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Orchids of Mount Ungaran (Indonesia) compiled from a decade of data collections between 2010 and 2021

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Abstract. *Kurniawan FH, Nazar L, Anjarwati R, Sasono HD, Rahayuningsih M. 2021. Orchids of Mount Ungaran (Indonesia) were compiled from a decade of data collection between 2010 and 2021. Nusantara Bioscience 13: 238-252.* Orchid is well known as a plant group widely used as ornamental plants because of their uniqueness. But, high exploitation, deforestation, and land-use changes have threatened orchid species and triggered extinction. It also happened in Mount Ungaran, Central Java, Indonesia, despite its designation as an essential ecosystem area. This research was conducted to add an updated list of wild orchid species that can serve as biodiversity baseline data for conservation management in Mount Ungaran. The study was carried out through exploration activities from 2010 to 2021. The study area covered 11 sites, i.e., Gentong, Kalisidi, Pasigitan, Banyuwindu, Watuondo, Indrakila, Gonoharjo, Gajahmungkur, Camp Mawar, Gondang, and Puncak, which were all included in the buffer zone of Mount Ungaran. A total of 115 species from 54 genera of orchids were successfully identified, including 78 species of epiphyte and 37 species of terrestrial orchids. Among the species recorded, at least 27 species were known to be endemic to Indonesia, and 8 species were endemic to the island of Java, of which four species were listed in the IUCN Red List. In addition, all the species found were listed in Appendix II of the CITES, except one species, *Paphiopedilum javanicum*, which was listed in Appendix I. This study recorded the new distribution records of several species of orchids that were previously only found in West Java or East Java, i.e., *Ania penangiana*, *Pholidota convallariae*, and *Crepidium junghuhnii*. This study has also documented a species from the genus *Crepidium*, which morphological characters have not been described in any identification guides. The Gentong area has the potential as a priority for in-situ orchid protection area of the highest number of species reached 54% of all orchids found on Mount Ungaran.

Keywords: Diversity, Mount Ungaran, Orchidaceae, wild orchid

INTRODUCTION

The Orchidaceae (orchid group) is one of the largest families in the plant kingdom, consisting of about 28,000 currently accepted species and some 800 subspecies distributed in about 763 genera (Biswas and Singh 2019). The Orchidaceae family can be divided into five sub-families: Apostasioideae, Cypripedioideae, Epidendroideae, Orchidoideae, and Vanilloideae (Chase et al. 2015; Dong et al. 2018). As a mega-biodiversity country in the tropical equator, Indonesia consists of at least 5,000 species of orchids (Hariyanto et al. 2020). The presence of mountains in Java contributed to the high value of wild orchids. It is recognized that Java has at least 731 species within 130 genera (Comber 1990). For example, Mount Ungaran in Central Java, with an extent of 5,500 ha, comprises forested areas and mixed plantations that serve as habitats for various species, including wild orchids.

Because of the richness of their members, orchids have a variety of diverse growth forms, such as lithophytes, terrestrials, epiphytes, to saprophytes. It's the same with leaf shapes ranging from pencil form, elongated, rounded, peltate, etc. Like most monocotyledonous plants, the orchid lamina exhibits parallel leaf veins types with thicknesses that vary from thin to fleshy. Orchid species may be recognized by the unique flower structures, which show three sepals**,** one on the back called the dorsal sepals, while the other two are called lateral sepals. In addition, orchids also have two lateral petals and one differentiation petal (Artaka 2019; De 2020). This differentiation petal is modified as labellum and column, the modification to self-pollination and even attract their pollinators (Attri and Kant 2011).

Orchids have ecological, economic, and even health benefits. In ecology, orchids are bio-indicators of environmental health due to their sensitivity to environmental changes, play a role in the nitrogen cycle, and support soil composition due to their association with mycorrhizae (Seaton et al. 2013; Nurfadilah et al. 2016). Economically, orchids are popular as ornamental plants; thus, wild orchids have the potential as a parental lineage in a breeding program to produce beautiful desired varieties (Sadili and Sundari 2017). Regarding health benefits, some orchid species are herbal medicines such as pain relievers, anti-inflammatory, anti-rheumatic, and digestive, and even used as toners and beauty soaps (Asseleih et al. 2015). Unfortunately, such uses often reduce the natural population of some orchid species and even cause local extinction.

Despite being designated as an important bird and biodiversity area (Birdlife International 2021), some forested areas in Mount Ungaran have been deforested (up to 31.5-40.1%) during the 2000-2005 periods due to agricultural expansion and settlement development (Rahayuningsih et al. 2015; Rahayuningsih et al. 2020). Furthermore, other data showed that from 1991-2009, about 75% of the forest of Mount Ungaran was converted to other land uses (Rahayuningsih et al. 2017). In addition, the existence of orchids in Mount Ungaran is also threatened by illegal collection by orchid hunters. Altogether, these threats put pressure on various types of orchids to endangerment, moreover for species that have not been recorded (Agustini et al. 2016; Besi et al. 2019).

Several studies regarding the conservation of Mount Ungaran have been carried out, including data collection on birds and another biodiversity (Rahayuningsih et al. 2015; Rahayuningsih et al. 2017; Rahayuningsih et al. 2020). However, the study on orchids of Mount Ungaran has not been fully revealed, while the threats to the plant, as mentioned above, continue unabated. Over many years, wild orchids' botanical collections have been focused on ex-situ species conservation to save them from extinction (Besi et al. 2019). Although a book on orchids in Ungaran has been published for a conservation purposes (Utami et al. 2018), some anecdotal information about undocumented species has not yet been published scientifically.

Therefore, this study aimed to inventory orchids in a broader scope of Mount Ungaran to provide an updated list of orchid species in the area. The documented species will be accompanied by data on species composition based on the area studied, life types, current global distribution, and their conservation status. The result of this study can be used as baseline information to support the ongoing conservation and management program, including the plan for establishing Mount Ungaran as an Essential Ecosystem Area (*Kawasan Ekosistem Esensial/KEE*).

MATERIALS AND METHODS

Study sites

Mount Ungaran is located in Central Java Province, Indonesia (S 7°12' E 110°20'), one of the remaining forest areas on Java Island that Perhutani manages. Mount Ungaran has 5,500 ha, covered by two regencies, i.e., Kendal and Semarang provinces of Central Java, Indonesia. Mount Ungaran has an average temperature range from 22 to 27ºC and an altitude range between 900-2,050 masl. Mount Ungaran has several habitat types, i.e., primary dry forest and secondary dry forest with coffee plantation under the canopy. The study took place in 11 sites, i.e., Gentong, Kalisidi, Pasigitan, Banyuwindu, Watuondo, Indrakila, Gonoharjo, Gajahmungkur, Camp Mawar, Gondang, and Puncak (Figure 1).

