Orchid diversity in Kalisegoro village Semarang city, Indonesia

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Abstract. Kalisegoro Village is one of the sub-districts in Semarang City, which is proclaimed a thematic village with the theme "super orchid village." The number of individuals and orchid species cultivated by the Kalisegoro Village community has increased since the community empowerment carried out by PT Phapros and UNNES, which began in 2017. Data on the orchids species in Kalisegoro Village, both wild orchids and orchids cultivated by the community, are currently unavailable. This study aims to analyze the diversity and taxonomic identification of orchid species in Kalisegoro Village. A total of 30 orchids species from 14 genera were recorded from this area. D. bigibbum is the most dominant species with an Importance Value Index (IVI) of 34.5%. The Diversity Index (H') analysis shows that the diversity of orchids in Kalisegoro Village is moderate, namely 2.59 with a fairly high-density index with a value of Dmg = 5.04. The evenness index value is E = 0.76, which means that the distribution of orchids in the research location is quite evenly distributed.

1. Introduction

Orchids are members of the Orchidaceae, one of the largest families of angiosperms, with more than 28,000 species from 768 genera [1]. It is estimated that around 5,000 orchid species grow in Indonesia, while in Java, there are approximately 731 species, about 231 species of which are endemic [2-3]. Despite their high diversity, many orchids are naturally rare [4]. This is exacerbated by human activities that cause habitat destruction, degradation, climate change, and illegal harvesting, making orchids, even more threatened [5-6].

Orchids have been widely traded for commercial purposes, both legally and illegally, for various purposes, such as ornamental plants in the horticulture and floriculture trade, traditional medicinal products, perfume, and aromatherapy [7-9]. The widespread and illegal harvest of orchids in the wild for trade is a threat to wild orchid populations and species in many places [7]. One study reported a large-scale commercial orchid trade in Southeast Asia that was not recorded by official government statistics and CITES authorities [10]. Not only orchids, but the illegal trade also threatens Southeast Asian charismatic mammals, reptiles and amphibians, and tropical plant species. Some of them are in the threatened category [10].

The threat to orchid populations in the wild requires urgent conservation action. One of the conservation efforts that can be done is by cultivating orchids that involve community participation. As stated in The Law of Republic Indonesia No. 5 of 1994 concerning "Ratification of the United
Nations Convention On Biological Diversity” (United Nations Convention on Biological Diversity), that the role of society with traditional characteristics is very much needed in exploiting the wealth of biological diversity and the desire to share equitable benefits in the use of this traditional knowledge through innovations and practices related to the conservation of biodiversity and its sustainable use [11].

Cultivation of orchids by the community and providing economic benefits for the community [12] can also reduce the rate of harvesting of orchids in the wild, thereby reducing the threat to wild orchid populations and species. Based on this, PT. Phapros, together with Semarang State University (UNNES), has been conducting community empowerment in Kalisegoro Village regarding orchid cultivation since 2017. The community empowerment is related to the Thematic Village program that is being launched by the Semarang City Government. Where for Kalisegoro Village, it has the thematic "Super Orchid Village." Assistance in the form of seeds, seeds, and orchid plants has been given to the Griya Mekarsari Orchid Group to be developed and cultivated. So that over the course of three years (2017-2019), the number and species of orchids cultivated by the community of Kalisegoro Village have increased.

Data on the orchids species in Kalisegoro Village, both wild orchids and orchids cultivated by the community, are currently unavailable. Therefore, it is necessary to study the diversity of orchid species in Kalisegoro Village. The orchid diversity data can be a reference in determining the orchid species and conditions that must be considered in supporting environmental conservation in Kalisegoro Village. This study aims to analyze the diversity and taxonomic identification of orchid species in Kalisegoro Village.

2. Methods

The research was conducted in 3 months, from August to October 2019, at Kalisegoro Village, Gunungpati district, Semarang City. The research location is an area overgrown with orchids, wild orchids, and orchids cultivated by the community. Sampling was carried out by purposive sampling method by making square plots measuring 10 x 10 meters which are placed on the transect line along 300 meters.

The species of orchids found in each plot were identified and the number of species counted and then documented using a camera. Species name, genera, coordinates of the orchid location, and altitude where orchids are grown are collected and recorded in a tally sheet. Other important morphological characteristics, such as habitus, orchid size, position, color, and shape of the roots, stems, leaves, and flowers of the orchids, were also recorded in a tally sheet. Species identification was carried out based on the identification key, while references such as Orchid of Java and Orchid of Sumatra were used to support identification. The data is tabulated to calculate species richness, Shannon-Wiener diversity index, and Index of Evenness.

3. Results and Discussion

The characteristics of the Kalisegoro Village area are residential and dry areas. Many orchid plants grow in residential locations. There are orchid cultivation activities by the community as ornamental plants and for commercial purposes. The community carries out the cultivation of orchids by planting them in their house yards and greenhouses. Of the three greenhouses in Kalisegoro Village, three of them are in the hamlet four areas (Research station II), while one greenhouse is in hamlet 3 (Research station I).

