

The diversity and vegetation structure based on growth levels at an urban green campus in Pekanbaru City, Indonesia

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Abstract. Darmawati, Mulyadi A, Suwondo, Harto S. 2021. *The diversity and vegetation structure based on growth levels at an urban green campus in Pekanbaru City, Indonesia. Biodiversitas* 22: 5123-5132. The Bina Widya campus of the University of Riau, Pekanbaru, Indonesia has the green open space (GOS) in its area and there are many species of vegetation. In a green open space, variables like diversity and vegetation structure must be considered based on growth levels, this study intended to determine the composition, structure, and diversity of vegetation. The results showed that there were 33 species of trees, 29 species of poles, 16 species of saplings, and 8 species of seedlings from 44 species belonging to 22 families. There were 874 individuals which consisted of 534 trees, 207 poles, 87 saplings, and 46 seedlings. The most common species found was *Swietenia macrophylla* King (Meliaceae) with 289 individuals. The highest Important Value Index of vegetation species at each growth level was the tree of *Alstonia scholaris* (L) R.Br (300%, location IX), the pole of *Hibiscus tiliaceus* L. (300%, location VII), saplings of *Vitex pinnata* L. (300%, location IV), and *S. macrophylla* King (300%, locations I), seedlings of *S. macrophylla* King (300%, location I), and *Garcinia mangostana* L (300%, location IX). We did not find vegetation species at the levels of sapling or seedling in locations of II, III, V, VI, and VIII. It is necessary to replant the vegetation. The highest Species Diversity Index (H') at location X was trees (2.34), poles (2.28), saplings (1.77), and seedlings (1.17). The average H' vegetation at Bina Widya Campus UNRI was 2.44 (medium). Vegetation on the Bina Widya Campus is fairly steady in terms of delivering advantages for human environmental services.

Keywords: Campus, green open space, growth level, important value index, species diversity index

INTRODUCTION

A sustainable campus must have a healthy campus environment by reducing energy and natural resource consumption, waste production, environmental management, and upholding social justice such as human rights and environmental benefits, whose overall value must be represented at the community, city, and national levels (Velazquez et al. 2006; Alshuwaikhat et al. 2008). The Stockholm Declaration in 1972 has opened the world's eyes to the dependence between humans and the environment, then bringing several ways to create a sustainable environment (Alshuwaikhat et al. 2008). The involvement of universities in improving environmental conditions is realized through the concept of a sustainable campus. The campuses should be promoted as an environmental model for sustainable development (Scholl et al. 2015). The Green Campus (GC) initiative is one of the sustainable campus concepts aimed towards the university's environment. Green Campus is a concept to build environmentally friendly sustainable living practices in educational institutions around the world (UI GreenMetric 2020a). The GC program is basically motivated by the problems, that the campus environment is expected to be a comfortable, clean, shady (greeny), beautiful, and healthy place to gain knowledge. The campus environment is also an inseparable part of the

urban ecosystem (Tudorie et al. 2020) which applies environmentally friendly principles (Speake et al. 2013). The GC program aims to increase awareness and concern for the campus community as a collection of scientific communities to participate and be responsible for reducing environmental problems such as global warming (UI GreenMetric 2020a).

University of Riau (UNRI) is one of the state universities in Indonesia. The main campus is called the Bina Widya Campus, which has an area of 345.617 ha, it has been functioning since 1983. In implementing the 'tri dharma' of higher education, UNRI conducts education, research, and community service, and is assisted by the Center for Environmental Studies (CES). One of the UNRI-CES work programs is to create a GC environment by integrating the concept of sustainable development based on the mandate in Indonesia Law No. 32 of 2009 concerning Environmental Protection and Management into the policies, management, and activities of higher education (Pusat Studi Lingkungan Hidup 2019). In 2020, UNRI was ranked 35th at the National University of Indonesia (UI) GreenMetric (UI GreenMetric 2020b), an institution established by UI to assess the university's actions towards reforestation and environmental sustainability in the world. UNRI's actions for campus reforestation are shown through regular tree planting activities every single year. The GC is a campus

environment surrounding by green trees, which is known as Green Open Space (GOS).