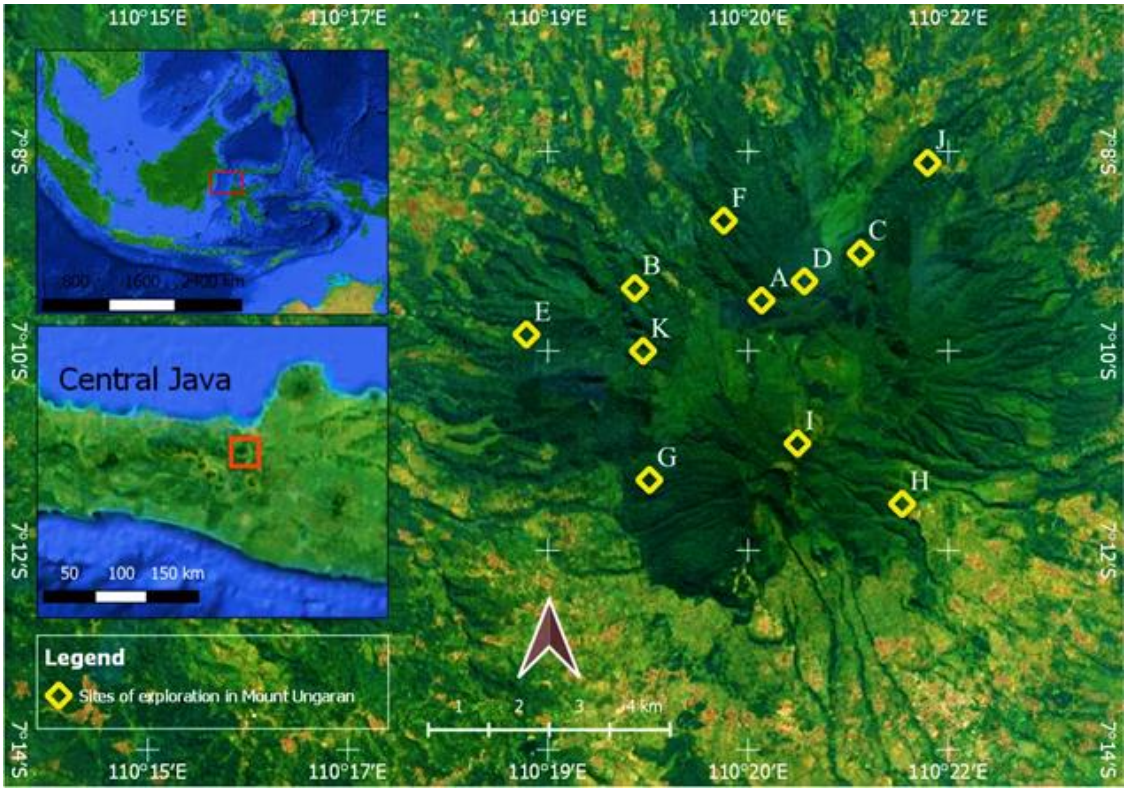

Figure 1. Map of the study sites of orchids exploration in Mount Ungaran, Central Java, Indonesia: A. Gentong, B. Watuondo, C. Kalisidi, D. Pasigitan, E. Banyuwindu, F. Gonoharjo, G. Gondang, H. Mawar Camp, I. Puncak, J. Indrakila (Source: Google Satelite and field data. Coordinates system WGS 84)

Gentong, Kalisidi, Pasigitan, Banyuwindu, Watuondo, Gonoharjo, and Indrakila are sub-montane forests with altitudes between 900-1,500 m asl, represent the secondary forest with the domination of *Syzygium* sp., *Weinmannia fraxinea* and some of Lauraceae and Euphorbiaceae families. Under the canopy in, these areas are commonly used by localities as coffee plantations. Then, Gajahmungkur, Gondang, and Puncak are montane forests with ranges of altitudes 1,500-2,050 masl, represent the primary forest, and are relatively dominated by members of Fagaceae family (*Lithocarpus* sp., and *Castanopsis* sp.) (Figure 1). In addition, we explored Mawar Camp (1,000-1,800 masl), a unique area with three vegetation types: homogenous pine plantation, primary forest, and intensive coffee plantation. Mawar Camp is used by localities as a legal tracking route to submit the mountain. We explored all of these areas from 2010 to 2021, divided into 3 periods: the first in 2010-2014, the second in 2014-2018, and the last third in 2018-2021.

Data collection procedures

Data were collected using an opportunistic sampling method by searching for species in habitats along defined pathways in every 11 sites. We used the photographic approach to minimize the collection of living specimens and the herbarium. The picture of each orchid organ in each species was as detailed as possible, including the habitus, leaves, stem, inflorescence, and flower. In addition, clear flower photographs must show that the petals, sepals, labellum, and column were conducted as important orchid characters for identification. Finally, GPS tagged each orchid species found in the pathways as a base for weekly monitoring to check the flowering periods.

Data analyze

The taxonomical identification used several sources, including Orchids of Java (Comber 1990), *Die Orchideen von Java Figuren atlas* (Smith 1908), and the online data from Swiss Orchids Foundation (https://orchid.unibas.ch/index.php/en/) The valid names and the current distribution data were retrieved based on the current data of The World Checklist of Selected Plant Families (Govaerts et al. 2021). Expert consultations were also sought to make an accurate identification. The protection status of each species was based on IUCN (http://www.iucnredlist.org), Index of CITES species (https://checklist.cites.org/#/en), and Indonesian Regulation of Peraturan Menteri Lingkungan Hidup dan Kehutanan Republik Indonesia No. P.106/MenLHK/Setjen/Kum.1/12/2018 for validation (KLHK 2018).

RESULTS AND DISCUSSION

Species composition

Across the 11 sites surveyed in Mount Ungaran, a total of 115 orchid species were found, including 78 species that were epiphyte, and the remaining 37 species were terrestrial in their life type (Table 1). All the species found were successfully identified except one from the genus *Crepidium.* Among the 11 areas surveyed, Gentong had the highest number of species, with 61 species, while Indrakila had the lowest number, with only six species (Figure 2A). The second survey period found the most significant number of orchids, with a record of 93 identified species, followed by the first with 82 species and the third with 52 species (Figure 2B). We found 27 species endemic to Indonesia and eight endemics to Java island. The protection status of CITES includes 114 species in Appendix II, and only a species is in Appendix I, and National regulations did not protect all of these species. On the other hand, four species are protected by the IUCN Redlist, including *Paphiopedilum javanicum* (Reinw. ex Lindl.) Pfitzer, which is categorized as Endangered and Appendix I.

Table 1. Orchids found and identified in Mount Ungaran, Central Java Province, Indonesia

Taxa	Growth habit	Protection status			Global current distribution	Specific distribution in the areas studied
		IUCN	CITES	Indonesian law		
Acriopsis liliifolia var. *liliifolia* (J.Koenig) Ormerod	E	-	II	-	Andaman Is., Bismarck Archipelago, Borneo, Cambodia, Caroline Is., East Himalaya, Jawa, Laos, Lesser Sunda Is., Malaysia, Maluku, Myanmar, New Guinea, Philippines, Queensland, Solomon Is., Sulawesi, Sumatera, Thailand, Vietnam	Ban, Maw, Gond
Aerides odorata Lour.	E	-	II	-	Andaman Is., Assam, Bangladesh, Borneo, Cambodia, China South-Central, China Southeast, East Himalaya, India, Jawa, Laos, Lesser Sunda Is., Malaysia, Myanmar, Nepal, Nicobar Is., Philippines, Sulawesi, Sumatera, Thailand, Vietnam, West Himalaya	Gen, Ban, Gond
Agrostophyllum cyathiforme J.J.Sm.	E	LC	II	-	Borneo, Jawa, Malaysia, Sumatera	Maw, Gond
Agrostophyllum stipulatum subsp. *bicuspidatum* (J.J.Sm.) Schuit.	E	-	II	-	Borneo, Jawa, Malaysia, Sulawesi, Sumatera	Gen, Kal, Pas, Gon, Ban, Gaj, Wat, Gond
Ania penangiana (Hook.f.) Summerh.	T	-	II	-	Assam, Borneo, East Himalaya, Hainan, India, Jawa, Malaysia, Maluku, Nepal, New Guinea, Sumatera, Taiwan, Thailand, Vietnam	Gen, Pas
Anoectochilus reinwardtii Blume	T	-	II	-	Borneo, Jawa, Malaysia, Maluku, Sumatera, Thailand	Gen, Wat
Appendicula alba Blume	T	-	II	-	Borneo, Jawa, Lesser Sunda Is., Malaysia, Philippines, Sulawesi, Sumatera, Thailand	Gen, Gaj, Gond
Appendicula angustifolia Blume**	E	-	II	-	Jawa, Sumatera	Gen, Kal, Pas, Gon, Ban, Gaj, Wat, Gond
Appendicula ramosa Blume**	E	-	II	-	Jawa, Lesser Sunda Is., Sulawesi, Sumatera	Ban
Appendicula reflexa Blume	E	-	II	-	Bismarck Archipelago, Borneo, Cambodia, Caroline Is., Fiji, Jawa, Lesser Sunda Is., Malaysia, Maluku, New Caledonia, New Guinea, Nicobar Is., Philippines, Santa Cruz Is., Solomon Is., Sulawesi, Sumatera, Taiwan, Thailand, Tonga, Vanuatu, Vietnam, Wallis-Futuna Is.	Gen, Pun
Arundina graminifolia (D.Don) Hochr.	T	-	II	-	Assam, Bangladesh, Borneo, Cambodia, China South-Central, China Southeast, East Himalaya, Hainan, India, Jawa, Laos, Lesser Sunda Is., Malaysia, Maluku, Myanmar, Nansei-shoto, Nepal, Philippines, Sri Lanka, Sulawesi, Sumatera, Taiwan, Thailand, Tibet, Vietnam	Pun
Bogoria raciborskii J.J.Sm.**	E	-	II	-	Borneo, Jawa	Ind
Bryobium retusum (Blume) Y.P.Ng & P.J.Cribb	E	-	II	-	Borneo, Christmas I., Jawa, Lesser Sunda Is., New Caledonia, Solomon Is., Sulawesi	Wat
Bulbophyllum angustifolium (Blume) Lindl.	E	-	II	-	Jawa, Lesser Sunda Is., Malaysia, Sumatera	Gen, Gaj
Bulbophyllum biflorum Teijsm. & Binn.	E	-	II	-	Borneo, Jawa, Lesser Sunda Is., Malaysia, Sumatera, Thailand	Gen, Kal, Pas, Gon, Ban, Wat
Bulbophyllum capitatum (Blume) Lindl.**	E	-	II	-	Borneo, Jawa	Gaj, Gaj, Gond
Bulbophyllum depressum King & Pantl	E	-	II	-	Assam, Borneo, China South-Central, China Southeast, East Himalaya, Hainan, India, Jawa, Laos, Lesser Sunda Is., Malaysia, Myanmar, Sumatera, Thailand, Vietnam	Gen, Pas, Wat
Bulbophyllum ecornutum subsp. *ecornutum* (J.J.Sm.) J.J.Sm.	E	-	II	-	Borneo, Jawa, Lesser Sunda Is.	Wat
Bulbophyllum flavidiflorum Carr**	E	-	II	-	Jawa, Lesser Sunda Is., Sumatera	Gaj, Gaj, Pun

