PROS SEM NAS MASY BIODIV INDON
Volume 4, Nomor 2, Desember 2018
Halaman: 173-177

ISSN: 2407-8050
DOI: 10.13057/psnmbi/m040213

Diversity and conservation strategy of orchids under anthropogenic influence in Taman Wisata Alam Curug Setawing, Yogyakarta

Keanekaragaman dan strategi konservasi pada anggrek terdampak antropogenik di Taman Wisata Alam Curug Setawing, Yogyakarta

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Manuskrip diterima: 18 June 2018. Revisi disetujui: 19 Juli 2018.

Abstract. *Kurniawan FY, Setiaji A, Putri F, Suyoko A, Semiarti E. 2018. Keanekaragaman. Pros Sem Nas Masy Biodiv Indon 4: 173-177.* Yogyakarta memiliki ekoregion yang unik dengan keragaman anggrek yang tinggi. Hutan di Taman Wisata Alam Curug Setawing (TWACS), Yogyakarta terletak di kawasan hutan lindung kemasyarakatan dan menyimpan keanekaragaman anggrek yang tinggi. Dibandingkan dengan keluarga tumbuhan lainnya, anggrek paling rawan akan ancaman, seperti koleksi berlebih, pembukaan lahan dan perubahan iklim. Dalam eksplorasi ini, kami memberikan informasi awal mengenai keragaman anggrek di daerah wisata yang baru dibuka dan faktor-faktor pengaruhnya serta strategi konservasi di area terdampal antropogenik. Sepuluh petak imajiner ukuran 20 m x 20 m masing-masing didirikan secara acak dengan memilih plot sepanjang dua jalur di lokasi. Semua anggrek yang dikumpulkan diidentifikasi dengan mencocokkan sampel koleksi dengan buku-buku flora anggrek. 15 spesies anggrek liar dapat ditemukan di TWACS. Berdasarkan distribusi subfamili, 73,33% spesies termasuk Epidendroideae, 20% Orchidoideae, dan 6,66% Vanilloideae. Berdasarkan cara hidupnya, 46,66% spesies termasuk epifit dan 53,33% terestrial. *Dendrobium crumenatum* memiliki nilai indeks nilai penting tertinggi dibandingkan dengan spesies lain. *Zeuxine* sp. hanya menemukan satu individu karena kemungkinan telah memasuki masa dormansi. Penelitian ini mengungkapkan bahwa untuk meningkatkan ukuran populasi anggrek, beberapa pohon (terutama *Albizia chinensis*, *Syzygium aromaticum*, bambu, *Artocarpus heterophyllus*, dan *Albizia saman*) harus ditanam di daerah di mana spesies anggrek baru-baru ini hilang melalui inventarisasi secara berkala.

Keywords: anggrek, keanekaragaman, konservasi, TWACS

Abstract. *Kurniawan FY, Setiaji A, Putri F, Suyoko A, Semiarti E. 2018. Keanekaragaman. Pros Sem Nas Masy Biodiv Indon 4: 173-177.* Yogyakarta has unique ecoregions with a high diversity of orchids. Forest in Taman Wisata Alam Curug Setawing (TWACS), Yogyakarta is located in a community protected forest area and keeps a high diversity of orchids. Relative to other plant families, orchids are subject to high levels of threat, such as over-collection, land clearing and climate change. In this study, we describe the diversity of orchids in newly opened tourist areas and their influencing factors and conservation strategies under anthropogenic areas. Ten imaginary plots of 20 m x 20 m each were established randomly by selecting points along the two trail in location. All collected orchids are identified by matching the collection sample with orchid flora books. 15 species of wild orchids can be found in TWACS. Based on subfamily distribution, 73.33% of species including Epidendroideae, 20% Orchidoideae, and 6.66% Vanilloideae. Based on growth form, 46.66% of species belong to epiphytes and 53.33% terestrial orchids. Dendrobium crumenatum has the highest of IVI compared to other species. *Zeuxine* sp. found only one individual because it is likely to enter the dormancy period. The study reveals that to improve the population size, trees (mainly *Albizia chinensis*, *Syzygium aromaticum*, bamboo, *Artocarpus heterophyllus*, and *Albizia saman*) should be planted in areas where the orchid species is recently missing through regular inventory.