The green open space provides many functions such as bioecological (physical) functions, which are part of the air circulation system (city lungs), oxygen producer (Jones 2018; Rózová et al. 2020), microclimate regulator (Zölch et al. 2016), as shade (Bagheri et al. 2017), rainwater absorber, air and water circulation system, (Zhang et al. 2015), animal habitat provider (Gulwadi et al. 2019; Iskandar and Iskandar 2016), absorbent (processing) of air, water and soil, pollutants, windbreaks, suitable places to absorb heat, reduce noise from the surrounding streets, reduce dust (Basrowi et al. 2018; Ives et al. 2016; Sivarajah et al. 2018), socio-economic (productive) or become - foodstuffs (Herdiansyah 2020), and cultural functions that are able to describe local cultural expressions, communication media for city residents, places of recreation, places of education and research (Hanan 2013). The GOS function can be used to define local cultural expressions such as constructing a city image based on regional characteristics, such as planting *Oncosperma tigillarium* (Jack) Ridl, in Riau the plant is called 'Nibung'. The existence of a Science Park and Butterfly Garden on the Bina Widya campus is as a means of communication and as a natural laboratory for practicum and experimental research.

According to the regulation of the Indonesia Minister of Home Affairs No. 1 of 2007 about the arrangement of GOS in urban areas, one of the benefits of GOS is as an educational facility or as an open learning space, a place to meet and socialize (Shan 2014; Wolsink 2016). Green Open Space also has a supporting function of urban ecosystems (Tudorie et al. 2020), aesthetic, and ecological functions (Podhrazka et al. 2021). Aesthetic functions can improve comfort and enhance the city environment on a local (residential) and macro (city landscape as a whole) scale (Purnomohadi 2006). Green Open Space in the campus could be in the form of an urban forest that functions as the protection and preservation of germplasm (Lacy and Shackleton 2017; Palliwoda et al. 2017). The vegetation also serves as an integral component in soil and atmospheric systems (Liu et al. 2020; Piao et al. 2015; Tian et al. 2021).

Several studies about vegetation diversity have been carried out by researchers on several different topics such as plant diversity and the relationship between plant communities and environmental (Sembeta et al. 2014), diversity of tree vegetation in the forest (Alhani et al. 2015), plant diversity in traditional fruit gardens (Matius et al. 2018), diversity in Celetuh Geopark (Wulandari et al. 2018), vegetation analysis of karst (2020), diversity of urban parks (Sidik et al. 2021), diversity of wild edible plants to sustainable food security (Hassen 2021), diversity of medicinal plants in home gardens (Ramli et al. 2021), and maintaining tree biodiversity on the university (Susilowati et al. 2021).

The knowledge of the composition, structure, and diversity of vegetation species are some parameters that must be considered in managing campus vegetation and

GOS. Knowledge about vegetation based on the growth level is very significant in vegetation management so that the existence of vegetation is guaranteed in an area so that it will have a sustainable effect. Therefore, it is necessary to know the condition of the composition, structure, and diversity of vegetation species based on the growth level at Bina Widya Campus UNRI, so that vegetation management and GOS can be sustainable and function as they should. This study aims to identify the composition, structure, and diversity of vegetation species based on growth levels at Bina Widya Campus UNRI, Pekanbaru.

MATERIALS AND METHODS

Study area

This study was conducted at Bina Widya Campus University of Riau (UNRI), Pekanbaru, Indonesia (Figure 1). The selection of location was determined by using a purposive random sampling technique based on certain scientific considerations by looking at the condition of the existing vegetation, such as the density of plants, and the number of plants.

There were 11 locations where vegetation samples were documented (Figure 1). The location I: the front entrance to Subrantas street, II: the science park, III: next to the Faculty of Social and Political Sciences, IV: in front of the Mapala secretariat, Faculty of Economics, V: behind the wall climbing venue, VI: in front of the Chemistry building, Faculty of Mathematics and Natural Sciences, VII: in front of the canteen of the Faculty of Engineering, VIII: behind the Student Executive Board of the Faculty of Fisheries and Marine Sciences, IX: in front of the Dean of the Faculty of Fisheries and Marine Sciences, X: Arboretum, and XI: the back entrance lane SM Amin street.

Data collection

The selected procedure considered the conditions of the study area such as the distribution, amount and type of vegetation. Vegetation analysis was carried out using two procedures, i.e., belt transect and line transect. Belt transects are used in the green campus area, i.e., locations II, III, IV, V, VI, VII, VIII, IX, and X. At each location three plots were made, each plot measuring 20 m × 20 m for tree level, 10 m × 10 m for pole level, 5 m × 5 m for sapling level, and 2 m × 2 m for seedling level with nested pattern. While line transects are used in the longitudinal line area, i.e., locations I and XI. At each location, five plots were made, each measuring 4 m × 100 m. The plot is made from the guard post at the gate of UNRI to the inside of the campus. The samples measured were all levels of vegetation growth, such as seedlings, saplings, poles, and trees and recorded the names and number of individuals present in each plot. Species names were identified using references (Thomas 2011; Karyati and Adhi 2018), and verified with an online world database manufacturer (Plants of the World Online 2021).