Bulbophyllum gibbosum (Blume) Lindl.	E	-	II	-	Borneo, Jawa, Lesser Sunda Is., Malaysia, Sumatera	Pun, Gond
Bulbophyllum laxiflorum (Blume) Lindl.	E	-	II	-	Borneo, Cambodia, Jawa, Laos, Malaysia, Myanmar, Philippines, Sulawesi, Sumatera, Thailand, Vietnam	Gen
Bulbophyllum lobbii Lindl. subsp. *lobbii*	E	-	II	-	Assam, Bangladesh, Borneo, Cambodia, East Himalaya, Jawa, Lesser Sunda Is., Malaysia, Myanmar, Philippines, Sumatera, Thailand	Gen, Kal, Ind
Bulbophyllum stelis J.J.Sm**.	E	-	II	-	Jawa, Sumatera	Pun
Bulbophyllum sulcatum (Blume) Lindl.	E	-	II	-	Jawa, Lesser Sunda Is., Malaysia, Sumatera, Thailand, Vietnam	Gaj, Gaj
Calanthe triplicata (Willemet) Ames	T	-	II	-	Andaman Is., Assam, Bismarck Archipelago, Borneo, Cambodia, Caroline Is., China South-Central, China Southeast, East Himalaya, Fiji, Hainan, India, Jawa, Kazan-retto, Laos, Lesser Sunda Is., Malaysia, Maluku, Marianas, Myanmar, Nansei-shoto, New Caledonia, New Guinea, New South Wales, Norfolk Is., Ogasawara-shoto, Philippines, Queensland, Samoa, Society Is., Solomon Is., Sri Lanka, Sulawesi, Sumatera, Taiwan, Thailand, Tonga, Tubuai Is., Vanuatu, Vietnam, Wallis-Futuna Is.	Gen, Kal, Pas, Gon, Ban, Gaj, Wat, Ind
Ceratostylis backeri J.J.Sm.*	E	-	II	-	Jawa	Gaj, Pun
Ceratostylis graminea Blume**	E	-	II	-	Jawa, Sumatera	Gen, Pas
Ceratostylis radiata J.J.Sm.	E	-	II	-	Assam, Borneo, Jawa, Malaysia, Myanmar, Sumatera, Thailand, Tibet, Vietnam	Gen
Ceratostylis subulata Blume	E	-	II	-	Assam, Borneo, Cambodia, East Himalaya, Hainan, Jawa, Laos, Malaysia, Maluku, Myanmar, New Guinea, Nicobar Is., Philippines, Santa Cruz Is., Solomon Is., Sumatera, Thailand, Vanuatu, Vietnam	Gen, Ban
Chrysoglossum ornatum Blume	T	-	II	-	Assam, Borneo, Cambodia, China South-Central, China Southeast, East Himalaya, Fiji, Hainan, India, Jawa, Laos, Malaysia, Myanmar, Nepal, New Caledonia, New Guinea, Philippines, Samoa, Sri Lanka, Sulawesi, Sumatera, Taiwan, Thailand, Tibet, Vanuatu, Vietnam	Gen, Pas, Gon
Cleisostoma discolor Lindl.	E	-	II	-	Assam, Borneo, Cambodia, East Himalaya, India, Jawa, Laos, Lesser Sunda Is., Malaysia, Sumatera, Thailand, Vietnam	Ban
Coelogyne miniata (Blume) Lindl.**	E	-	II	-	Jawa, Lesser Sunda Is., Sumatera	Gaj, Maw, Pun
Coelogyne speciosa (Blume) Lindl.**	E	-	II	-	Jawa, Lesser Sunda Is., Sumatera	Gen, Kal, Pas, Gon, Ban, Gaj, Wat, Maw, Ind
Corymborkis veratrifolia (Reinw.) Blume	T	-	II	-	Andaman Is., Assam, Bangladesh, Bismarck Archipelago, Borneo, Cambodia, Caroline Is., China South-Central, China Southeast, Christmas I., East Himalaya, Fiji, India, Jawa, Laos, Lesser Sunda Is., Malaysia, Maluku, Marianas, Myanmar, Nansei-shoto, New Guinea, Nicobar Is., Ogasawara-shoto, Philippines, Queensland, Samoa, Santa Cruz Is., Society Is., Solomon Is., Sri Lanka, Sulawesi, Sumatera, Taiwan, Thailand, Tonga, Vanuatu, Vietnam, Wallis-Futuna Is.	Gen, Ban, Gond
Crepidium acuminatum (D.Don) Szlach.	T	-	II	-	Andaman Is., Assam, Bangladesh, Cambodia, China South-Central, China Southeast, East Himalaya, India, Jawa, Laos, Myanmar, Nepal, Nicobar Is., Northern Territory, Philippines, Sumatera, Thailand, Tibet, Vietnam, West Himalaya	Gen
Crepidium junghuhnii (J.J.Sm.) Szlach.*	E	-	II	-	Jawa	Gen, Gaj
Crepidium kobi (J.J.Sm.) M.A.Clem. & D.L.Jones*	T	-	II	-	Jawa	Gen, Maw
Crepidium perakense (Ridl.) Szlach.	T	-	II	-	Borneo, Jawa, Malaysia, Thailand	Ban
Crepidium sp.	T	-	II	-	N/A	Gaj, Maw