Keywords: Conservation, diversity, orchids, TWACS

INTRODUCTION

Species diversity indicates the number of species of plants and animals present in a region. Maintaining a wide diversity of species in each ecosystem is necessary to preserve the web of life that sustains all living things (De and Medhi 2014). Orchids is also essential for preserving ecological processes. With approximately 25,000 species that account for 10% of angiosperms worldwide, Orchidaceae is one of the most speciose and widespread families of flowering plants (Swarts and Dixon 2009) with representatives capable of occupying almost every conceivable ecological situation, apart from marine environments and habitats characterised by extreme cold throughout the year (Kull et al. 2006). There are also an important component of any forest ecosystem with a highly

intricate mutual relationship with other biota. This part also attracts insects and other pollinating agents to enable its propagation (Liu et al. 2006). Orchid seeds require syimbiosis by arbuscular-mycorrhizal fungi for germination and depend on this interaction for nutrition into adulthood (McCormick et al. 2018). Apart from the aesthetic appeal which is its main feature, many orchids are known to have medicinal properties (Gutiérrez 2010) and are used in religious ceremonies and social culture in India and world over (Kala 2009). Their presence along with other epiphytes is an indication of a healthy ecosystem.

Relative to other plant families, there is evidence that orchids are subject to high levels of threat, the increasing popularity of orchids among collectors, along with factors such as land clearing and climate change, through both natural and anthropogenic causes (Wraith and Pickering 2017). In recent decades orchids also feature prominently in many national Red Data Books, and the abundance of many orchid species is believed to have fallen to critical levels (Kull et al. 2006). Globally, habitat loss is recognised as the major threat to biodiversity with extensive areas of vegetation cleared annually, including in areas of high orchid diversity (Brummitt et al. 2015). In Kulon Progo, Yogyakarta, the development of the tourism sector is massive by opening new natural attractions, such as Taman Sungai Mudal, Kedung Pedut Waterfall, Kleco Hill, and Taman Wisata Alam Curug Setawing (TWACS). The natural beauty of the area is the driving force of regional economic development, but at the expense of new land clearing that threatens orchid biodiversity.

Kulon Progo has a unique ecosystem with Menoreh Mountains that have the second largest orchid diversity after Mount Merapi National Park for Yogyakarta. Knowledge about the distribution patterns and ecology of species is fundamental for conservation and management of biodiversity (Margules and Pressey 2000). In this study, we describe the diversity of orchids in newly opened tourist areas and their influencing factors and conservation strategies under anthropogenic areas.

MATERIALS AND METHODS

Study area

Forest around the Taman Wisata Alam Curug Setawing (TWACS) lies in the Mts. Menoreh of Kulon Progo District, Province of Yogyakarta Special Region, Indonesia, with coordinate 7°44'24.3"S, 110°08'44.3"E and occupies an area of 95,604.20 sq.m. Ten imaginary plots of 20 m x 20 m each were established randomly by selecting points along the two trail in location. Sampling started on April 2018 until May 2018.

Species identification

All collected orchids are identified by matching the collection sample with orchid flora books, Orchids of Java (Comber 1990) and Orchids of Sumatra (Comber 2001). Subfamily refers to the NCBI taxonomy. Observations on the flower morphology carried out to identify the species level. Non-flowering species can only be identified to the genus level. Additional data about the subfamily and growth form of the orchids (e.g. if it was terrestrial, epiphytic or lithophytic) was obtained.