Based on the results of research in Kalisegoro Village, it is known that there are at least 30 species from 14 genera with a total of 314 individual orchids. Of the 30 species of orchids found, four were included in the CITES Appendix II (Convention on International Trade in Endangered Species of Wild Fauna and Flora) list. Species included in the CITES Appendix II list are not threatened but could become threatened if the trade continues without regulation [13]. The species included in the Appendix II list are *Appendicula cornuta*, *Dendrobium crumenatum*, *Dendrobium x superbiens*, and *Phalaenopsis sanderiana* (Table 1).
The results showed that of the 30 types of orchids found, 25 were epiphytic orchids, while the remaining 3 were terrestrial orchids (Table 1). Epiphytic orchids are estimated to represent about 70% of all orchids in the world [14]. In general, epiphytic orchids use other plants to support their survival [15]. In the wild, the habitat is in the form of trunks, branches, and twigs of tall trees and attached to other substrates suitable for their survival [16]. Orchids do not have a specific relationship with the host but instead play microclimate support [17]. Epiphytic orchids in Kalisegoro Village are cultivated in pots using growing media such as fern stalks, wood charcoal, and coconut husk.

Terrestrial orchids are different from epiphytic orchids, and terrestrial orchids take their nutrients as a whole from the soil or weathered litter. One of the differences in the way of life of epiphytic and terrestrial orchids is their light requirements, and some terrestrial orchid species require full light [18]. The terrestrial orchids cultivated by the Kalisegoro Village community are planted in pots using growing media such as soil, and some are combined with fern roots.

Table 1. Species name, place to grow, number of individual orchids, and appendix CITES category.

| No | Species                        | Place to Grow | Research Station | Number of Individual | Appendix CITES Category |
|----|--------------------------------|---------------|------------------|----------------------|-------------------------|
|    |                                |               | I                | II                   |                         |
| 1  | Coelogyne sp                   | epiphyte      | 1                | 1                    |                         |
| 2  | Aerides odorata                | epiphyte      | 3                | 3                    |                         |
| 3  | Appendicula cornuta            | epiphyte      | 1                | 1                    | II                      |
| 4  | Cattleya labiata               | epiphyte      | 2                | 9                    | 11                      |
| 5  | Cymbidium sp                   | terrestrial   | 1                | 1                    |                         |
| 6  | Dendrobium affine              | epiphyte      | 1                | 5                    | 6                       |
| 7  | Dendrobium bigibbum            | epiphyte      | 13               | 64                   | 77                      |
| 8  | Dendrobium burana              | epiphyte      | 13               | 7                    | 20                      |
| 9  | Dendrobium crumenatum          | epiphyte      | 5                | 5                    | II                      |
| 10 | Dendrobium burana Greenstar    | epiphyte      | 1                | 1                    |                         |
| 11 | Dendrobium lasianthera x burana jade | epiphyte      | 1                | 1                    |                         |
| 12 | Dendrobium aphyllum            | epiphyte      | 1                | 1                    |                         |
| 13 | Pteroceras teres               | epiphyte      | 2                | 2                    |                         |
| 14 | Dendrobium phalaenopsis        | epiphyte      | 5                | 23                   | 28                      |
| 15 | Dendrobium schulleri           | epiphyte      | 4                | 4                    |                         |
| 16 | Dendrobium shopie bonnie       | epiphyte      | 1                | 2                    | 3                       |
| 17 | Arachnis meggie oei            | epiphyte      | 5                | 5                    |                         |
| 18 | Dendrobium striaenopsis        | epiphyte      | 4                | 14                   | 18                      |
| 19 | Dendrobium x superbiens        | epiphyte      | 2                | 2                    | II                      |
| 20 | Doritis pulcherrima             | epiphyte      | 2                | 2                    |                         |
| 21 | Doritis sp                     | epiphyte      | 1                | 2                    | 3                       |
| 22 | Liparis sp                     | terrestrial   | 1                | 4                    | 5                       |
| 23 | Oncidium varicosum             | epiphyte      | 2                | 2                    |                         |
| 24 | Phalaenopsisamabilis           | epiphyte      | 5                | 49                   | 54                      |
| 25 | Phalaenopsis aphrodite          | epiphyte      | 2                | 8                    | 10                      |
| 26 | Phalaenopsis multiflora        | epiphyte      | 8                | 8                    |                         |
| 27 | Phalaenopsis sanderiana        | epiphyte      | 6                | 6                    | II                      |
| 28 | Spathoglottis plicata          | terrestrial   | 1                | 1                    |                         |
| 29 | Vanda mokara                   | epiphyte      | 3                | 3                    |                         |
| 30 | Vanda Tricolor                 | epiphyte      | 30               | 30                   |                         |

Total 108 206 314

Importance Value Index (IVI) is calculated to describe the level of control given by a species to a community. A species is considered dominant if it has a higher IVI than other species [19]. The IVI analysis shows that five orchid species dominate in Kalisegoro Village. The five orchid species are *Dendrobium bigibbum* (IVI = 34.5%), *Phalaenopsis amabilis* (IVI = 22.4%), *Vanda tricolor* (IVI =
19.2%), *Dendrobium phalaenopsis* (IVI = 12%), and *Dendrobium burana* (IVI = 10.6%) (Figure 1). *Dendrobium* is the most dominating genus. In addition to its varied color and flower shapes, *Dendrobium* is also recorded as one of the Orchidaceae family's largest genera, with more than 2,000 species of orchids included in it [20]. *Dendrobium* dominates Indonesia's market, followed by *Phalaenopsis*, *Vanda*, and other species [21].

