

# Inventory of orchids in Polewali Mandar, West Sulawesi, Indonesia

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**Abstract.** Puspitaningtyas DM. 2019. *Inventory of orchids in Polewali Mandar, West Sulawesi, Indonesia. Biodiversitas 20: 1887-1896.* Sulawesi is the fourth largest island in Indonesia. It is also a unique island, possessing very high biodiversity due to its location in the Wallacea area, and having combined plants from both Asia and Australia. An inventory of orchids in Polewali Mandar District was conducted from 25 May to 13 June 2014 to assess the orchid diversity in the area. Orchid specimens were collected by using explorative method. A total of 60 accession numbers were collected in the study area. These collections represent 22 genera and 51 species, consisting of 41 epiphytic orchids and 10 terrestrial orchids. Some species are widely distributed in Indonesia, but few species are found only in eastern part of Indonesia such as Wallacea region, and are even endemic to Sulawesi. *Luisia celebica* Schltr. and *Micropera sterrophylla* (Schltr.) Garay are noted as endemic to Sulawesi, while *Dendrobium bicaudatum* Reinw. ex Lindl., *Habenaria beccarii* Schltr., *Malaxis trigonopetala* (J.J.Sm.) S. Thomas, Schuit. & de Vogel and *Pinalia quinquangularis* (J.J.Sm.) Ormerod are endemic to the Wallacea region, mainly Sulawesi and Moluccas. Among those orchids found in the study, *Dendrobium clavator* Ridl., *Pinalia quinquangularis* (J.J.Sm.) Ormerod, and *Pinalia xanthocheila* (Ridl.) W.Suarez & Cootes are noted as new records in Sulawesi. Many new records of orchids are still to be expected from Sulawesi.

**Keyword:** Orchid, Polewali Mandar, West Sulawesi, inventory, exploration

## INTRODUCTION

Indonesia has two of the world's 25 biodiversity hotspots, the Sundaland and Wallacea. Sulawesi with land area of 174,600 square km, is the fourth largest island of Indonesia. It is also a unique island because it is located on the Wallacea line which has a mixed flora from both Asia and Australia and is thought of having very high biodiversity (van Steenis 1950). It is the most geologically complex island as habitat for mixed flora and fauna from Asia and Australia and is also a place of evolution of various endemic fauna (Coates et al. 2000). Its flora is most closely related to the floras of dry areas in the Philippines, Moluccas, Lesser Sundas, and Java. The lowland forests have affinities to New Guinea, whereas the upland areas are more related to Borneo (Whitten et al. 1987).

The richness of Sulawesi's flora has not been fully revealed until now. Schlechter (1925) estimated the endemic orchids to Sulawesi to be around 253 species, more than the record of Smith (1929) which was only 161 species. The latest publication on the inventory of orchids in Sulawesi and Maluku (Thomas and Schuiteman 2002) recorded 820 species, 60% of which (548 species) were found in Sulawesi. These collections are stored in BO (Herbarium Bogoriense), CP (Herbarium Department of Plant Pathology, Copenhagen), G (Herbarium Conservatoire et Jardin Botaniques de la Ville de Geneve), K (Kew), L (Leiden), NSW (National Herbarium of New South Wales) and PNH (Philippine National Herbarium) and the collections were mostly collected from South Sulawesi (Sulistiarini and Mahyar 2003). Even though there is a lot of information about these plants, but the

detailed information about the distribution and ecological character, especially in conservation areas is still very limited (Sulistiarini and Mahyar 2003).

Exploration research is an important step in efforts for *ex situ* plant conservation. Bogor Botanic Gardens as an *Ex Situ* Conservation Institution has an important role in plant species conservation, carrying out population studies, plant propagation, breeding, and reintroduction. The aim of this research reported here was to inventory the diversity of orchid species in Polewali Mandar District, West Sulawesi Province. In addition, this study also collected orchids of Sulawesi Island which can be used not only for conservation purposes, but also for research, education, reintroduction, and commercial purposes.

## MATERIALS AND METHODS

The research was conducted in Polewali Mandar District, West Sulawesi, Indonesia from 25 May to 13 June 2014, in 8 locations at altitudes between 175 m and 395 m, namely Butu Alla hillside, Mapinni-Bulo Village and Bulo Sub-district with an altitude of 175 m, Butu Tahuana hillside, Pulliwa Village, Bulo Sub-district 217-380 m, Ba'batapua Village, Matanga Sub-district 392 m, Kalimbua Village, Tapango Sub-district 246 m, Tapua Village, Matanga Sub-district 371 m, Mambutapua Village, Matanga Sub-district 384 m, Ambo Padang Village, Tutar Sub-district 295 m, Tubbi Village, Tubbi Sub-district 265 m. The latitude & longitude of these locations are between S 03°13'07,8" to S 03°17'14,5" and E 119°02'47,7" to E 119°16'22,9". The soil acidity (soil pH) was about 3.8-5.9,

the temperature during the day was between 27.8-30.4°C, relative humidity during the day ranged from 72.8-90.9%.