Data analysis

Data obtained was analysis descriptively to gain the special features of each species and the importance value of the species abundance by the following formula:

IV = RD + RF

Data of the density, frequency, relative density and relative frequency was calculated using the formulas:

$$Density = \frac{\text{Number of individuals of each species}}{\text{Area of the sampling}}$$

$$Frequency = \frac{\text{Number of sampling units in which the species was found}}{\text{Total number of sampling units}}$$

$$RD = \frac{\text{Density of species A}}{\text{Total density of all species}} \times 100\%$$

$$RF = \frac{\text{Frequency of species A}}{\text{Total frequency of all species}} \times 100\%$$

Note: Importance value index (IVI); Relative density (RD); Relative frequency (RF)

RESULTS AND DISCUSSION

Based on subfamily distribution, 73.33% of species including Epidendroideae, 20% Orchidoideae, and 6.66% Vanilloideae. According to Dressler (1990), 80% of the tribe of Orchidaceae belong to Epidendroideae. Its members have one stamens, which look very convex (incumbent) to suberect (up to the edge). Some authors classify it into monandroideae (Shukla and Misra 1979). The other four tribe are also classified into the Monandroideae. Based on growth form, 46.66% of species belong to epiphytes and 53.33% terestrial orchids.

Dendrobium crumenatum has the highest of IVI compared to other species. Pigeon orchid is the most cosmopolitan and abundant epiphytic orchid throughout the tropical area. Whereas *Zeuxine* sp. found only one individual because it is likely to enter the dormancy period.

Discussion

Orchids are widely distributed in the tropics and subtropics with different life forms (Cribb et al. 2003). Recent studies suggested that distribution of orchids were limited by the joint effect of habitat availability and pollination limitation (McCormick and Jacquemyn 2014). Specifically, patterns of orchid richness are regulated by habitat size and elevation range at large scales (Jacquemyn et al. 2005; Schödelbauerová et al. 2009; Acharya et al. 2011), while by light availability, soil moisture, canopy height and area (especially for the epiphytic orchids) at fine scales (Gravendeel et al. 2004; Huang et al. 2008;

McCormick and Jacquemyn 2014). The forests in Kulon Progo has characteristics suitable for growth, development, and spreading of orchids. The hilly areas are mostly located at 101-500 m altitude, and most have slope more than 160 (Sartohadi 2005). During the year 2016, the average monthly rainfall is 241 mm and rainy day 15 rd per month. The sampling sites are in protected forest community forest, with dominant land composition of latosol and grumusol soil. This means that the habitat is supported by dry soil conditions with moist air, availability of water sources, and the presence of shade trees and host.

Andhikari and Fischer (2011) showing that the bark water-holding capacity, bark pH, bark roughness and light intensity is affect the level of occupation of epiphytic orchids in a region. Many epiphytes grow on timber-producing trees medium rougness like *Albizia chinensis, Syzygium aromaticum, Cocos nucifera, Artocarpus heterophyllus, Tamarindus indica, Tectona grandis, and Albizia saman* are located in humus rich moist earth under tree shades. Climate change can influences orchid diversity by altering the seasonal changing. Longer dry season and late rainy season will affect orchids in growth and reproduction (Barman and Devadas 2013). This may be the cause of terrestrial orchids more easily found on bamboo clumps, growing in wet soil containing partly-decomposed bamboo leaf litter, in the shade cast by the bamboo plant's canopy.

The environment plays a role in selecting species to survive in a habitat. Ecologically it can be argued that the important value shown by each species is an indication that the species is considered dominant in the area, which has a higher frequency, density, and dominance value than any other species. Referring to table 1 *D. crumenatum* a species with the highest importance value index (IVI), i.e 32.58%. Most species have relatively low IVI. Such conditions are common in vegetation types that lead to climactic and stable conditions. But not so in this study, the distribution pattern orchids tend to spread causing significant value figures to be low.

Conservation and management implications

Kulonprogo mountain has an area of 154.41 km^2 (51.19%) and 75.38% is non-forest area (Juhadi 2012), or less than 30% means it is below the minimum threshold (*UU No. 47 tahun 1997*). Being the forest area is a fulfilling its function is important, especially in the provision of water, flood and erosion control, recreation and forest products for various purposes (Kepas 1985; Ka'ban 2006). Although TWACS is included in protected forest areas, it is necessary to monitor regularly on the status and utilization of this forest.