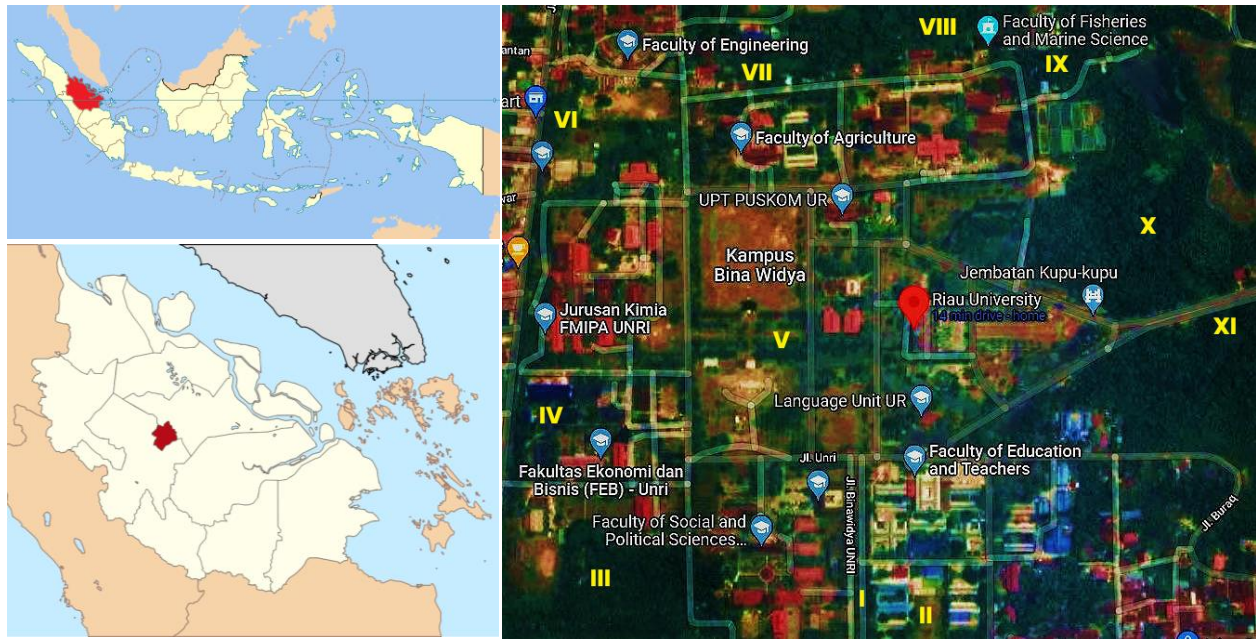


Figure 1. Study area at Bina Widya Campus of University of Riau, Pekanbaru, Indonesia with eleven study sites

Data analysis

The vegetation analysis was conducted to obtain quantitative information about the structure and composition of vegetation towards relative density (Whittaker 1975), relative frequency (Whittaker 1975), relative dominance which was calculated by using Simpson's formula (Odum 1993). The measurement of the important value index for each plant species was sum of relative density, relative frequency, and relative dominance (Mueller-Dombois 1984). The species diversity index was calculated using the Shannon-Wiener formula (Agrawal and Gopal 2013; Iskandar and Iskandar 2016; Shannon and Weaver 1949). An illustration of the distribution of individuals in a particular species of vegetation can be seen in the frequency value. The density of a species shows the number of individuals with a certain unit area. The species diversity index is an index that expresses community structure and ecosystem stability.

$$\text{Relative density (RD)} = \frac{\text{Total number of individuals of species}}{\text{Total number of individuals of all species}} \times 100\%$$

$$\text{Relative frequency (RF)} = \frac{\text{Total frequency of species occur in all plots}}{\text{Total frequency of all species occur in all plots}} \times 100\%$$

$$\text{Relative dominance (RDo)} = \frac{\text{Total basal area of species}}{\text{Total basal area all species}} \times 100\%$$

$$\text{Important Value Index (IVI)} = \text{RD} + \text{RF} + \text{RDo}$$

Important Value Index (IVI) is to show the value of the ecological importance of a plant species in a particular ecosystem. The index is used for determining the rank of species based on their ecology importance. This indicator is used for determining dominant species in each level of growth around certain communities (Susilowati et al.

2020). The species diversity index used the following formula:

$$H' = - \sum p_i \ln p_i$$

Where :

Pi = species composition

ni = significance value of species

N = significance of all species

The criteria for the species diversity index are if $H' < 1$: low level of species diversity, $1 < H' < 3$: medium level of species diversity, $H' > 3$: high level of species diversity. Wiener is a suitable index to calculate the level of species diversity (Suratissa and Rathnayake 2016).