Cymbidium bicolor subsp. *pubescens* (Lindl.) Du Puy & P.J.Cribb	E	-	II	-	Andaman Is., Borneo, Cambodia, Jawa, Lesser Sunda Is., Malaysia, Nicobar Is., Philippines, Sulawesi, Sumatera	Gen
Cymbidium lancifolium Hook.	T	-	II	-	Assam, Bangladesh, Borneo, Cambodia, China South-Central, China Southeast, East Himalaya, Hainan, Japan, Jawa, Korea, Laos, Malaysia, Maluku, Myanmar, Nansei-shoto, Nepal, New Guinea, Sulawesi, Sumatera, Taiwan, Thailand, Tibet, Vietnam, West Himalaya	Gen, Ban
Dendrobium atavus J.J.Sm.*	E	-	II	-	Jawa	Ban
Dendrobium aureilobum J.J.Sm.	E	-	II	-	Jawa, Malaysia, Sumatera	Ban, Wat
Dendrobium barbatum Breda	E	-	II	-	Bangladesh, Jawa, Sumatera	Gen, Kal, Pas, Gon, Ban, Wat
Dendrobium connatum (Blume) Lindl.	E	-	II	-	Borneo, Jawa, Lesser Sunda Is., Malaysia, Maluku, Sumatera, Thailand	Gen
Dendrobium conspicuum Bakh.f.	E	-	II	-	China South-Central, Jawa, Lesser Sunda Is., Sumatera, Vietnam	Gaj
Dendrobium crumenatum Sw.	E	-	II	-	Andaman Is., Borneo, Cambodia, Christmas I., India, Jawa, Laos, Lesser Sunda Is., Malaysia, Maluku, Myanmar, New Guinea, Nicobar Is., Philippines, Sri Lanka, Sulawesi, Sumatera, Taiwan, Thailand, Vietnam	Gen, Kal, Pas, Gon, Ban, Wat
Dendrobium lobulatum Rolfe ex J.J.Sm.**	E	-	II	-	Borneo, Jawa, Maluku, Sumatera	Gen, Kal, Pas, Gon, Ban, Gaj, Wat
Dendrobium macrostachyum Lindl.	E	-	II	-	Andaman Is., Bangladesh, Borneo, India, Jawa, Lesser Sunda Is., Malaysia, Maldives, Myanmar, Nepal, Nicobar Is., Queensland, Sri Lanka, Sulawesi, Sumatera, Thailand, Vietnam, West Himalaya	Ban
Dendrobium mutabile (Blume) Lindl.**	E	-	II	-	Jawa, Lesser Sunda Is., Sumatera	Gen, Kal, Pas, Gon, Ban, Gaj, Wat, Maw, Ind
Dendrobium nudum (Blume) Lindl.**	E	-	II	-	Borneo, Jawa, Sumatera	Gaj
Dendrobium sagittatum J.J.Sm.**	E	-	II	-	Jawa, Lesser Sunda Is., Sumatera	Gen, Kal, Pas, Gon, Ban, Gaj, Wat, Gond
Dendrobium salaccense (Blume) Lindl.	E	-	II	-	Andaman Is., Assam, Borneo, China South-Central, East Himalaya, Hainan, India, Jawa, Laos, Lesser Sunda Is., Malaysia, Myanmar, Sri Lanka, Sumatera, Thailand, Tibet, Vietnam	Gaj, Gond
Dendrochilum aurantiacum Blume**	E	-	II	-	Jawa, Sumatera	Gaj
Dendrochilum pallidiflavens Blume var. *pallidiflavens*	E	-	II	-	Borneo, Jawa, Lesser Sunda Is., Malaysia, Myanmar, Philippines, Sumatera, Thailand	Pas, Gond
Epipogium roseum (D.Don) Lindl.	T	-	II	-	Angola, Assam, Borneo, Cameroon, Central African Repu, China South-Central, China Southeast, Congo, East Himalaya, Fiji, Ghana, Guinea, Gulf of Guinea Is., Hainan, India, Japan, Jawa, Kenya, Laos, Lesser Sunda Is., Liberia, Malawi, Malaysia, Maluku, Myanmar, Nansei-shoto, Nepal, New Caledonia, New Guinea, New South Wales, Nigeria, Pakistan, Philippines, Queensland, Solomon Is., Sri Lanka, Sudan, Sulawesi, Sumatera, Taiwan, Thailand, Tibet, Uganda, Vanuatu, Vietnam, West Himalaya, Zaïre	Gen, Pas
Eria bogoriensis J.J.Sm.	E	-	II	-	Jawa, Lesser Sunda Is., New Guinea	Ban

Eria javanica (Sw.) Blume	E	-	II	-	Assam, Bismarck Archipelago, Borneo, China South-Central, East Himalaya, Jawa, Laos, Lesser Sunda Is., Malaysia, Maluku, Myanmar, New Guinea, Philippines, Sulawesi, Sumatera, Taiwan, Thailand, Vietnam	Kal
Erythrodes blumei (Lindl.) Schltr.	T	LC	II	-	Jawa, Malaysia, Nicobar Is., Sumatera	Gen, Kal
Eulophia zollingeri (Rchb.f.) J.J.Sm.	T	-	II	-	Andaman Is., Assam, Borneo, China South-Central, China Southeast, East Himalaya, India, Japan, Jawa, Malaysia, Maluku, Myanmar, Nansei-shoto, New Guinea, Ogasawara-shoto, Philippines, Queensland, Sri Lanka, Sulawesi, Sumatera, Taiwan, Thailand, Vietnam	Gen
Gastrochilus sororius Schltr.	E	-	II	-	Borneo, Java, Phillipines, Sulawesi, Sumatera	Gond
Goodyera bifida (Blume) Blume	T	-	II	-	Borneo, Jawa, Lesser Sunda Is., Malaysia, Sulawesi, Sumatera, Thailand	Maw
Goodyera novembrilis (Rchb.f.) Ormerod**	T	-	II	-	Jawa, Lesser Sunda Is., Sumatera	Gen, Gon, Wat
Goodyera reticulata (Blume) Blume*	T	-	II	-	Borneo, Jawa, Lesser Sunda Is., Vietnam	Gen, Pas
Goodyera rubicunda (Blume) Lindl.	T	-	II	-	Assam, Bismarck Archipelago, Borneo, China South-Central, East Himalaya, Fiji, Jawa, Lesser Sunda Is., Malaysia, Maluku, Nansei-shoto, New Caledonia, New Guinea, Philippines, Queensland, Samoa, Solomon Is., Sulawesi, Sumatera, Taiwan, Tonga, Vanuatu, Vietnam	Gen, Kal, Wat
Habenaria loerzingii J.J.Sm.*	T	-	II	-	Jawa	Maw
Habenaria undulatifolia Frapp. ex Cordem.*	T	-	II	-	Jawa	Gen, Kal, Pas, Ban, Wat
Hetaeria lamellata Blume*	T	-	II	-	Jawa	Gen
Liparis caespitosa (Lam.) Lindl.	E	-	II	-	Assam, Bismarck Archipelago, Borneo, Cambodia, China South-Central, East Himalaya, Fiji, Hainan, India, Jawa, Laos, Lesser Sunda Is., Madagascar, Malawi, Malaysia, Maluku, Mauritius, Mozambique, Nepal, New Caledonia, New Guinea, Philippines, Réunion, Samoa, Society Is., Solomon Is., Sri Lanka, Sulawesi, Sumatera, Tanzania, Thailand, Tibet, Tubuai Is., Uganda, Vanuatu, Vietnam, West Himalaya	Wat, Gond
Liparis condylobulbon Rchb.f.	E	-	II	-	Borneo, Fiji, Jawa, Lesser Sunda Is., Maluku, Myanmar, New Caledonia, New Guinea, Philippines, Queensland, Samoa, Santa Cruz Is., Solomon Is., Sulawesi, Sumatera, Taiwan, Thailand, Vanuatu, Vietnam, Wallis-Futuna Is.	Gen, Pas
Liparis elliptica Wight	E	-	II	-	Assam, China South-Central, China Southeast, East Himalaya, Fiji, India, Japan, Jawa, Lesser Sunda Is., Myanmar, Nansei-shoto, Nepal, New Caledonia, Philippines, Samoa, Sri Lanka, Taiwan, Thailand, Tibet, Vietnam	Maw, Pun
Liparis latifolia Lindl.	E	-	II	-	Borneo, Hainan, Jawa, Lesser Sunda Island, Malaysia, Philippines, Sulawesi, Sumatera, Thailand	Pas
Liparis pallida (Blume) Lindl.	E	-	II	-	Jawa, Lesser Sunda Is., Philippines, Sumatera	Gen
Liparis wightiana Thwaites	E	-	II	-	India, Jawa, Sri Lanka, Sumatera, Thailand	Gen
Luisia javanica J.J.Sm.**	E	-	II	-	Jawa, Maluku, Sulawesi	Gen, Kal, Pas, Ban
Luisia taurina J.J.Sm.**	E	-	II	-	Borneo, Jawa, Sumatera	Kal
Macodes petola (Blume) Lindl.	T	-	II	-	Borneo, Jawa, Malaysia, Nansei-shoto, Philippines, Sumatera, Thailand	Gen
Mycaranthes latifolia Blume	E	-	II	-	Borneo, Jawa, Lesser Sunda Is., Malaysia, Sulawesi, Sumatera, Thailand	Gen, Kal, Pas, Gon, Ban, Gaj, Wat
Mycaranthes oblitterata Blume	E	-	II	-	Borneo, Cambodia, Jawa, Lesser Sunda Is., Malaysia, Sumatera, Thailand, Vietnam	Gaj
Nephelaphyllum pulchrum Blume	T	-	II	-	China, Kambodia, Assam, East Himalaya, Laos, Myanmar, Thailand, Vietnam, Borneo, Java, Malaysia, Phillipines, Sumatera	Gond