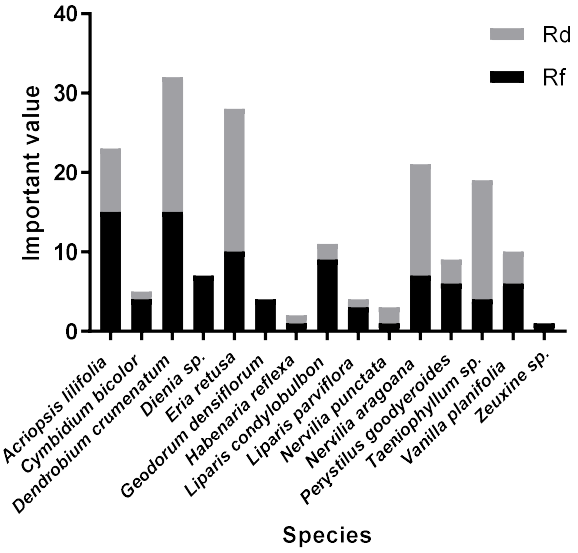

Figure 1. Important value index of wild orchids in Taman Wisata Alam Curug Setawing (TWACS), Yogyakarta

Table 1. Orchids species in Taman Wisata Alam Curug Setawing (TWACS), Yogyakarta

Species	Subfamily	LF	D	F	RD	RF	IVI
Acriopsis liliifolia (J.Koenig) Seidenf.	Epidendroideae	E	47	1	8,79	15,38	24,17
Cymbidium bicolor Lindl.	Epidendroideae	E	10	0,3	1,87	4,62	6,48
Dendrobium crumenatum Sw.	Epidendroideae	E	92	1	17,20	15,38	32,58
Dienia ophrydis (J.Koenig) Seidenf.	Epidendroideae	T^E	32	0,5	0,00	7,69	7,69
Bryobium retusum (Blume) Y.P.Ng & P.J.Cribb	Epidendroideae	E	99	0,7	18,50	10,77	29,27
Geodorum densiflorum (Lam.) Schltr.	Epidendroideae	T	3	0,3	0,56	4,62	5,18
Habenaria reflexa Blume	Orchidoideae	T	8	0,1	1,50	1,54	3,03
Liparis condylobulbon	Epidendroideae	E	12	0,6	2,24	9,23	11,47
Liparis parviflora (Blume) Lindl.	Epidendroideae	E	10	0,2	1,87	3,08	4,95
Nervilia punctata (Blume) Makino	Epidendroideae	T^A	15	0,1	2,80	1,54	4,34
Nervilia aragoana	Epidendroideae	T^A	77	0,5	14,39	7,69	22,08
Peristylus goodyeroides (D.Don) Lindl.	Orchidoideae	T	20	0,4	3,74	6,15	9,89
Taeniophyllum sp.	Epidendroideae	E	85	0,3	15,89	4,62	20,50
Vanilla planifolia Jacks. ex Andrews	Vanilloideae	T^E	24	0,4	4,49	6,15	10,64
Zeuxine sp.	Orchidoideae	T^A	1	0,1	0,19	1,54	1,73

Note: LF= life form; D=density; f=frequency; RD=relative density; RF=relative frequency; IVI=important value index. LF: E=epiphyte; T=terestrial, A=amoebophyte