Analysis of the Diversity Index ($H'$) of orchids at the research location showed that the diversity of orchids was classified as moderate, namely 2.59, with details at research station I were 2.53. At observation station, II was 2.15. The results of the analysis using the t-test obtained a value of $\rho = 0.606$ ($\rho > 0.05$), meaning that there was no significant difference in the diversity index at the two locations (Table 2).

The orchid diversity index in Kelurahan Kalisegoro ($H' = 2.59$) illustrates that the diversity of orchid species in Kelurahan Kalisegoro is in the medium category close to high. Species diversity is said to be moderate if the diversity index value ($H'$) is greater than or equal to one and less than or equal to three ($1 \leq H' \leq 3$) [22]. The higher the $H'$ index value, the higher the community's diversity and ecosystem, the more stable it is [23]. The factors that influence the level of orchid diversity in Kalisegoro are the existence of orchid cultivation business, community hobbies (fun) to maintain orchids, and orchid seed assistance from various stakeholders such as PT. Phapros, The Agricultural Departement of Semarang City and UNNES.

Meanwhile, the orchid species richness index in Kalisegoro Village is in the high category ($D_{mg} = 5.04$, $D_{mg} > 5$). The high species richness index value is related to the number of constituent species at the research location and the community's utmost care so that environmental factors at risk of orchid growth can be conditioned properly. The density index at research station I ($D_{mg} = 4.6$; moderate) was higher than that at research station II ($D_{mg} = 3.1$; low). This is related to the number of orchid species that make up the location. It is known that the number of orchid species at research station I (23 species) is more than the number of orchid species at research station II (18 species).

![Figure 1. The importance value index (IVI) of orchid species in Kalisegoro village](image-url)
Table 2. Diversity index, species richness index, evenness index, and distribution of orchids in Kalisegoro village

| Parameter                  | Research Station | Total |
|----------------------------|------------------|-------|
|                            | I    | II   |      |
| Number of species          | 23   | 18   | 30   |
| Number of individual orchids| 108  | 206  | 314  |
| Diversity Index (H')       | 2.53 | 2.15 | 2.59 |
| Richness index (Dmg)       | 4.70 | 3.19 | 5.04 |
| Evenness Index (E)         | 0.81 | 0.74 | 0.76 |
| Pola Persebaran (Id)       | -0.01| 0.36 | 0.15 |

The evenness index of orchids in Kalisegoro Village is $E = 0.76$. Because the $E$ value is almost close to 1 (the maximum evenness value), it can be concluded that there are no species that dominate in the community. The evenness index at research station I ($E = 0.81$) was higher than that at research station II ($E = 0.74$). The evenness index in the research location is closely related to the dominance of the number of individuals per species. It is known that several orchid species dominate in terms of the number of individuals per species, such as Dendrobium bigibbum (77 individuals), Phalaenopsis amabilis (48 individuals), Vanda tricolor (38 individuals), Dendrobium phalaenopsis (28 individuals), and Dendrobium burana (20 individuals). This is supported by data on orchids' distribution patterns in Kalisegoro Village, which are regularly distributed ($Id = 0.158; Id <1$).

The distribution pattern of orchid species at each research station is also distributed regularly, respectively, at research station II ($Id = -0.01$) and research station II ($Id = 0.36$). A limiting factor generally causes the regular distribution patterns of orchids in the wild to a population's existence [24]. The regular spread results from negative interactions between individuals, such as competition for food or other specialties [25]. Meanwhile, the level of evenness and distribution pattern of orchid species in Kalisegoro Village is estimated to be due to the people's preference in collecting orchids, including orchid species that are easy to cultivate, affordable orchid seed prices, fast flowering, beautiful flowers, and high selling value of orchids. Phalaenopsis amabilis has a high abundance because, in the greenhouse, people cultivate it for sale. This species is in demand by the public because it has pretty and beautiful flowers.

4. Conclusion

Based on the results of research in Kalisegoro Village, it is known that there are at least 30 species from 14 genera of orchids. Of the 30 orchid species found, four were included in the CITES Appendix II list, namely Appendicula cornuta, Dendrobium crumenatum, Dendrobium x superbiens Phalaenopsis sanderiana. Dendrobium bigibbum is the most dominant species with an Importance Value Index (IVI) of 34.5%. The Diversity Index (H') analysis shows that the diversity of orchids in Kalisegoro Village is moderate, namely 2.59 with a fairly high-density index with a value of Dmg = 5.04. The evenness index value is $E = 0.76$, which means that the distribution of orchids in the research location is quite evenly distributed. It can be said that there is not one orchid species that dominates the location.

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