Nervilia concolor (Blume) Schltr.	T	-	II	-	Andaman Is., Assam, Bangladesh, Bismarck Archipelago, Cambodia, Caroline Is., China South-Central, Cook Is., East Himalaya, Fiji, India, Jawa, Laos, Lesser Sunda Is., Malaysia, Maluku, Marianas, Myanmar, Nansei-shoto, Nepal, New Caledonia, New Guinea, Niue, Northern Territory, Pakistan, Philippines, Queensland, Samoa, Society Is., Solomon Is., Sulawesi, Sumatera, Taiwan, Thailand, Tibet, Tonga, Vanuatu, Vietnam, Wallis-Futuna Is., West Himalaya	Maw
Nervilia punctata (Blume) Makino	T	-	II	-	Borneo, Cambodia, Fiji, India, Jawa, Malaysia, New Guinea, Nicobar Is., Sumatera, Thailand, Vietnam	Gen, Pas, Gon, Wat, Maw
Oberonia similis (Blume) Lindl.**	E	-	II	-	Jawa, Lesser Sunda Is.	Ban, Wat, Maw
Paphiopedilum javanicum (Reinw. ex Lindl.) Pfitzer**	T	EN	I	-	Borneo, Jawa, Lesser Sunda Is., Sumatera	Gen
Phaius flavus (Blume) Lindl.	T	-	II	-	Assam, Borneo, Cambodia, China South-Central, China Southeast, East Himalaya, Hainan, Japan, Jawa, Laos, Malaysia, Maluku, Myanmar, Nansei-shoto, Nepal, New Guinea, Philippines, Sulawesi, Sumatera, Taiwan, Thailand, Tibet, Vietnam	Gen, Gaj, Maw
Phaius pauciflorus (Blume) Blume	T	-	II	-	Borneo, Jawa, Lesser Sunda Is., Malaysia, Sumatera	Gen
Phalaenopsis amabilis (L.) Blume	E	-	II	-	Bismarck Archipelago, Borneo, Jawa, Lesser Sunda Is., Maluku, New Guinea, Philippines, Queensland, Sulawesi, Sumatera	Ind
Pholidota articulata Lindl.	E	-	II	-	Assam, Borneo, Cambodia, China South-Central, East Himalaya, Jawa, Laos, Malaysia, Myanmar, Nepal, Sulawesi, Sumatera, Thailand, Tibet, Vietnam, West Himalaya	Ban
Pholidota carnea (Blume) Lindl.	E	-	II	-	Borneo, Jawa, Lesser Sunda Is., Malaysia, Maluku, New Guinea, Philippines, Sulawesi, Sumatera, Thailand	Ban, Gond
Pholidota convallariae (E.C.Parish & Rchb.f.) Hook.f.	E	-	II	-	Assam, China South-Central, East Himalaya, Jawa, Myanmar, Sumatera, Thailand, Tibet, Vietnam	Gaj, Pun
Pholidota globosa (Blume) Lindl.**	E	LC	II	-	Jawa, Lesser Sunda Is., Sumatera	Gaj, Pun
Pholidota imbricata Lindl.	E	-	II	-	Andaman Is., Assam, Bangladesh, Bismarck Archipelago, Borneo, Cambodia, China South-Central, East Himalaya, Fiji, India, Jawa, Laos, Lesser Sunda Is., Malaysia, Maluku, Myanmar, Nepal, New Caledonia, New Guinea, Nicobar Is., Philippines, Queensland, Santa Cruz Is., Solomon Is., Sri Lanka, Sulawesi, Sumatera, Thailand, Tibet, Tonga, Vanuatu, Vietnam, West Himalaya	Gen, Kal, Pas, Gon, Ban, Wat
Phreatia plantaginifolia (J.Koenig) Ormerod	E	-	II	-	Andaman Is., Borneo, Cambodia, Jawa, Lesser Sunda Is., Malaysia, Maluku, Philippines, Sulawesi, Sumatera, Thailand, Vietnam	Ban, Pun
Phreatia tjibodasana J.J.Sm.**	E	-	II	-	Jawa, Sumatera	Maw, Pun, Gond
Pinalia djaratensis Schltr.**	E	-	II	-	Jawa, Sumatera	Ban
Pinalia multiflora (Blume) Kuntze**	E	-	II	-	Jawa, Lesser Sunda Is., Sumatera	Gaj, Pun
Polystachya concreta (Jacq.) Garay & H.R.Sweet	E	-	II	-	Andaman Is., Angola, Argentina Northwest, Bahamas, Bolivia, Borneo, Brazil North, Brazil Northeast, Brazil South, Brazil Southeast, Brazil West-Central, Burundi, Cambodia, Cameroon, Cape Provinces, Cayman Is., Central African Repu, China South-Central, Colombia, Comoros, Congo, Cuba, Dominican Republic, Ecuador, Equatorial Guinea, Ethiopia, Florida, French Guiana, Gabon, Ghana, Guatemala, Guinea, Gulf of Guinea Is., Guyana, Haiti, India, Ivory Coast, Jamaica, Jawa, Kenya, KwaZulu-Natal, Laos, Leeward Is., Lesser Sunda Is., Liberia, Madagascar, Malawi, Malaysia, Maluku, Mauritius, Mexico Southeast, Mozambique, Nicobar Is., Nigeria, Northern Provinces, Panamá, Peru, Philippines, Puerto Rico, Rwanda, Réunion, Seychelles, Sierra Leone, Sri Lanka, Sudan, Sulawesi, Sumatera, Suriname, Swaziland, Tanzania, Thailand, Togo, Trinidad-Tobago, Uganda, Venezuela, Venezuelan Antilles, Vietnam, Windward Is., Zambia, Zaïre, Zimbabwe	Gen, Gon, Wat

Pteroceras compressum (Blume) Holttum	E	-	II	-	Jawa, Malaysia, Sumatera, Thailand	Gen, Kal, Pas, Gon, Ban, Wat
Rhomboda cristata (Blume) Ormerod	T	-	II	-	Jawa, Lesser Sunda Is., Philippines	Gen
Rhomboda velutina (J.J.Sm.) Ormerod**	T	-	II	-	Jawa, Lesser Sunda Is.	Gen
Rhynchostylis retusa (L.) Blume	E	-	II	-	Andaman Is., Assam, Bangladesh, Borneo, Cambodia, China South-Central, East Himalaya, India, Jawa, Laos, Malaysia, Myanmar, Nepal, Nicobar Is., Philippines, Sri Lanka, Sumatera, Thailand, Vietnam, West Himalaya	Ban, Gond
Schoenorchis juncifolia Reinw. ex Blume	E	-	II	-	Borneo, Jawa, Lesser Sunda Is., Malaysia, Sumatera	Maw
Spathoglottis aurea Lindl.	T	-	II	-	Borneo, Jawa, Lesser Sunda Is., Malaysia, New Guinea, Sulawesi, Sumatera, Thailand, Vietnam	Wat
Spathoglottis plicata Blume	T	-	II	-	Andaman Is., Assam, Bangladesh, Bismarck Archipelago, Borneo, Cambodia, Caroline Is., Cook Is., East Himalaya, Fiji, India, Jawa, Laos, Lesser Sunda Is., Malaysia, Maluku, Marianas, Myanmar, Nansei-shoto, New Caledonia, New Guinea, Nicobar Is., Niue, Philippines, Queensland, Samoa, Santa Cruz Is., Solomon Is., Sri Lanka, Sulawesi, Sumatera, Taiwan, Thailand, Tonga, Vanuatu, Vietnam, Wallis-Futuna Is.	Maw
Stereosandra javanica Blume	T	-	II	-	Borneo, China South-Central, East Himalaya, Jawa, Malaysia a, Myanmar, Nansei-shoto, New Guinea, Philippines, Samoa, Solomon Is., Sumatera, Taiwan, Thailand, Vietnam	Gen
Taeniophyllum hasseltii Rchb.f.	E	-	II	-	Christmas I., Jawa, Malaysia, Thailand	Gen
Tainia speciosa Blume	T	-	II	-	Borneo, Jawa, Malaysia, Sumatera, Thailand	Gen
Thelymitra javanica Blume	T	-	II	-	Jawa, Philippines	Pun
Thrixspermum obtusum (Blume) Rchb.f.*	E	-	II	-	Jawa	Maw
Trichotosia pauciflora Blume	E	-	II	-	Borneo, Jawa, Lesser Sunda Is., Malaysia, Sumatera, Thailand	Gen, Pas
Tropidia angulosa (Lindl.) Blume	T	-	II	-	Andaman Is., Assam, Bangladesh, China South-Central, China Southeast, East Himalaya, India, Jawa, Laos, Lesser Sunda Is., Malaysia, Myanmar, Philippines, Sumatera, Thailand, Tibet, Vietnam	Kal
Tropidia curcugiloides Lindl.	T	-	II	-	Andaman Is., Assam, Bangladesh, Borneo, Cambodia, China South-Central, China Southeast, East Himalaya, Hainan, India, Jawa, Laos, Lesser Sunda Is., Malaysia, Myanmar, Sulawesi, Sumatera, Taiwan, Thailand, Vietnam	Gen
Tuberolabium zollingeri (Rchb.f.) Ormerod & Juswara**	E	-	II	-	Jawa, Lesser Sunda Is.	Gen, Pas, Ban, Wat
Vanda tricolor Lindl.**	E	-	II	-	Jawa, Lesser Sunda Is.	Gen, Ban, Gaj
Zeuxine gracilis (Breda) Blume	T	-	II	-	Assam, Borneo, East Himalaya, India, Jawa, Malaysia, Sumatera	Gen