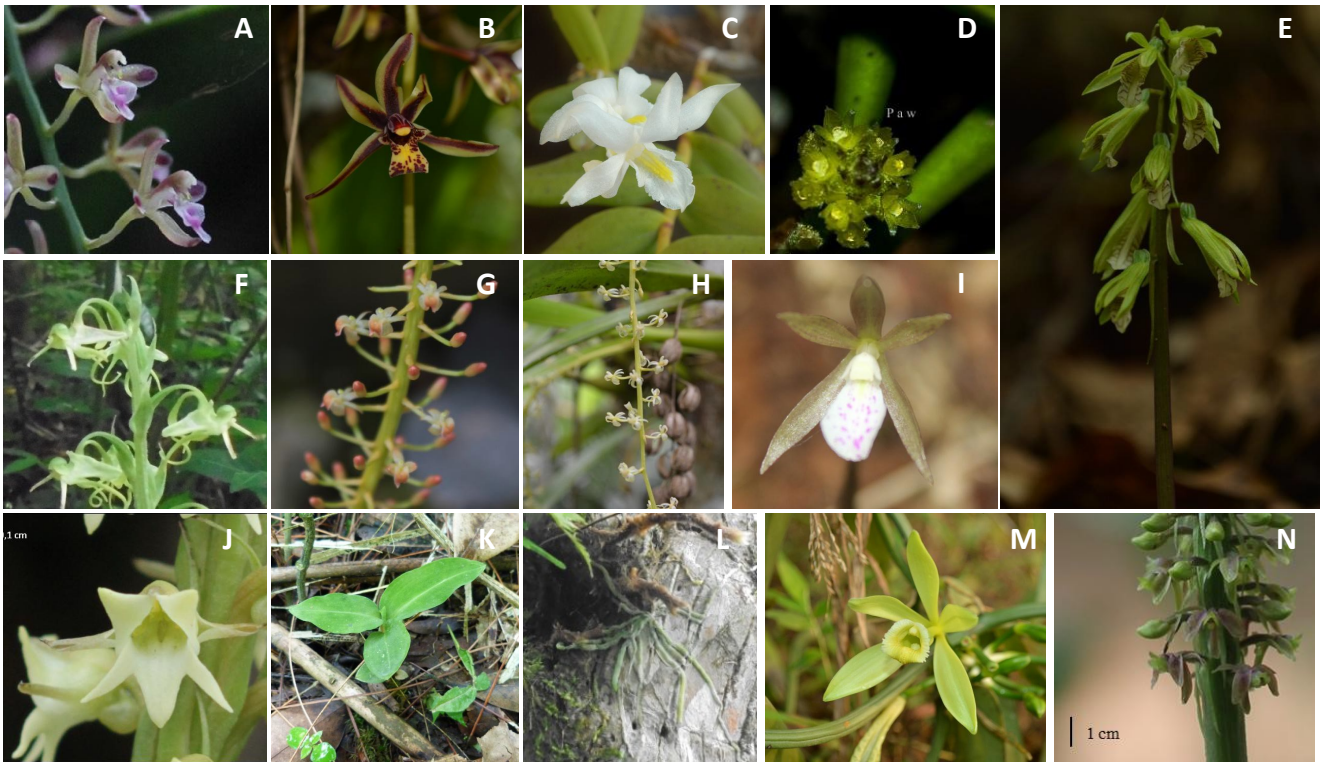

Fig 2. Orchid species in Taman Wisata Alam Curug Setawing (TWACS), Yogyakarta. A. *A. liliifolia*, B. *C. bicolor*, C. *D. crumenatum*, D. *B. retusum*, E. *G. densiflorum*, F. *H. reflexa*, G. *L. condylobulbon*, H. *L. parviflora*, I. *N. punctata*, J. *N. aragoana*, K. *P. goodyroides*, L. *Taeniophyllum* sp., M. *V. planifolia*, N. *Zeuxine* sp.

Our results show that orchids is mainly found either in groups of trees or in forest patches or park areas. Orchid exploitation was not observed in Kulon Progo since orchids are not well known and less valuable. Yet, terrestrial orchids which grow among crops are known as weeds and treated like weeds. To improve the population size, we suggest planting of new host trees in groups instead of single isolated trees. These trees should be planted in areas where orchids population still exists to be able to provide suitable habitats for the orchids in the future. We suggest that habitats with a mixture of mature trees are essential for the conservation of large, viable populations of epiphytic and terestrial orchids in longer run.

According to Zotz (2007), the growth and maturation of epiphytic orchids is extremely slow. The time from germination to maturation is estimated to be one decade (Hietz 1999). This reflects that a long-term management plan is needed where to make sure that enough suitable host trees are available for orchid colonization. This includes both protection of existing host trees and planting of new ones. Long-term studies are further needed to understand the relationship between temporal variation in environmental conditions and functioning of orchid populations. Studying how tropical epiphytes are affected by microclimate and intensity of land use yield critical information for the conservation of wild orchids in the face of ongoing rapid landuse and environmental changes. Data on the size of orchid population can also be reported for gain conservation status of wild orchids.

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