RESULTS AND DISCUSSION

The species composition

The results showed that at the Bina Widya Campus UNRI, there were 33 species of trees, 29 species of poles, 16 species of saplings, and 8 species of seedlings from 44 species belonging to 22 families. The most common species was *Swietenia macrophylla* King with 289 individuals, the plant was found in the locations of I, V, VI, VII, X, and XI, in the growth levels of seedling, sapling, poles and trees and followed by *Eucalyptus grandis* W. Hill ex Maiden with 115 individuals, the plant was found in the locations of III and VII at the growth levels of poles and trees (Table 1).

Swietenia macrophylla is a plant that is suitable for pedestrians, especially in the entrance, because the leaves are dense, and has strong roots and branches so that the plant is not easily broken. The plant species is a large tree

with a height of 35-40 m and diameter of 125 cm, can reduce air pollution by around 47% - 69%, so it is called a protective tree as well as an air filter and water catchment area. The tree is able to survive in arid soil. Its leaves function to absorb the surrounding pollutants, dense foliage allows the removal of air pollutants, and provides shade (Ferrini et al. 2020). The leaves also release oxygen, which makes the surrounding environment become fresh. The soil and roots of *Swietenia macrophylla* King can bind the falling water, so that it becomes a water reserve (Syam 2020). The trees in urban areas must be resistant to high temperature pollutants, has limited root space, and be able to adapt to less water availability in compacted soils. The tree is currently listed as a "vulnerable" tree in the records of The International Union for Conservation of Nature (World Conservation Monitoring Centre 1998). The campus of GOS can also function as a savior for other endangered plants and as a place for ex-situ cultivation. There were 20 species of plants found in the location X Arboretum, such as *Alstonia scholaris* (L) R.Br, *Annona muricata* L, *Archidendron pauciflorum* (Bent.) I.C Nielsen, *Averrhoa bilimbi* L, *Callerya atropurpurea* (Wall) Schot, *Calophyllum macrocarpum* Hook.f, *Endospermum diadenum* (Miq), *Ficus benjamina* L, *Hevea brasiliensis* (Willd. Ex A.Juss.) Mull.Arg, *Palaquium burchii* H.J.L, *Pentaspadon motley* Hook.f, *Porterandia anisophylla* (Jack ex Roxb.) Ridl, *S. macrophylla*, *Samanea saman* (Jacq.) Merr, *Scorodocarpus bornestratum* (Baill.) Becc, *Shorea leprosula* Miq, *Syzygium antisepticum* (Blume) Merr. & L.M.Perry, *Terminalia catappa* L, *Acacia mangium* Willd, *Vitex pinnata* L. Meanwhile, the location with the fewest species was found in location I, with 3 species, i.e. *S. macrophylla*, *Pterocarpus indicus* Willd and *Adenanthera pavonina* L. The composition and structure of the vegetation community are influenced by phenology, dispersal, and natality (Kimmmins 1987). Its success as a new individual is influenced by the different fertility and fecundity in each species.

The number of individuals was 874, it consisted of 534 tree individuals, 207 pole individuals, 87 sapling individuals, and 46 seedling individuals (Figure 3). The predominant growth level was the tree, followed by pole, sapling, and seedling. The highest number of individuals at the tree level was found at the location I (109 individuals), and location XI (117 individuals). The plants planted at the

entrance of Bina Widya Campus was still dominated by road shading plants, such as *S. macrophylla*. This plant has a function as a shade, air pollution reduction, and air filter so that it makes the air around the campus become fresh (Chen et al. 2017; Tiwary and Kumar 2014). This plant has strong roots to avoid vehicle vibrations, is easy to grow in hot areas, and is resistant to wind, making it suitable for use as a shade plant. In addition, the sides plants can absorb pollution elements from motor vehicle fumes, especially lead (Pb), because the campus entrance is not only always passed by the academic community on foot but also by riding the motorbikes and cars.

Plants that are cultivated should have the ability to absorb pollutants, which will help in the improvement of environmental conditions (Gratani et al. 2016; Ives et al. 2016).

