Inventorying medicinal orchid in Indonesia from global database

R.K. Wati[1], *I.P.* Astuti[2], and *R.* Cahyaningsih[2*]

[1]National Research and Innovation Agency, Research Center for Biosystematics and Evolution, Jakarta, Indonesia
[2]National Research and Innovation Agency, Research Center for Plant Conservation, Botanical Gardens, and Forestry, Jakarta, Indonesia

Abstract. The global database plays an important role in preserving vital data and information that aids in the conservation and sustainable use of organisms, including plant species. Many data related to Orchidaceae as one of the largest families of flowering plant species are stored in global databases. An inventory study was done on the medicinal orchid species distributed in Indonesia from several global databases. This study aimed to acquire data from several global databases (i.e., POWO, MPNS, and IUCN REDLIST) related to what and where species are distributed in Indonesia, which species have medicinal records, and other information supporting conservation and sustainable use. The result showed six thousand orchid species with 200 genera in Indonesia. Bulbophyllum, Dendrobium, and Crepidium are the top five biggest genera. More than five thousand orchid species are endemic and distributed mainly in Papua, Kalimantan, and Jawa. About 130 orchid species have medicinal use; 115 orchid species are documented as medicinal plants worldwide, including 39 species recorded in Indonesia. IUCN Redlist has assessed 430 species, with 87 species included in IUCN Redlist species; one medicinal species listed as endangered species (Vanilla planifolia Andrews); and five species assessed as least concerned species. These findings could be important as a foundation for future conservation and sustainable use studies, not only in Indonesia but also in the world.

1 Introduction

With an estimated 25,000-35,000 species in the world, orchids are the highest number of species of all angiosperm families [1]. Despite of their ornamental value, orchids are significant sources of secondary metabolites with phytochemical that important for human healthcare [2]. Secondary metabolites directly derived or modified forms contribute up to 50% of medication nowadays [3]. The history of orchid usage as medicinal was recorded from China, which four orchids *Dendrobium catenatum* Lindl., *D. moniliforme* (L.) Sw. were consumed as tonics, *Gastrodia elata* Blume and *Bletilla striata* (Thunb.) Rchb.f to treat tuberculosis and bronchiectasis [4].

* Corresponding author: ria.cahyaningsih@brin.go.id

Asia is considered as a hotspot of medicinal orchids with 70% are found in this region [4]. Indonesian orchid estimated up to 5,000 species distributed evenly in various regions and some of them are endemic [5]. However, studied on orchids in Indonesia mainly focused on their documentations [6], distribution pattern [7], but very lack on its medicinal uses [6]. The medicinal uses study is important as a first report to do the scientific research that could lead to new finding on their secondary compound. Orchids and their habitat are under increasing pressure and facing greater risk, especially with their complex interaction with pollinators, mycorrhizal fungi and host trees compared to other plant groups [8].

Global plant database has been built to gather all information about plants including their taxonomy and ethnobotanical and economic use of plant. However, much the information and economic use are very sparse or simply not readily accessible to most of scientist and policy makers [9]. Some global plant databases i.e., POWO, MPNS and IUCN Redlist can directly be accessed via online. The Economic Botany Data Collection Standard also used by ethnobotanist to generalize classification schemes [10].

To be able to conserve, apply sustainable management and stop the overexploitation and illegal trade, the most important step is to make a list of medicinal orchids at their species level. However, no complete list has been published of medicinal orchids in Indonesia. The objective of this study was to acquire data from several global databases related to what species are distributed in Indonesia, which species have medicinal records, and other information supporting conservation and sustainable use.

2 Materials and methods

Data from POWO were collected, which included orchid species names and distribution in seven major areas of Indonesia: Sumatera, Kalimantan, Jawa, Lesser Sunda Islands (LSI), Sulawesi, Maluku Islands, and Papua [11]. Given that not all of the territory in Kalimantan and New Guinea belongs to Indonesia, but also belongs to neighbouring countries, such as Malaysia and Brunei Darussalam in Kalimantan and Papua New Guinea in New Guinea, the species name list was cross-checked against the orchid species list from GBIF [12], which are orchid species with their occurrences within Indonesia area. Following that, each species' name was completed with medicinal record information from MPNS [13] and conservation status based on its IUCN Redlist categories, whether the species included in the category of Not Evaluated Data, Data Deficient, Least Concern, Near Threatened, Vulnerable, Endangered, Critically Endangered, Extinct in the Wild, or Extinct [14]. Data from Cahyaningsih et al. were also used to expand on the findings of this study for national medicinal records [15].

All required data for inventorying was managed in excel form, comprising species name, distribution area (i.e., all major areas in Indonesia), whether the species are endemic or not, medicinal record, and conservation status. The orchid is referred to as endemic when it is only found in Indonesia and is not found in other areas/countries. All orchid species' name and their taxonomic updates were crosschecked to the WCSV list through the tool of Taxonomic Name Resolution Service at TNRS (Taxonomic Name Resolution Service) Website [16]. The data then was analysed and interpreted.