Notes: (*): Javan endemic; (**): Indonesian endemic; T: Terrestrial, E: Epiphyte; (-): Not evaluated, LC: Least concern, EN: Endangered; II: Appendix II; Gen: Gentong, Kal: Kalisidi, Pas: Pasigitan, Gon: Gonoharjo, Ban: Banyuwindu, Gaj: Gajah Mungkur, Wat: Watuondo, Gond: Gondang, Ind: Indrakila, Pun: Puncak, Maw: Mawar Camp

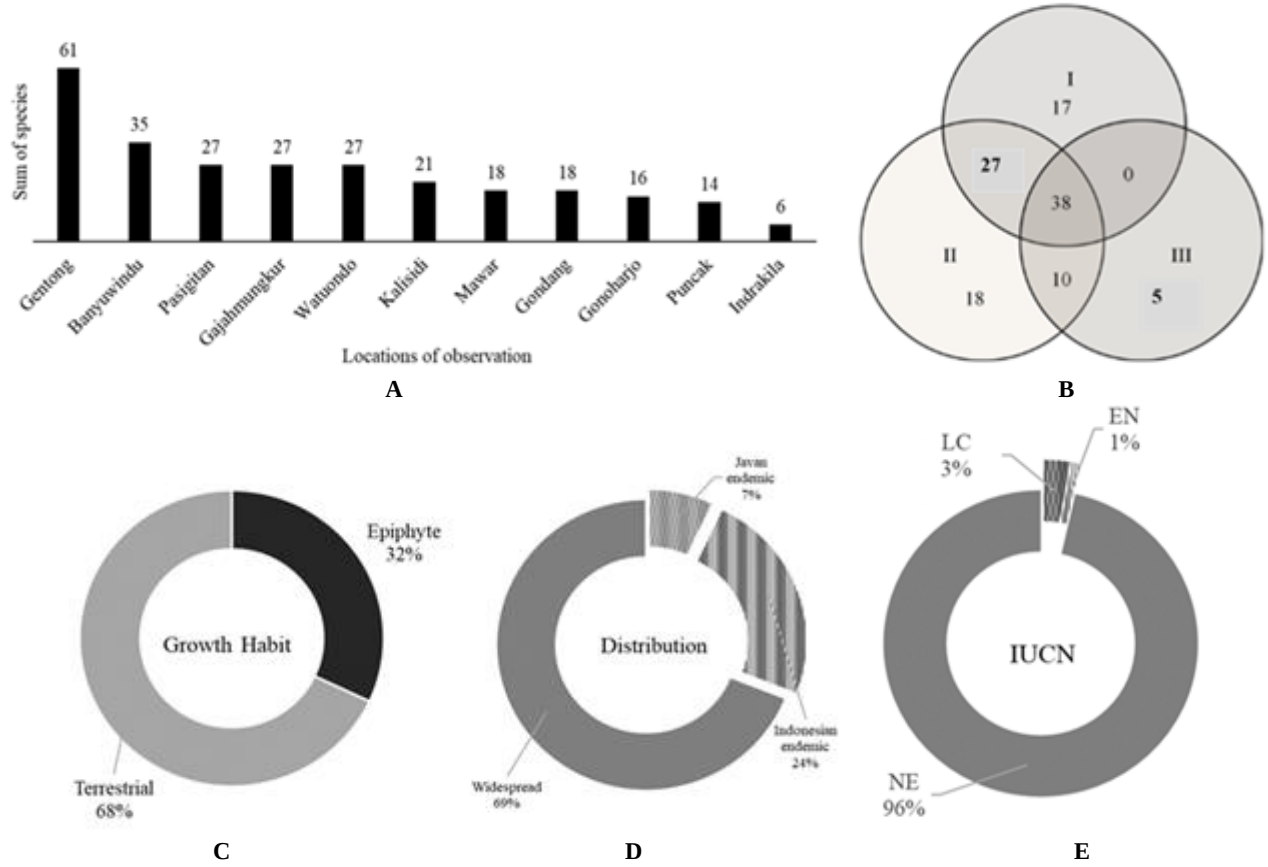

Figure 2. The composition of orchids recorded in Mount Ungaran, Central Java, Indonesia. A. Location; B. Period of observation: I. 2010-2014, II. 2014-2018, and III. 2018-2021; C. Growth habits; D. Distribution; and E. Conservation status of IUCN

Discussion

Of the five sub-families of Orchidaceae, only three sub-families occurred in Mount Ungaran, namely Cypripedioideae, Orchidoideae, and the rich one, Epidendroideae. Each sub-family had specific characteristics that can be used as a discriminant for grouping some genera with other related genera. The members of the Cypripedioideae sub-family are spectacular orchids with terrestrial on their life type and have distinct slipper-shaped pouches as the shape of their labellum. In this study, the sub-family was represented by only a single genus *Paphiopedilum* with a single species, namely *P. javanicum.* This endangered orchid has a green herbaceous leaf with many dark spots on the abaxial side. The main feature of *Paphiopedilum* is its pouch-like lip on the flower (Romadlon et al. 2021). While the diagnostic characteristics of *P. javanicum* are the presence of mottled leaves, with darker green spots superimposed over a light green background; the dorsal sepal is ovate, acute, green with white margins, longitudinally striped dark brown; petals long-oblong, held nearly horizontal but sometimes dropping, greenish finely spotted reddish-brown in the lower two-thirds, white or pink in the apical third; and the dull lip brownish-green (Comber 1990; Hendriyani et al. 2019)

The second sub-family in this study is Orchidoideae, a group of orchids that grow as terrestrial with erect inflorescences. Sub-family Orchidoideae shows several diagnostic characteristics such as their life form as terrestrial, the growing from tubers or a horizontal fleshy rhizome; anther basifixed or not; pollinia segmented, comprising massulae, or mealy (Chase et al. 2015). The Orchidoideae sub-family in this study was represented by 9 genera grouped into 3 tribes: Cranichideae, Diurideae, and Orchideae. The Cranichideae was represented by seven genera, including *Anoectochilus, Erythrodes, Goodyera, Hetaeria, Rhomboda, Macodes,* and *Zeuxine*. At the same time, the Diurideae tribe was represented by the genus *Thelymitra,* equal to Tribe Orchideae, which was only represented by the *Habenaria* genus.