The vegetation structure

Table 2 showed that the highest relative density of trees was *A. scholaris* (100%), found at location IX followed by *S. macrophylla* (99.15%) at location XI, and *E. grandis* (97.65%) at location III. The lowest density was *A. scholaris* (23.29%) at location X. The relative density value is an illustration of the number of species in each location. The highest relative frequency value was *A. scholaris* (100%) at location IX, followed by *S. macrophylla* (90.91%) at location XI. The lowest relative frequency was *A. scholaris* (13.89%) at location X. The success of each species of vegetation to survive in a certain area is influenced by all physical environmental factors (temperature, light, soil structure, humidity), biotic factors (interaction among species, competition, parasitism), and chemical factors including water availability, oxygen, pH, interacting nutrients in the soil (Krebs 1994). The relative dominance value of each vegetation species is influenced by the density of species, and the average diameter (at breast height) of mainly tree vegetation. The highest relative dominance species was *A. scholaris* (100%) at location IX, and the lowest was *Rhodamnia cinerea* Jack (18.48%) at location VIII. The relative domination indicates the land surface area that has been covered by a plant species (Odum 1993).

Table 1. The growth levels of vegetation composition at Bina Widya Campus, University of Riau, Pekanbaru, Indonesia

Family	Species name	Local name	Location found (see Figure 1)	T	P	Sa	S	Total
Anacardiaceae	<i>Pentaspadon motley</i> Hook.f	Pelajau	X	-	2	-	-	2
Annonaceae	<i>Annona muricata</i> L	Sirsak	IX	-	-	1	-	1
Apocynaceae	<i>Alstonia scholaris</i> (L) R.Br	Pulai	II	-	-	1	-	1
			III	2	2	-	-	4
			VI	38	4	-	-	42
			IX	7	-	-	-	7
			X	17	5	-	-	22
Arecaceae	<i>Arenga pinnata</i> (Wurmb) Merr	Aren	VI	1	-	-	-	1
	<i>Cocos nucifera</i> L	Kelapa	V	1	-	-	-	1
	<i>Elaeis guineensis</i> Jacq	Sawit	VII	24	-	-	-	24
	<i>Roystonea regia</i> (Kunth) O.F.Cook	Palem Raja	V	1	2	-	-	3

Clusiaceae	<i>Calophyllum macrocarpum</i> Hook.f	Bintangor	X	2	-	-	-	2
	<i>Garcinia mangostana</i> L	Manggis	VI	-	2	-	-	2
			IX	-	-	-	1	1
Combretaceae	<i>Terminalia catappa</i> L	Ketapang	II	1	-	-	-	1
			III	-	1	-	-	1
			VI	2	2	-	-	4
			X	-	-	1	-	1
Dipterocarpaceae	<i>Shorea leprosula</i> Miq	Meranti Bunga	X	5	3	2	-	10
Euphorbiaceae	<i>Endospermum diadenum</i> (Miq.) Airy Shaw	Sendok-sendok	VIII	1	-	-	-	1
			X	-	1	-	-	1
	<i>Hevea brasiliensis</i> (Willd. Ex A.Juss.) Mull.Arg	Karet	II	8	5	-	-	13
			X	13	11	2	4	30
	<i>Hura crepitans</i> L	Kalpataru	V	2	-	-	-	2
Fabaceae	<i>Acacia mangium</i> Willd	Akasia	IV	-	2	-	1	3
			VII	-	-	1	1	2
			X	-	-	15	9	24
			XI	-	-	-	6	6
	<i>Adenanthera pavonina</i> L	Saga	I	4	-	-	-	4
			IV	4	-	-	-	4
			V	4	2	-	-	6
			VI	2	-	-	-	2
			VII	-	-	3	1	4
	<i>Archidendron pauciflorum</i> (Bent.) I.C Nielsen	Jengkol	IV	1	-	-	-	1
			VII	2	-	-	-	2
			X	1	-	-	-	1
	<i>Callerya atropurpurea</i> (Wall.) Schot	Merimbungan	X	5	4	1	-	10
	<i>Cynometra ramiflora</i> L	Kepel	XI	-	1	-	-	1
	<i>Erythrina crista-galli</i> L	Dadap Merah	V	1	-	-	-	1
	<i>Pterocarpus indicus</i> Willd	Angsana	I	46	13	9	-	68
	<i>Samanea saman</i> (Jacq.) Merr	Trembesi	X	-	4	-	-	4
Lamiaceae	<i>Trema micrantha</i> (L.) Blume	Mengkirai	II	-	1	-	-	1
	<i>Vitex pinnata</i> L	Laban	II	1	-	1	-	2
			IV	3	15	11	3	32
			VIII	4	4	1	-	9
			X	8	14	6	9	37
Malvaceae	<i>Durio zibethinus</i> Moon	Durian	VI	1	-	-	-	1
	<i>Hibiscus tiliaceus</i> L	Waru	VII	-	1	2	1	4
Meliaceae	<i>Swietenia macrophylla</i> King	Mahoni	I	59	25	1	5	90
			V	3	-	-	-	3
			VI	2	1	-	-	3
			VII	1	-	10	-	11
			X	8	6	1	-	15
			XI	116	39	8	4	167
Moraceae	<i>Artocarpus heterophyllus</i> Lam	Nangka	V	1	-	-	-	1
			XI	1	-	-	-	1
	<i>Artocarpus integer</i> (Thunb.) Merr	Cempedak	IX	-	1	-	-	1
	<i>Ficus benjamina</i> L	Beringin	X	1	-	-	-	1
Myrtaceae	<i>Eucalyptus grandis</i> W.Hill ex Maiden	Eukaliptus	III	83	13	-	-	96
			VII	19	-	-	-	19
	<i>Rhodamnia cinerea</i> Jack	Marpoyan	VIII	6	5	4	-	15
			X	-	2	2	-	4
	<i>Syzygium antisepticum</i> (Blume) Merr. & L.M.Perry	Kelat	X	4	2	1	-	7
	<i>Syzygium polycephalum</i> (Miq.) Merr. & .M.Perry	Gowok	VIII	-	2	-	-	2
Olacaceae	<i>Scorodocarpus borneensis</i> (Baill.) Becc	Kulim	X	1	-	-	-	-
Oxalidaceae	<i>Averrhoa bilimbi</i> L	Belimbing wuluh	X	1	-	-	-	1
Phyllanthaceae	<i>Baccaurea macrocarpa</i> (Miq.) Mull.Arg	Tampui	IX	-	1	1	-	2
Rubiaceae	<i>Porterandia anisophylla</i> (Jack ex Roxb.) Ridl	Kopi-kopi	X	1	-	-	-	1
Sapindaceae	<i>Nephelium mutabile</i> Blume	Pulasan	X	1	1	-	-	2
	<i>Pometia pinnata</i> J.R.Forst. & G.Forst	Matoa	V	7	-	-	-	7
Sapotaceae	<i>Palaquium rostratum</i> (Miq.) Burck	Nagasari	VIII	1	-	-	-	1
	<i>Palaquium burchii</i> H.J.L	Balam	X	2	-	-	-	2
Theaceae	<i>Eurya acuminata</i> DC	Jenggiti	VIII	-	2	-	-	2
Thymelaceae	<i>Aquilaria malaccensis</i> Lam	Gaharu	VIII	1	-	-	-	1
			X	3	6	2	1	12
Total of ind.	534	207	87	46	874			
Total of species	33	29	16	8				