3 Results and discussion

In this study, a total of 6347 orchid species records within 200 genera were collected from several global database online (POWO, GBIF) that occurred in Indonesia (see Fig.1). The taxonomic status of them is accepted names (5789) whether at level of species (5594), variety

(107), or subspecies (87), synonyms of other species (165), and others (no opinion 92 and no information 301).

The top 5 genera were *Bulbophyllum*, *Dendrobium*, *Crepidium*, *Dendrochilum*, and *Taeniophyllum*. Most of the orchid distributed in Papua with 3005 species recorded, while the lowest recorded from Lesser Sunda Island (Table 1). New Guinea is known as the world's most floristically diverse island with 19% vascular plant flora larger than Madagascar and 22% larger than plant flora recorded in Borneo [11]. The recent report by Camara-Leret et al. [17] almost 35% of flora in New Guinea are orchids and the largest orchid genera found in New Guinea are *Bulbophyllum* and *Dendrobium*. This pattern similar with our finding in this database.

From more than 5,000 species in Indonesia, 80% of orchids occurred in Indonesia are endemic. Highest endemism occurs in Papua with more than 90%. Indonesia is a part of the Malesian region, where the archipelago located between mainland Asia and Australia and reported as among the highest diversity of species worldwide [18]. The uniqueness of species within this island may be explained by largest area and habitat diversity [19]. The highest treeline in New Guinea recorded at up to 4050m and the alpine is an example of islands within an island with numerous young isolated and fluctuating habitat that induce local endemicity and active species radiations [20].

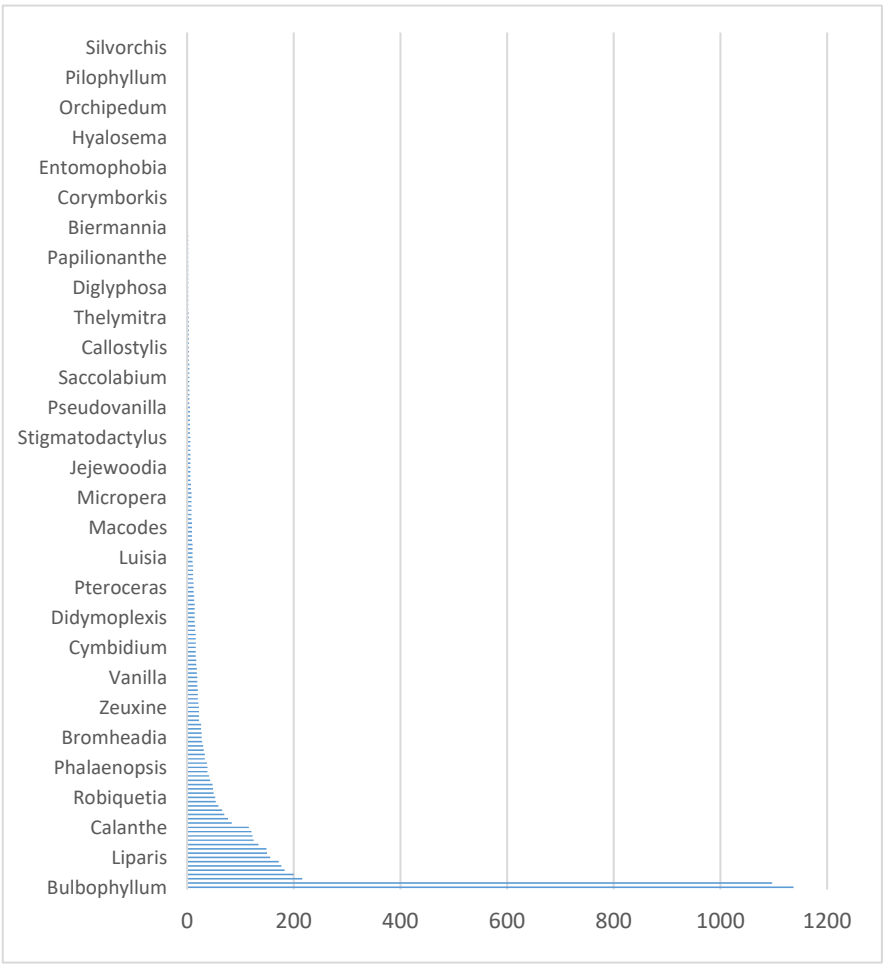

Fig. 1. Orchid genera distributed in Indonesia.

Table 1. Distribution of orchid with its medicinal records in Indonesia.

Orchid Species	Jawa	Kalimantan	LSI	Maluku	Papua	Sulawesi	Sumatera
Native	870	1855	318	473	3005	739	1269
Limited dist.*	237	1168	60	170	2714	398	531
Medicinal rec.	93	96	52	52	50	59	100
Introduced	2		1		4		
Medicinal rec.	1		1		1		

*Regardless distribution outside Indonesia

Regarding the medicinal orchids in our list recorded 130 orchid species which consist of 59 genera have medicinal use. The top genera medicinal orchids are *Dendrobium* (23 species), *Calanthe* (7 species), *Liparis* (6 species), *Bulbophyllum*, *Cymbidium*, *Eulophia*, *Habenaria*, *Phaius* (each 4 species) and *Coelogyne*, *Phalaenopsis*, *Vanilla* (each with 3 species). Genera of *Calanthe*, *Coelogyne*, *Cymbidium*, and *Dendrobium* [3] and *Vanilla* are among the medicinal orchid [21].