As the largest sub-family in the Orchidaceae family (80% out of all orchid species), Epidendroideae has diverse characteristics (Dong et al. 2018). There are 26 known tribes as members of this sub-family (Freudenstein and Chase 2015). Although Epidendroideae has a diverse member with various variations, the members can be compiled into this group due to synthetic features such as a single anther that is entirely incumbent to the sub-erect. The anther form arises from column elongation or, as in the vandoids, from early anther bending. Most of these family members are epiphytes, but some tribes contain only

terrestrial orchids. We found 45 genera in this sub-family which can be grouped into 11 tribes as follows: Tribe Arethuseae was represented by genera *Arundina, Nephelaphyllum, Calanthe, Phaius, Spathoglottis, Tainia, and Ania*; Tribe Collabieae was represented by genus *Chrysoglossum*; Tribe Coelogyneae was represented by genera *Coelogyne, Pholidota*, and *Dendrochilum*; Tribe Epidendreae was represented by genus *Agrostophyllum*; Tribe Epipogieae was represented by genera *Epipogium* and *Stereosandra*; Tribe Gastrodieae was represented by genus *Nervilia*; Tribe Malaxideae was represented by genera *Crepidium* and *Liparis*, Tribe Podochileae *Bulbophyllum, Dendrobium, Eria, Bryobium, Mycaranthes, Pinalia, Trichotosia, Appendicula, Ceratostylis*, and *Phreatia*; Tribe Tropidieae was represented by genera *Tropidia* and *Corymborkis*; Tribe Cymbidieae was represented by genera *Acriopsis, Cymbidium*, and *Eulophia*; Tribe Vandeae was represented by genera *Aerides, Rhynchostylis, Phalaenopsis, Luisia, Bogoria, Cleisostoma, Thrixspermum, Vanda, Polystachya, Taeniophyllum, Schoenorchis, Gastrochillus*, and *Tuberolabium*. Some studies showed that the average temperature on Mount Ungaran ranges from 22-27^{o}C and the range of altitude is between 900-2,050 masl (Rahayuningsih et al. 2017). Such characteristics will support mosses as well as mycorrhizal fungi to life (Nurfadilah et al. 2016). Mosses and mycorrhizal fungi are important successors as natural orchids microhabitats (Kurniawan et al. 2020). The presence of this moss provides the moisture needed for orchid roots to grow and develop (Sathiyadash et al. 2012). In addition, the availability of large and old trees with many branches is also a factor in the number of orchid species, especially those with epiphytic life forms. Trees with these characteristics can store substrates that keep nutrients and water (Garcia et al. 2020; Kusumastuti et al. 2021). This condition was observed in Gentong (Rahayuningsih et al. 2015), so it was not surprising that the area had the most orchid species, and 50% were epiphytic species. That is also why the Epidendroideae subfamily, whose members are the most epiphytic species, had the most abundant wealth compared to other sub-families in Ungaran.

The species richness of Ungaran orchids is less than in some conservation areas in West Java. For example, in Gede-Pangrango National Park (NP) with 201 species. That is not surprising due to intensive care and more organized area by their zonation. However, the number of Mount Ungaran orchid species will not be much different compared to Java's eastern part conservation area with equal forestry management, such as Bromo Tengger Semeru NP with 135 species (Artaka 2019). Nevertheless, it means that Mount Ungaran has the potential for natural orchids' habitat.

Our previous study of orchids in Mount Ungaran only found 68 species (Utami et al. 2018). Another previous study of orchids in Ngesrepbalong village (Gentong site) showed 12 species (Dewi et al. 2018). The number of orchid species found in this study provides evidence that Mount Ungaran has a high richness of orchids and might still have an opportunity to record additional species. Interestingly, we also got field information from residents that other species from the type list compiled can still be found on the other side of Mount Ungaran.

The 2014-2018 observation recorded the highest number of orchid species, with 93 species, while the last observation period (2018-2021) found the lowest number of orchid species, with only 53 species. It is likely due to the forest fires in Mount Ungaran and the spread of COVID-19, which decreased the intensity and range of exploration during that period.

This study recorded the new distribution records of several species of orchids previously only found in West Java or East Java by Comber (1990). These species are *Ania penangiana, Pholidota convallariae*, and *Crepidium junghuhnii*. At the same time, some species are losing their endemic statuses, such as *Goodyera reticulata, Bogoria raciborskii, and Taeniophyllum hasseltii* (Averyanov et al. 2018; Ong et al. 2019; Hsu et al. 2020). In this study, we encountered several confusable and sympatric *Crepidium* species displaying the complex structure of the flowers. Based on the consultation with several experts, this species is a variation of *C. koordersii*. The description of the holotype that refers to *C. koordersii* is a diamond-shaped labellum, a tapered auricle in the shape of a triangle that narrows towards the base (Smith 1905; Comber 1990). However, the type we encountered was different, with the labellum tending to be rounded, the auricle kidney-shaped with rounded ends, and a purplish on both its tepals and sepals. The other discussion said this species is a natural hybrid between *C. koordersii* and *C. Acuminatum*. The *Crepidium* genus has pretty diverse members; at least 365 species have been known as members of this genus (Govaerts et al. 2021). Based on these reasons mentioned and the various member of the genus (Besi et al. 2020), it is essential to conduct a deeper study of the characteristics in more detail in live specimens and their herbarium so that we are in the process of waiting for the inflorescences for a more detailed study as a follow-up to the findings of this species and continue to designate this species as *Crepidium* sp.

Overexploitation of orchids to fulfill the orchid species market needs conservation action as soon as possible. Especially orchids with large and unique flowers, such as *Bulbophyllum lobbii*, Vanda tricolor, *Aerides odorata, Rhynchostylis retusa*, and *P. javanicum*. These orchids were rarely found in this study, and even the endangered P. javanicum was found only in one individual. In addition, *Macodes petola*, and *Anoectochilus reinwardtii*, which have unique leaves with glowing leaf veins, are the main attraction for orchid lovers. From the 11 observation locations, Gentong has the potential to be designated as an in-situ conservation area to conserve the remaining orchids of Mount Ungaran. Not only has a high level of species diversity, but forest cover on Gentong is also relatively good, with dense tree crowns that provide ideal habitat and microclimate to support orchid growth. Large trees and coffee plantations left without intensive care also become a suitable habitat for epiphytic orchids.

