species, of course regardless of human intervention (intentionally planted).

Important Value (NP)

As stated above, the number of plant species observed was 46 belonging to 27 families. Then, The Important Value (NP) of each species at all stations was relatively small (Table-1). This result indicates that the vegetation condition of the study area was relatively homogeneous, but there were six types of plants possessing a relatively high importance compared to others, namely *Pterocarpus indicus* (19.61%), *Swietenia mahagoni* (19.56%), *Polyathia longifolia* (12 .76%), *Mimusops elengi* (12.48%), *Roystonia regia* (12.27%), and *Samanea saman* (10.17%). According to Ismaini et al. (2015) Importance value (NP) of plant species in a community is one of the parameters that shows the role of the plant species in its community. The presence of a plant species in an area shows the ability to adapt to the habitat and wide tolerance to environmental conditions. The greater the NP of a species, the greater the level of control over the community will be and vice versa. In addition, species that have a high NP have an important role in the development of the community in the

area, both related to its role as a component of the ecosystem and in maintaining the stability of the ecosystem in that place.

The control of certain species in a community showed by the ability of a species to be the most existing resources in certain area compared to other species. Species that had a high NP (Table-1) are the species that dominate the USK campus area.

Moreover, the lowest important plant values are *Phyllantus acidus* (0.22%), *Psidium guajava* (0.16%), *Averrhoa carambola* (0.16%), and *Averrhoa balimbi* (0.16%) meaning that this species has a low level of control in an area. This lowest NP also indicates a relatively low adaptability and tolerance. This will have an impact on the existence of these species in the future, if there is a pressure that cannot be overcome, it will result in the loss of a species in a community, even though the life of the species has human intervention.

Diversity Index of Species (H')

Based on the calculation of the tree species diversity index of 21 observation stations showed that 12 stations had a moderate diversity index (medium) and nine stations had a low diversity index (Table-2).

The species diversity index (H') of trees at USK campus ranged from 1.549 to 2.634, categorized as medium. This implies that managers should add species of trees to be planted. They are suggested to plant more tree species to increase the diversity of tree. The higher the value of H', the better the productivity and stability of the ecosystem [11].

Table-2. Species Diversity Index (H') at All Observation Stations

Observation Station	Species Diversity Index (H')	Category	Total of Species
(1) FKG	1,661	Low	6
(2) FKEP	2,089	Medium	10
(3) FK	2,291	Medium	12
(4) FP	2,584	Medium	17
(5) FISIP	1,720	Low	7
(6) FT	2,557	Medium	14
(7) FKH	2,634	Medium	15
(8) FKIP	2,545	Medium	14
(9) FH	2,564	Medium	15
(10) RKU	2,218	Medium	11

Observation Station		Species Diversity Index (H')	Category	Total of Species
(11)	Jamik Mosque	2,087	Medium	9
(12)	Student Sport Hall	1,966	Low	8
(13)	FEB	2,166	Medium	11
(14)	PPs (Postgraduate)	1,938	Low	8
(15)	USK Main Library	2,408	Medium	12
(16)	KPA	2,219	Medium	10
(17)	FMIPA	2,427	Low	13
(18)	Language Center	1,676	Low	6
(19)	FKP	2,215	Medium	10
(20)	Student Domitories	1,643	Low	7
(21)	Lecturer Housing	1,549	Low	20

Ecosystems have regularity as a manifestation of the ecosystem's ability to maintain itself, regulate itself, and automatically rebalance [12]. The equilibration in an ecosystem is called homeostasis or the ability of the ecosystem to withstand various changes in the overall system [13].

The condition of the ecosystem in balance means that the ecosystem has been stable, in this case the ecosystem in question in GOS which is in the campus area in line with the time towards the climax, so that one has great endurance to face various disturbances that befall it. The resilience of the ecosystem depends on the age of the ecosystem. Ecologically, resilience relates to an ecosystem's ability to recover after being affected by disturbances. The faster the condition of the ecosystem recovers, the more disturbances that can be overcome so that it has high resilience [14]. Resilience is the nature of an ecosystem that allows the ecosystem to recover to its original balance after experiencing disturbances [12].

In addition, to maintain high diversity, communities in ecosystem need regular and random disturbances. Communities that are highly stable, regionally widespread, and homogeneous, exhibit lower species diversity than those consisting of mosaic or regionally forested forms and are disturbed at any given time by fire, wind, flood, disease, and human intervention. Generally, after the disturbance has passed, there will be an increase in species diversity until reaching to a point where the dominance of a few long-lived and large species, thus reversing the

tendency to decline in diversity [15]. The data in Table-2 shows that the tree species diversity index for all observation stations is relatively the same. There are 15 stations that have a medium diversity index category ranging from 2.089 to 2.634 while those with a low category ranging from 1.549 to 1.966. Referring to Barbour et al. and Djufri, et al., the value of ranges from 0-7. If $\hat{H} \leq 1$ is a very low category, $\hat{H} \geq$1-2 is a low category, $\hat{H} \geq$ 2-3 is a medium category, $\hat{H} \geq$3-4 is a high category, and $\hat{H} \geq 4$ is a very high category [8][13].

Based on the value of the diversity index (Table-2) it is known that the large number of species did not have a high Diversity index. For example, at station 7 (FKH) there were 15 species with a species diversity index of 2.634, while at station 4 (FP) there were 17 species with the species diversity index was 2.584. The species diversity index is determined by the variation of the important values shown by each species in each sampling unit [13]. Furthermore, Barbour et al. stated that the species diversity index ($\hat{H}$) can be considered as information about the community. The more varied the composition, the more difficult to estimate each sample although in general that multiple species tend to produce a species diversity index [8]. Therefore, to maintain high diversity, communities require regular and random disturbances. Communities that are highly stable, regionally widespread, and homogeneous, exhibit lower species diversity than those consisting of mosaic or regionally forested forms and are disturbed at any given time. In general, an increase after the disturbance has passed, there will be an increase in species diversity to a point where only a few species live for long periods of time and are large in size, thus reversing the tendency for diversity to decline [15][16]. The same thing can happen to the target land, including the GOS at the Syiah Kuala University.

CONCLUTION

The species composition of tree in the USK campus consist of 46 species belonging to 27 families, which is counted as a small number when compared to the Cronquist classification of 317 families.

Six tree species that have relatively high importance compared to others, namely *Pterocarpus indicus* (19.61%), *Swietenia mahagoni* (19.56%), *Polyathia longifolia* (12.76%), *Mimusops elengi* (12.48%), *Roystonia regia* (12.27%), and *Samanea saman* (10.17%).

The species diversity index (H') of trees on the USK campus ranges from 1.549 to 2.634, or in medium category.

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