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Vegetation analysis in Cipayung City Forest, East Jakarta may reveal the difficulty of natural reproduction based on age pyramid

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ABSTRAK

Hutan kota adalah fitur penting perkotaan dengan berbagai layanan untuk populasi manusia dan non-manusia di perkotaan. Kami melakukan survei pada tiga kelompok umur-ukuran di Hutan Kota Cipayung di Jakarta Timur menggunakan kuadrat bersarang. Hutan kota ini memiliki 7 jenis pada pengelompokan sapling, pole, *dan* tree. *Karena jumlah jenis terbanyak terdapat pada kelompok pohon, lebih sedikit pada tiang, dan paling sedikit pada pohon muda; berbentuk piramida umur terbalik/konstriktif, vegetasi di Hutan Kota Cipayung mungkin memerlukan pengelolaan misalnya penanaman ulang untuk mempertahankan keanekaragaman hayatinya. IV tertinggi adalah* Eucalyptus globulus, *yang mungkin tidak dapat bereproduksi secara alami di Cipayung. IV tertinggi pada kelompok tiang adalah* Calophyllum inophyllum *dengan populasi yang sangat sehat di setiap kelompok umur-ukuran. IV tertinggi pada kelompok anakan adalah* Cordyline fruticosa, *jenis tumbuhan ornamental.*

Kata kunci : Reproduksi alami, Hutan kota, Analisis vegetasi

ABSTRACT

Urban forest is an important urban feature with various services for human and non-human urban populations. We surveyed three age-size groupings in Cipayung City Forest in East Jakarta using nested quadrats. This urban forest harbours 7 species of sapling, pole and tree. As the highest number of species is in tree grouping, lower in pole, lowest in sapling; in the form of upside-down/constrictive age pyramid, plant species in Cipayung City Forest may need management plant replanting to maintain its biodiversity. The highest IV is Eucalyptus globulus, which may not be able to reproduce naturally in Cipayung. The highest IV in pole grouping is C. inophyllum with a very healthy population in every age-size grouping. The highest IV in sapling grouping is C. fruticosa, an ornamental species.

Keywords : Natural reproduction, Urban forest, Vegetation analysis

INTRODUCTION

Development and economic development in urban areas tend to reduce green open space which results in disruption of ecosystem balance such as temperature changes, air pollution, water pollution and falling land surfaces. Efforts to reduce this can be done by building or developing Urban Forests with potential tree species that are suitable for the type of area and its designation (Mulyana et al., 2013). The sustainability of forests as a

valuable resource cannot be separated from the issue of stand development and management. Forests will still be able to play a role in accordance with their social, economic and ecological functions if forests are managed properly, in accordance with their functions and roles, one of which is the Urban Forest (Agustian Haryanto Dwi et al., 2015). The urban forest is one of the most important features in an urban environment because it functions as a buffer zone for clean water sustainability, fresh environment, and protector of flora and fauna and fauna (Paransi et al., 2021). Development and economic development in an urban area tend to minimize green open space which has an impact on the disruption of ecosystem balance such as temperature changes, air pollution, water pollution, declining land surfaces and flood hazards. Efforts to reduce these negative impacts can be done by maintaining sustainability and ecosystems and the need for good management so that the existence of quality and function is maintained continuously and sustainably (Suhendang, 2002). Jakarta needs a good quality environment to make it comfortable for its residents. One of the efforts to overcome this is to build and create green open space.

The urban forest functions effectively as a climate controller including as a temperature reducer, solar radiation absorber, wind breaker, soil and water conservation as well as a place for animal life. Cipayung City Forest is a forest located in Jalan Ali, Cipayung District. With a forest area of about 1.3 hectares, this forest is located next to the Jagorawi Toll Road. To get around the forest area, some paving blocks are already available, which are used for leisurely walking or running. However, Cipayung City Forest still needs to be managed and developed again as a better community tourism facility. The purpose of this study was to understand the species composition, structure, density, dominance, frequency and species diversity index in the Cipayung City Forest, East Jakarta.