A total of 115 of the species were used globally, while 39 species are recorded in Indonesia. Most of the medicinal orchids are native species to Indonesia regardless of outside Indonesia distribution, whether they have wide distribution or limited distribution in Indonesia, and some of them are endemic in Indonesia regardless of how many main areas within Indonesia distribution. According to our finding, there are some medicinal orchids are only found in one specific island or area of Indonesia, such as *Calanthe rubens* Ridl., *Dendrobium cumulatum* Lindl., *D. hymenanthum* Rchb.f., *Calanthe monophyla* Ridl., *Vanilla abundiflora* J.J.Sm., *Smitinandia micrantha* (Lindl.) Holttum are only distributed in Kalimantan; *Dipodium scandens* (Blume) J.J.Sm. are only distibuted in Jawa; *Habenaria plantaginea* Lindl. is distributed in LSI; *Habenaria stenopetala* Lindl., *Crepidium resupinatum* (G.Forst.) Szlach., *Spiranthes sinensis* (Pers.) Ames, *Dendrobium canaliculatum* var. *foelschei* (F.Muell.) Rupp & T.E.Hunt, *Calanthe hololeuca* Rchb.f. are only distributed in Papua; and *Eulophia andamanensis* Rchb.f. and *Galeola faberi* Rolfe are only distributed in Sumatera. Moreover, we found eight endemic species, namely *Anoectochilus setaceus* Blume, *Coelogyne sanderiana* Rchb.f., *Dendrobium faciferum* J.J.Sm., *D. purpureum* Roxb., *D. utile* J.J.Sm., *Dipodium scandens* (Blume) J.J.Sm., *Habenaria multipartite* Blume ex Kraenzl., and *Vanilla abundiflora* J.J.Sm. In addition, *Vanilla planifolia* Andrews is recorded as introduced plants in Papua, LSI, and Jawa and *Pelexia obliqua* (J.J.Sm.) Garay is recorded as introduced plants in Jawa.

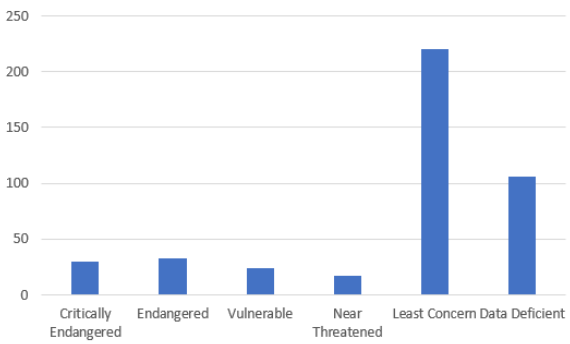

Fig. 2. The current status and categories of Indonesian orchids assessed by IUCN Redlist.

The conservation status of orchid species in Indonesia according to IUCN Redlist were 430 have been assessed and 87 out of them are included in IUCN Redlist species, which are vulnerable, endangered, and critically endangered (see Fig. 2). One medicinal species included in endangered species (*Vanilla planifolia* Andrews) and 5 species assessed as least concerned species are *Bromheadia finlaysoniana* (Lindl.) Miq., *Dendrobium discolor* Lindl., *Erythrorchis altissima* (Blume) Blume, *Spiranthes sinensis* (Pers.) Ames, and *Zeuxine strateumatica* (L.) Schltr. Recent publication by Cahyaningsih et al. reported 34 species of medicinal plants need to be prioritized for conservation [15]. Medicinal plant specifically facing many pressures such as over exploitation, indiscriminate collection, uncontrolled deforestation and habitat destruction, however multiple biological characters also effect the species rarity such as habitat specificity, distribution range, population size, species diversity, growth rate and reproductive system [22]. Medicinal plant needed to be harvested in high volume, mostly from wild populations and it has been reported the demand for wild resources increased by 8-15% per year in recent decades [23]. Conservation strategy including *in situ* (strict regulation, extended area of natural reserves and wild nurseries) and *ex situ* (botanic garden and seed banks) conservation and good agricultural practices and sustainable use should be adequately taken to protect the medicinal plants [23]. Another approach such as tissue culture, micropropagation, and molecular based approaches could be applied to improve yield and modify the potency of medicinal plants [24].

4 Conclusion

In conclusion, inventorying medicinal orchid in Indonesia from a global database revealed that Indonesia is rich in orchid species, with approximately 21% having a medicinal record. The majority of orchids are native to Indonesia, with only a few being highly endemic to the country. Given the threats, medicinal orchids in Indonesia may become extinct in the future if their medicinal potential is not recorded and developed in further research. This finding could serve as a foundation for future research that leads to new discoveries about their secondary compounds and any specific conservation study of medicinal orchids, benefiting not only researchers and users, but also policymakers.

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