Notes: S: Seedling; Sa: Sapling; P: Poles; T: Trees; -: Absent

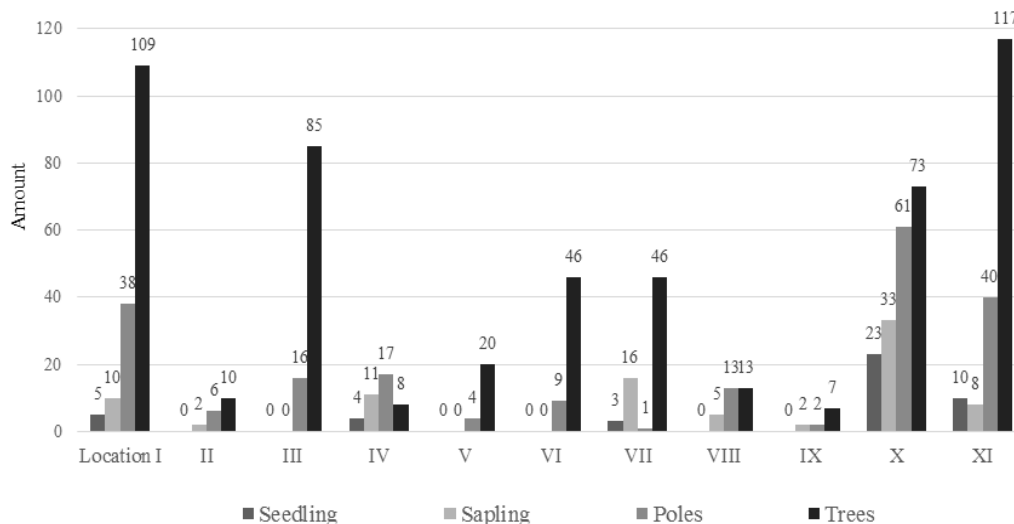


Figure 3. The number of individuals by growth level in each location at Bina Widya Campus, University of Riau, Pekanbaru, Indonesia

The highest IVI of trees at each location was different from one another. The highest IVI was *A. scholaris* (300%) at location IX, followed by *S. macrophylla* (289.39%) at location XI. The species with the highest IVI value are the dominant species and they have an important role and effect on the ecology compared to other species. Important Value Index is one of the parameters which can provide an overview of the role of the species that are concerned in the community (Sundarapandian and Swamy 2000).