METHODOLOGY

Time and place of research

The research was conducted in Cipayung City Forest, East Jakarta. The research was conducted in May 2023

Research Methods

The method used in this study was the plot method. The dimensions of the stand measured were the number of species and the diameter of trees and poles. For fieldwork, we used meter tape, camera, stationery, wooden pegs, 5x5, 10x10, and 20x20 m quadrats.

The observation path was made as many as 2 paths, each path consisting of 4 measurement plots. This path was made for measuring vegetation at the research site. Measuring plots are made in each observation path with a size of 20 x 20 meters for tree measurements, sub-plots of 10 x 10 meters for pole observations, sub-plots of 5 x 5 meters for sapling (**Figure 1**).

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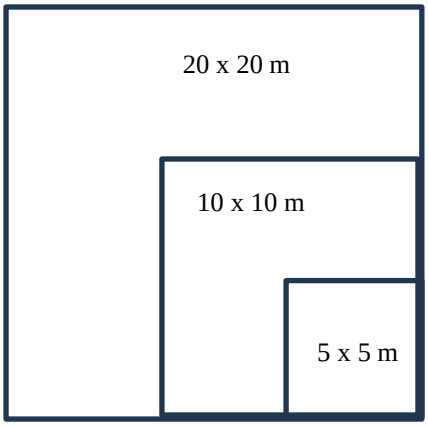

FIGURE 1: Research plot sizes

Data analysis method

The data obtained were analyzed using the formula and importance index (Soerianegara & Indrawan, 1988). We calculated density (De) as the number of individuals of a species per plot and relative density (RDe) as a percentage of De in all plots. We calculated frequency (F) as the occurrence of a species in a certain plot and relative frequency (RF) as a percentage of F in all plots. We calculated Dominance (Do) as the basal area of a species in a certain plot and relative dominance (RDo) as a percentage of Do in all plots. Finally, we combined RDe+RF+RDo into an Importance Value (IV, in percent).

RESULTS AND DISCUSSION

TABLE 1. Vegetation analysis of three age-size groupings. De: density; Do: dominancy; F: frequency; IV: importance value; RDe: relative density; RDo: relative dominance; RF: relative frequency.

Trees in 20 x 20 m quadrats								
No	Species	De	RDe (%)	F	RF (%)	Do	RDo (%)	IV (%)
1	*Artocarpus heterophyllus*	87.5	17.5	1	20	5.495	17.5	55
2	*Calophyllum inophyllum*	87.5	17.5	1	20	5.495	17.5	55
3	*Ceiba pentandra*	37.5	7.5	0.5	10	2.355	7.5	25
4	*Eucaplyptus globulus*	137.5	27.5	1	20	8.635	27.5	75
5	*Swietenia macrophylla*	112.5	22.5	1	20	7.065	25.5	68
6	*Syzygium polyanthum*	37.5	7.5	0.5	10	2.355	7.5	25
Pole In 10 x 10 m quadrats								
No	Species	De	RDe (%)	F	RF (%)	Do	RDo (%)	IV (%)
1	*Artocarpus heterophyllus*	75	23	1	25	4.71	23	71
2	*Calophyllum inophyllum*	100	29	1	25	6.28	29	83
3	*Cordyline fruticosa*	75	23	1	25	4.71	23	71
4	*Syzygium polyanthum*	87.5	25	1	25	5.495	25	75
Sapling in 5 x 5 m quadrats								
No	Species	De	RDe (%)	F	RF (%)	Do	RDo (%)	IV (%)
1	*Calophyllum inophyllum*	75	24	1	4	4.71	24	52
2	*Cordyline fruticosa*	212.5	68	1	4	13.345	68	140
3	*Syzygium polyanthum*	25	8	0.5	2	1.57	8	18

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Of three age-size grouping, we found 7 species in our study area: *Artocarpus heterophyllus, Calophyllum inophyllum, Ceiba pentandra, Cordyline fruticosa, Eucaplyptus globulus, Swietenia macrophylla,* and *Syzygium polyanthum* (**Table 1**). All species are known widely as useful plants. These are ideal plant selection for urban forest, as they are known not only providing service in social and material for urban populace, but also at the same time can produce large canopy important for ecological service in producing oxygen/reducing carbon dioxide and providing habitats for other urban biodiversity (Ossola & Niemelä, 2017).