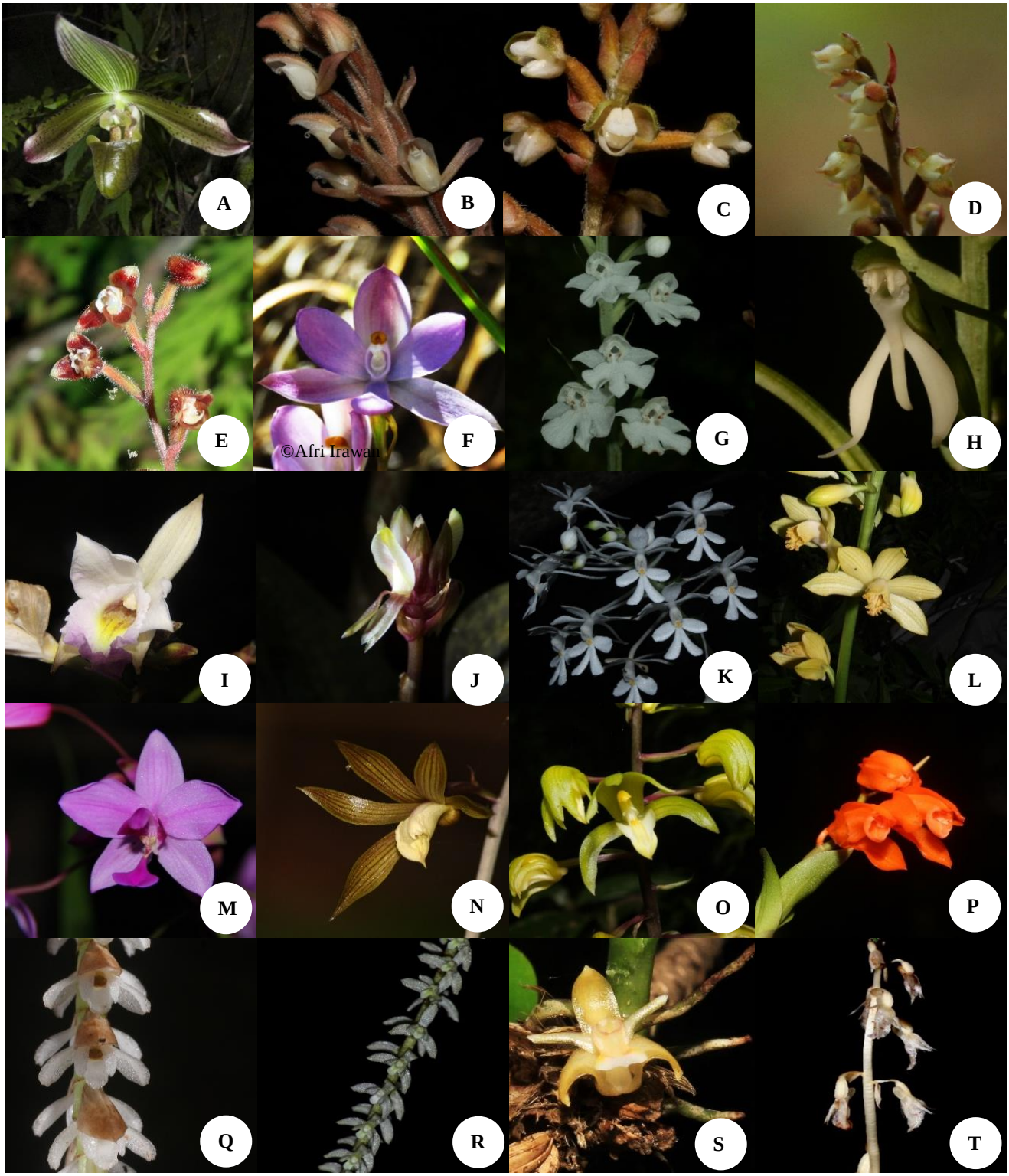

Figure 3. The representation of Mount Ungaran (Indonesia) Orchids is based on the sub-family: The representation of Ungaran Orchids in each sub-family. A. sub-family Cypripedioideae: *Paphiopedilum javanicum*. B-H. subfamily Orchidoideae: B. *Goodyera*, C. *Hetaeria lamellata*, D. *Rhomboda cristata*, E. *Macodes petola*, F. *Erythrodes blumei*, G. *Habenaria loerzingii*, H. *H. undulata*. I-T. Sub-family Epidendroideae: I. *Arundina gramminifolia*, J. *Nephelaphyllum pulchrum*, K. *Calanthe triplicata*, L. *Phaius callosus*, M. *Spathoglottis plicata*, N. *Ania penangiana*, O. *Chrysoglossum ornatum*, P. *Coelogyne miniata*, Q. *Pholidota globosa*, R. *Dendrochilum pallideflavens*; S. *Agrostophyllum stipulatum* subsp. *bicuspidatum*; T. *Epipogium roseum*

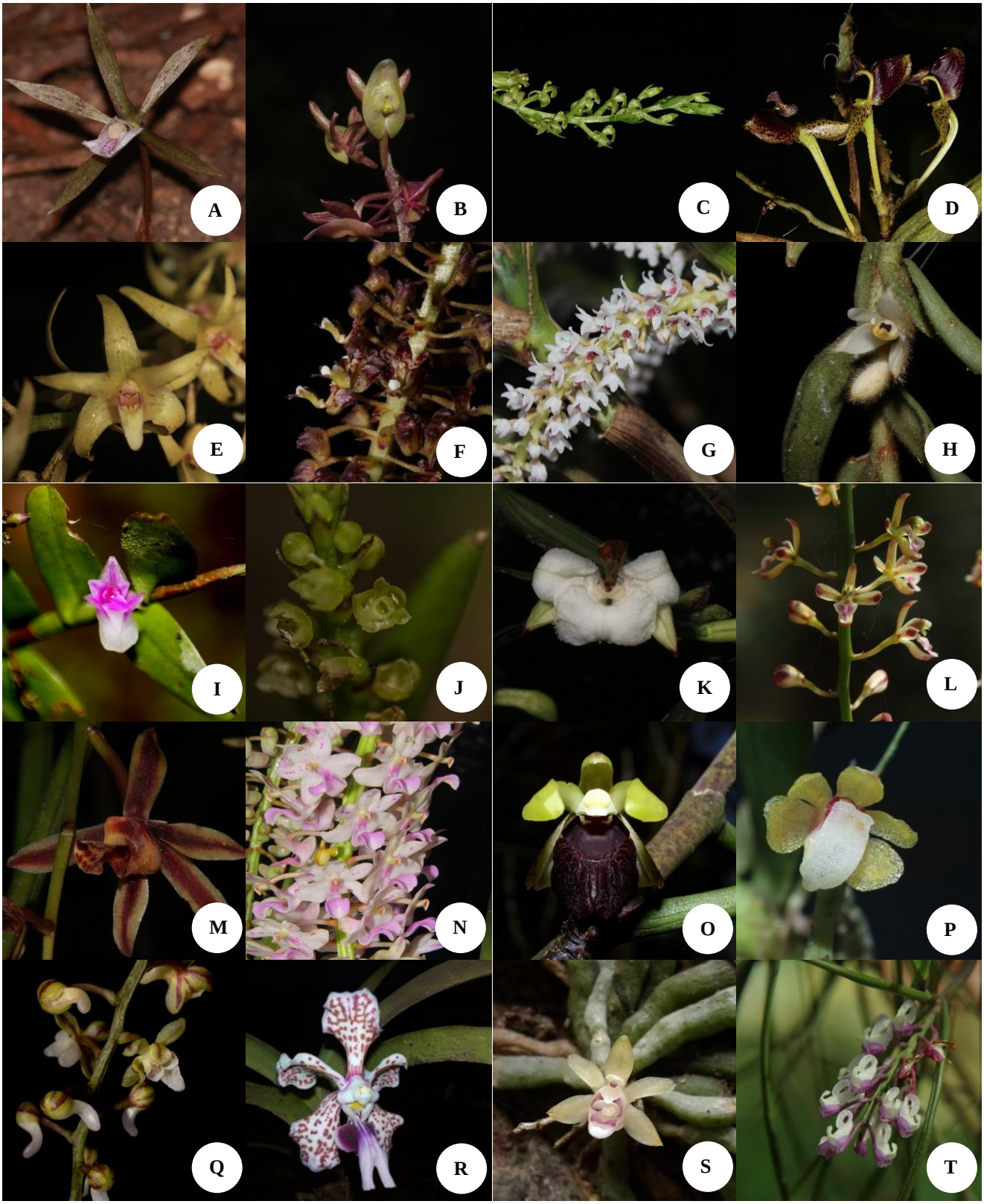

Figure 4. The representation sub-family Epidendroideae in Ungaran (continuation of figure 3): A. *Nervilia punctata*, B. *Crepidium acuminatum*, C. *Liparis caespitsa*, D. *Bulbophyllum ecornutum* subsp. *ecornutum*, E. *Eria javanica*, F. *Mycaranthes latifolia*, G. *Pinalia multiflora*, H. *Trichotosia pauciflora*, I. *Appendicula ramosa*, J. *Phreatia plantaginifolia*, K. *Corymborkis veratrifolia*, L. *Acriopsis liliifolia* var. *liliifolia*, M. *Cymbidium bicolor* subsp. *pubescens*, N. *Rhynchostylis retusa*, O. *Luisia taurina*, P. *Bogoria raciborskii*, Q. *Cleisostoma discolor*, R. *Vanda tricolor*, S. *Taeniophyllum hasseltii*, T. *Schoenorchis juncifolia*

Figure 5. *Crepidium* sp found in this research (A), compared with *C.koordersii* from the other side in west Java (B) and digitized sketch from Smith (1908) (C). Photo of *C.koordersii* by Yuda Rehata Yudistira

In conclusion, 115 orchid species were found in Mount Ungaran, highlighting that this area serves as a critical habitat for wild orchids. Among all species recorded, at least 27 species were known to be endemic to Indonesia, and 8 species were endemic to the island of Java, of which four species were listed in the IUCN Red List. Besides that, all of the documented species were listed in the Appendix II category of the CITES, except one species, *P. javanicum*, which is listed in Appendix I. Gentong is recommended as a priority for an in-situ orchid protection area due to the highest number of species recorded which contributed to 54% of all orchids found. Yet, future exploration efforts are still needed in the other area of Mount Ungaran to obtain complete information on orchid diversity to support its conservation and enrich the knowledge of orchids in the region.

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