Table 3 showed that *H. tiliaceus* at location VII had the highest relative density (100%), relative frequency (100%), and relative dominance (100), while *V. pinnata* at location X had the lowest relative density (22.95%), relative frequency (16%), and relative dominance (20.07%). The highest IVI species was *H. tiliaceus* (300%), found at location VII, while the lowest IVI species was *V. pinnata* (59.02%) at location X. The dominance value was obtained from species density and stem diameter. The vegetation species that has a high density and a high level of dominance indicates a large average diameter and has many individuals. *Swietenia macrophylla* will sustain because of its high density and distribution, especially at pole level, while *H. tiliaceus* is the dominant species at pole level, with the largest number of individuals, and widely distributed so that the species has the potential to replace the dominance of *E. guineensis* at the tree level because *H. tiliaceus* has a good regeneration with a high IVI. The highest IVI species at the sapling level were *V. pinnata* (300%, location IV), and *S. macrophylla* (300%, location XI), followed by *P. indicus* (246.16%, location I) (Table 4). Meanwhile, in the locations of III, V, VI, no sapling vegetation was found. The vegetation at these locations were only trees and poles. Location III was dominated by *E. grandis* at tree and pole levels. Location V was dominated by *P. pinnata* at tree level, and *A. pavonina* at pole level. Location VI was dominated by *A. scholaris* at tree and pole levels.

Table 5 showed that the highest IVI species were *S. macrophylla* (300%) at location I, and *G. mangostana* (300%) at location IX. This shows that the density of

species distribution and the area occupied is high. *Swietenia macrophylla* at location I was not only found at the seedling level, but also found at the levels of tree and poles but not at the sapling level. The availability of *S. macrophylla* found at seedling, pole, and tree levels indicate that the species has high adaptability in the location. At locations of II, III, V, VI, and VIII, only vegetation at the levels of tree and pole were found, and no vegetation at the seedling level. Considering that mostly sapling and no seedling not found in locations of II, III, V, VI, and VIII, Bina Widya Campus needs to be reforested so that GOS remains sustainable.

The species diversity

The diversity of vegetation species from seedlings to trees ranged from 0-2.34 (low-medium). The species diversity indices of seedling, sapling, pole or tree found at locations of V, VI, VII, VIII, IX and X ranged from 1.04-2.34 (medium), while other locations of I, II, III, IV, and XI were at the range of 0.72-0.98 (low). The overall species diversity index ranged from 0.72-7.57 (low-high). The average vegetation diversity index at Bina Widya Campus, UNRI was 2.44 (medium) (Table 6). This is due to the fact that the species diversity index is not spread evenly in each place, with high, medium, and low values. The lowest species diversity index was found at location III (0.72), while the highest was found at location X (7.57). This demonstrates that many types of plants are capable of adapting and winning the competition to reach the level of tree development. The high species diversity index at location X was due to the large number of plant species found, which were 190 individuals belonging to 20 species. The better the species diversity index means the more stable an ecosystem. If there are more species diversity at one location, the community will be more stable at that location. Ecosystem stability is characterized by species richness, species diversity, and even distribution of species. Ecosystem stability will provide benefits for the environment and humans (Suratissa and Rathnayake 2016).

Table 2. The highest IVI of trees level vegetation at Bina Widya Campus, University of Riau, Pekanbaru, Indonesia

Location	Species name	RD (%)	RF (%)	RDo (%)	IVI (%)
I	<i>Swietenia macrophylla</i> King	54.13	41.67	57.41	153.19
II	<i>Hevea brasiliensis</i> (Willd. Ex A.Juss.) Mull.Arg	88.89	75	90.41	254.30
III	<i>Eucalyptus grandis</i> W.Hill ex Maiden	97.65	75	93.95	266.59
IV	<i>Adenanthera pavonina</i> L	50	40	82.72	172.72
V	<i>Pometia pinnata</i> (L) R.Br	35	27.27	24.10	86.37
VI	<i>Alstonia scholaris</i> L	82.60	33.33	80.23	196.17
VII	<i>Elaeis guineensis</i> Jacq.	52.17	33.33	54.20	139.71
VIII	<i>Rhodamnia cinerea</i> Jack	46.15	14.28	18.48	78.92
IX	<i>Alstonia scholaris</i> (L) R.Br	100	100	100	300
X	<i>Alstonia scholaris</i> (L) R.Br	23.29	13.89	32.29	69.47
XI	<i>Swietenia macrophylla</i> King	99.15	90.91	99.34	289.39