Artocarpus heterophyllus (Moraceae) is known as highly useful plants as food, animal food, timber, latex, sideway tree, and as medicine (Khan et al., 2021). As an urban forest tree, *A. heterophyllus* is consumed by 63 vertebrate species from 31 families (Taconi & Pires, 2021), potentially providing nutrition for urban animals. Moreover, it is included as an extremely high carbon absorber >1 ton carbon per tree per year (Susanto, Kartawinata, et al., 2021).

Calophyllum inophyllum (Clusiaceae) is known as very useful plants as food (fat), energy (oil/fat), timber and medicine (Lim & Lim, 2012). As an urban plant, *C. inophyllum* is known to store 13.46-ton carbon per hectare per year (Hasnah et al., 2024). Although fruits are not consumed by animals, its nectar is consumed by pollinators (Rahman et al., 2019).

Ceiba pentandra (Malvaceae) had been known as a resource of fibre, timber and medicine. For urban environments, it has fast growth and propagation, and high production of nectar consumed by insects and mammals (Singaravelan & Marimuthu, 2004). It is considered as an extremely high carbon sequester (Susanto, Kartawinata, et al., 2021).

Cordyline fruticosa (Asparagaceae) is different, as it is the only monocot species within the study area. It is a slow carbon absorber, capable of absorbing only 0.159 kg carbon per hectare per year (Audu & Linatoc, 2017). It is used mainly as leafy ornamentals, medicine (Tematio Fouedjou et al., 2023), and minor nectar for insects.

Eucalyptus globulus (Myrtaceae) is also a fast-growing species producing fiber, timber and medicine, much like Ceiba pentandra. It is known to produce nectar consumed by insects and birds (Hingston et al., 2004), and able to store 6.9–7.2 tons of carbon per hectare per year (Pérez-Cruzado et al., 2011).

Swietenia macrophylla (Meliaceae) is a timber producing tree, and lately also used as medicine. For environmental purposes, it is a minor nectar producer for small insects (Paiva, 2012), however a high carbon sequesters, as much as 1.12-ton carbon per hectare per year (Racelis et al., 2019) .

Syzygium polyanthum (Myrtaceae) has been used by the local populace as timber, fruit, spice and medicinal tree. For the environment, it is known to produce abundant fruit consumed by birds and mammals (Mardiastuti, 2021). However, its potential as a carbon sequester in urban environments has not been studied.

In **Table 1**, according to age-size grouping, the sapling, as the smallest, has only 3 species, while pole has 5 species and tree has 7 species. This means that urban forest, including our study area in Cipayung City Forest, is extremely dependent on human

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management in plant regeneration. The tree group has 7 species, and apparently only 3 species had been able to reproduce naturally, resulting only 3 species in sapling group and. This means that *Artocarpus heterophyllus, Ceiba pentandra, Eucaplyptus globulus* and *Swietenia macrophylla* reproduction may depend entirely on human planting. It means we need to manage replanting when the trees are on larger diameter meaning older age. We found five species in pole grouping. We believe that these are slow growing individuals from management planting, not from natural propagation.

The data in **Table 1** revealed an age-size grouping as population (and species) pyramid in a form of upside-down/constrictive age pyramid. This form of population age pyramids is a form of warning on the natural ability of natural reproduction of plants in Cipayung. It is true that as an urban forest, Cipayung may need constant management in maintaining urban plant population, however, as a semi-natural habitat, natural plant propagation must be maintained as well. Our data revealed it is *indeed* the case, as constrictive age pyramid means that lower species in younger/smaller age-size grouping. This means that urban forest, other than Cipayung may also need constant monitoring, including constant replanting to maintain the healthy age pyramid of the whole park.

The most important species (i.e. highest IV) according to age-size grouping are *Eucalyptus globulus* in tree group, *Calophyllum inophyllum* in pole group and *Cordyline fruticosa* in sapling group. This result is logical as *Eucalyptus globulus* is a fast-growing plantation tree, and able to dominate the canopy and the diameter. However, as there is no *Eucalyptus globulus* in sapling and pole group, we believe this species is extremely difficult in natural propagation. *Eucalyptus globulus* is a species non-native to Jawa, and perhaps without natural pollinators or difficult seed germination or seedling survival as natural competition.

On the contrary, *Calophyllum inophyllum* is a species easily reproduced, producing copious seed and seedling. This species, as is found in all three age-size groupings, we believe may reproduce naturally, and form a healthy age pyramid naturally. And as it is a high carbon sequester and nectar producer, its easy reproduction in urban forest is believed highly beneficial for urban populace, including other non-human urban dwellers, including animal and plant species. *C. inophyllum* has the highest IV (**Table 1**) in pole grouping, higher than E. globulus. This again verifies that *E.globulus* may not be able to produce naturally in Cipayung, so that its importance in tree grouping is taken over in pole grouping.

Cordyline fruticosa does not appear in tree grouping, however, only appears in pole and sapling grouping, where it has the highest IV in the latter grouping. It is logical, as *C.fruticosa* belongs to the monocots, which mostly does not grow in large diameter, due to monocot type of growth. **Table 1** showed that in sapling grouping *C. fruticosa* has the highest IV, among two other species. It means, while having smaller diameter, *C.fruticosa* is copious, hence of high importance as sapling. As a pole, its importance is taken over by *C.inophyllum*.

CONCLUSIONS

Cipayung City Forest harbors 7 species of sapling, pole and tree. As the highest number of species is in tree grouping, lower in pole, lowest in sapling; in the form of

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upside-down/constrictive age pyramid, plant species in Cipayung City Forest may need management plant replanting to maintain its biodiversity. The highest IV is *Eucalyptus globulus*, which may not be able to reproduce naturally in Cipayung. The highest IV in pole grouping is *C. inophyllum* with a very healthy population in every age-size grouping. The highest IV in sapling grouping is *C. fruticosa*, an ornamental species.

AUTHIR CONTRIBUTIONS

V.N.: project conception, methodology, data collections, and analyses; H.: original manuscript draft, and manuscript review and editing.

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CONFLICT OF INTEREST STATEMENT

All authors declare no conflict of interest in the writing of this manuscript.

REFERENCES

Agustian Haryanto Dwi, Astiani Dwi, & Togar Fernando Manurung. (2015). Analisa Vegetasi Tegakan Hutan di Areal Hutan Kota Singkawang. *Jurnal HUtan Lestari*, *3*(2), 217–226. https://doi.org/10.26418/jhl.v3i2.10257

Audu, Y., & Linatoc, A. C. (2017). Inventory and Assessment of Carbon Storage Capacity of Non-Timber Plants in Universiti Tun Husein Onn Malaysia, Main Campus, Batu Pahat, Johor Malaysia. *Journal of Science and Technology*, *9*(4). https://doi.org/10.30880/ijie.2018.10.09.001

Hasnah, T. M., Hanudin, E., Leksono, B., Rahman, S. A., Purwanto, B. H., Windyarini, E., Maulana, A. M., & Baral, H. (2024). Carbon stock in calophyllum inophyllum provenances from eight islands in Indonesia: associate soil physicochemical properties and litter fiber content. *Forest Science and Technology*, 1–13. https://doi.org/10.1080/21580103.2024.2438605

Hingston, A. B., Potts, B. M., & McQuillan, P. B. (2004). Pollination services provided by various size classes of flower visitors to *Eucalyptus globulus* ssp. globulus (Myrtaceae). *Australian Journal of Botany*, *52*(3), 353–369. https://doi.org/10.1071/BT03002

Khan, A. U., Ema, I. J., Faruk, M. R., Tarapder, S. A., Khan, A. U., Noreen, S., & Adnan, M. (2021). A review on importance of Artocarpus heterophyllus L.(Jackfruit). *Journal of Multidisciplinary Applied Natural Science*, *1*(2), 106–116. http://dx.doi.org/10.47352/jmans.v1i2.88