Notes: RD: Relative Density; RF: Relative Frequency; RDo: Relative Dominance; IVI: Important Value Index

Table 3. The highest IVI of poles level vegetation at Bina Widya Campus, University of Riau, Pekanbaru, Indonesia

Location	Species name	RD (%)	RF (%)	RDo (%)	IVI (%)
I	<i>Swietenia macrophylla</i> King	65.79	50	69.53	185.32
II	<i>Hevea brasiliensis</i> (Willd. Ex A.Juss.) Mull.Arg	83.33	66.67	93.31	243.31
III	<i>Eucalyptus grandis</i> W.Hill ex Maiden	81.25	60	86.87	228.12
IV	<i>Vitex pinnata</i> L	83.33	60	86.42	229.75
V	<i>Adenanthera pavonina</i> L	50	50	52	152
VI	<i>Alstonia scholaris</i> (L) R.Br	44.44	33.33	58.37	136.14
VII	<i>Hibiscus tiliaceus</i> L	100	100	100	300
VIII	<i>Rhodamnia cinerea</i> Jack	38.46	20	38.16	96.62
IX	<i>Baccaurea macrocarpa</i> (Miq.) Mull.Arg	50	50	54.58	154.58
X	<i>Vitex pinnata</i> L	22.95	16	20.07	59.02
XI	<i>Swietenia macrophylla</i> King	97.5	90	98.60	286.10

Table 4. The highest IVI of saplings level vegetation at Bina Widya Campus, University of Riau, Pekanbaru, Indonesia

Location	Species name	RD (%)	RF (%)	RDo (%)	IVI (%)
I	<i>Pterocarpus indicus</i>	90	83.33	72.83	246.16
II	<i>Alstonia scholaris</i> (L) R.Br	50	50	64.48	164.48
III	-	-	-	-	-
IV	<i>Vitex pinnata</i> L	100	100	100	300
V	-	-	-	-	-
VI	-	-	-	-	-
VII	<i>Swietenia macrophylla</i> King	62.5	42.86	62.27	167.63
VIII	<i>Rhodamnia cinerea</i> Jack	80	50	95.15	225.15
IX	<i>Baccaurea macrocarpa</i>	50	50	76.53	176.53
X	<i>Acacia mangium</i> Willd	45.46	14.29	14.44	74.18
XI	<i>Swietenia macrophylla</i> King	100	100	100	300

Table 6. The number of species and index of species diversity at Bina Widya Campus, University of Riau, Pekanbaru, Indonesia

[illegible]

Table 5. The highest IVI of seedlings level vegetation at Bina Widya Campus, University of Riau, Pekanbaru, Indonesia

Location	Species name	RD (%)	RF (%)	RDo (%)	IVI (%)
I	<i>Swietenia macrophylla</i> King	100	100	100	300
II	-	-	-	-	-
III	-	-	-	-	-
IV	<i>Vitex pinnata</i> L	60	60	59.44	179.44
V	-	-	-	-	-
VI	-	-	-	-	-
VII	<i>Hibiscus tiliaceus</i> L	33.33	33.33	43.86	110.53
VIII	-	-	-	-	-
IX	<i>Garcinia mangostana</i> L	100	100	100	300
X	<i>Vitex pinnata</i> L	39.13	37.5	33.82	110.45
XI	<i>Acacia mangium</i> Willd	60	25	66.99	151.99

**Figure 4.** Some areas of vegetation: A. Urban forest /Arboretum; B. Tree vegetation; C. Fruit garden; D. Rectorate park; E. Educational garden; F. Butterfly park; G. Ecoedupark; H. Science park; I. Greenline

Location X is an urban forest where the vegetation is more natural than others so that the vegetation species are more diverse. The Bina Widya Campus is also part of the GOS of the City of Pekanbaru. Riau University was appointed as an urban forest based on the collaboration between the university and the Municipality Government

of Pekanbaru, reinforced by the Decree of the Mayor of Pekanbaru No. 94 of 2007 concerning the designation of the location of urban forests at Bina Widya Campus area (Pusat Studi Lingkungan Hidup 2019). The species of the urban forest at Bina Widya Campus are the species of protection and the type of germplasm conservation.

Scorodocarpus borneensis and *S. leprosula* are rare and local superior species because their woods are used to build a boat at the 'Pacu Jalur' festival. The festival is one of the traditions or local wisdom of the people of Kuantan Singingi Regency in particular, and the people of Riau Province in general, and held once a year. Vegetation species have different roles (Ferrini et al. 2020) such as medicine, food, clothing, boards, traditional and religious ceremonies. The vegetation of the Bina Widya Campus can be grouped into urban forest, tree lots, parks, and gardens (Figure 4).

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