Lim, T. K., & Lim, T. K. (2012). Calophyllum inophyllum. *Edible Medicinal And Non-Medicinal Plants: Volume 2, Fruits*, 7–20. https://doi.org/10.1007/978-94-007-1764-0_2

Mardiastuti, A. (2021). Urban trees to attract wild birds in a tropical urban residential complex in Sentul, West Java, Indonesia. *IOP Conference Series: Earth and Environmental Science*, *918*(1), 12003. http://dx.doi.org/10.1088/1755-1315/918/1/012003

Mulyana, S., Penelitian, B., Agroforestri, T., & Raya Ciamis-Banjar, J. (2013). Kajian Jenis Pohon Potensial Untuk Hutan Kota di Bandung. *Jurnal Analisis Kebijakan Kehutanan*, *10*(1), 58–71. https://doi.org/10.20886/jakk.2013.10.1.58-71

DOI: 10.21009/bioma.v20i2.49520

Ossola, A., & Niemelä, J. (2017). *Urban biodiversity: from research to practice*. Routledge.

Paiva, E. A. S. (2012). Anatomy, ultrastructure, and secretory activity of the floral nectaries in Swietenia macrophylla (Meliaceae). *American Journal of Botany*, *99*(12), 1910–1917. https://doi.org/10.3732/ajb.1200122

Paransi, S. E., Sangkertadi, & Wuisang, C. E. V. (2021). Analisis Pemanfaatan Hutan Kota di Kota Kotamobagu. *Media Matrasain*, *18*(2), 2723–1720. https://doi.org/10.35793/matrasain.v18i2.37065

Pérez-Cruzado, C., Merino, A., & Rodríguez-Soalleiro, R. (2011). A management tool for estimating bioenergy production and carbon sequestration in Eucalyptus globulus and Eucalyptus nitens grown as short rotation woody crops in north-west Spain. *Biomass and Bioenergy*, *35*(7), 2839–2851. https://doi.org/10.1016/j.biombioe.2011.03.020

Racelis, E., Racelis, D., & Luna, A. (2019). Carbon sequestration by large leaf mahogany (Swietenia macrophylla King.) plantation in Mount Makiling forest reserve, Philippines: A decade after. *Journal of Environmental Science and Management*, *22*(1). https://doi.org/10.47125/jesam/2019_1/08

Rahman, S. A., Baral, H., Sharma, R., Samsudin, Y. B., Meyer, M., Lo, M., Artati, Y., Simamora, T. I., Andini, S., & Leksono, B. (2019). Integrating bioenergy and food production on degraded landscapes in Indonesia for improved socioeconomic and environmental outcomes. *Food and Energy Security*, *8*(3), e00165. http://dx.doi.org/10.1002/fes3.165

Singaravelan, N., & Marimuthu, G. (2004). Nectar feeding and pollen carrying from Ceiba pentandra by pteropodid bats. *Journal of Mammalogy*, *85*(1), 1–7. https://doi.org/10.1644/1545-1542(2004)085%3C0001:NFAPCF%3E2.0.CO;2

Susanto, D. A., Kartawinata, K., & Nisyawati. (2021). Carbon potentials in biomass of fruit trees in home gardens in the Bogor Regency, West Java. *Journal of Tropical Ethnobiology*, *4*(2), 118–129. https://doi.org/10.46359/jte.v4i2.100

Taconi, S., & Pires, A. S. (2021). Vertebrate frugivory on jackfruit Artocarpus heterophyllus Lam.(Moraceae) in its native and exotic ranges. *Tropical Ecology*, *62*(2), 153–162. http://dx.doi.org/10.1007/s42965-021-00145-6

Tematio Fouedjou, R., Tsakem, B., Siwe-Noundou, X., Dongmo Fogang, H. P., Tiombou Donkia, A., Kemvoufo Ponou, B., Poka, M., Demana, P. H., Teponno, R. B., & Azefack Tapondjou, L. (2023). Ethnobotany, Phytochemistry, and Biological Activities of the Genus Cordyline. *Biomolecules*, *13*(12), 1783. https://doi.org/10.3390/biom13121783

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