The exploration activity was based on plant collection by using explorative method. The exploration method is carried out by following/using a path that is usually used by local people in hunting, looking for firewood or herbal medicines, and also making new pathways (Hidayat et al. 2017). Sampling living specimens were done when founding orchids by chance. The living specimens were recorded, identified and given collection number for inventory purpose. This was supplemented with environment data measured in Polewali Mandar District, i.e. latitude, altitude, relative humidity, air temperature and soil acidity. The tools used were GPS (Global Positioning System), Thermo-Hygrometers and soil pH meters.

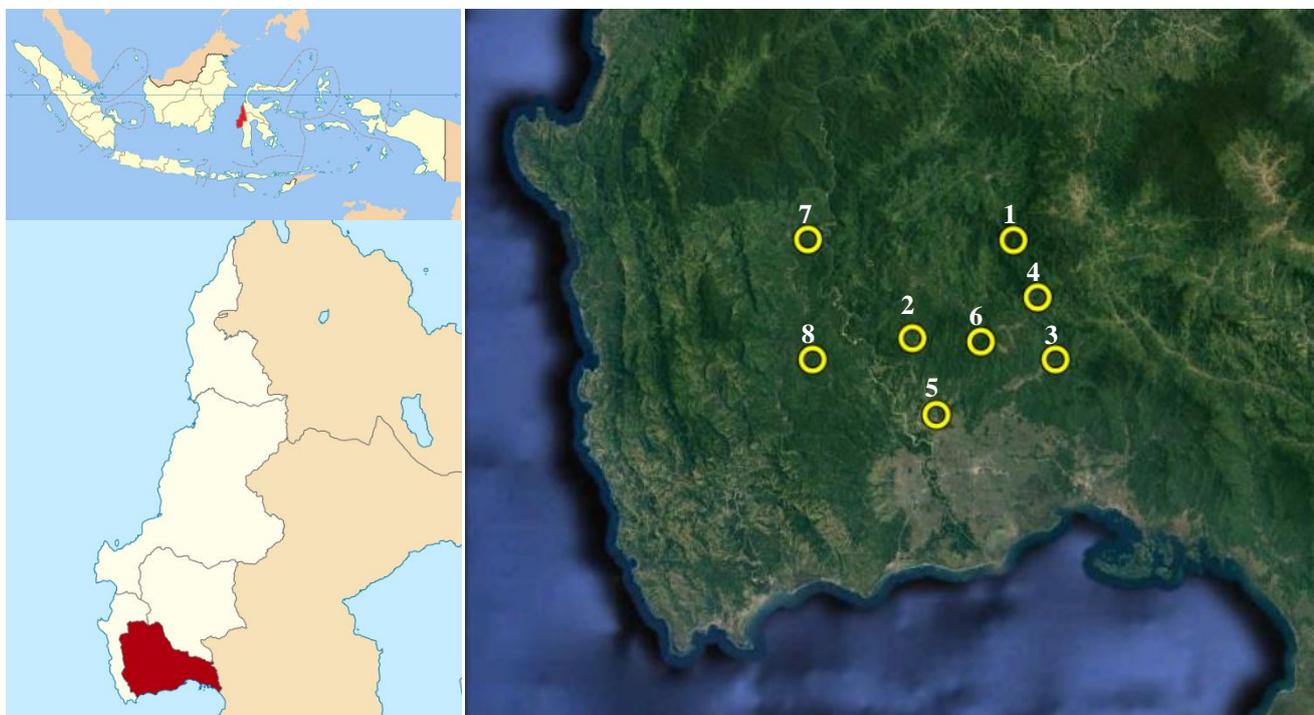
Observation, data recording, collecting of living orchids and documentation were carried out during exploration. Identification was done by observing plant morphology namely leaves, stems, roots, and flowers. For identification to species level, observation on flower morphology is needed. Most orchid without flower can only be identified to genus level. However, some species of orchids that have specific vegetative characteristics can be identified to species level even though they are not flowering. Identification to genus or species level was done using literature (Comber 1990; Seidenfaden and Wood 1992; Comber 2001; O'Byrne 2001, 2011) and reference to living collections in Bogor Botanic Gardens. Valid names were attributed based on the current listings in The Plant List

(2013) ([www.theplantlist.org](http://www.theplantlist.org)). Only specimens of abundant species were collected to support *in situ* conservation purpose, while some rare specimens were only recorded or photographed for documentation. Living materials were mostly planted out in Masenrempulu Enrekang Botanic Gardens, South Sulawesi and some species were also planted in Bogor Botanic Gardens, West Java for *ex situ* conservation purposes.

## RESULTS AND DISCUSSION

Approximately 60 accession numbers of orchids were collected in the study area, consisting of 22 genera and 51 species, 41 of which were epiphytic and 10 terrestrial (Table 1). The number of species for each genus is presented in Figure 2.

Table 1 and Figure 2 show that some genera were represented only by a single species, namely *Acriopsis*, *Luisia*, *Micropera*, *Pteroceras*, *Thelasis*, *Thrixspermum*, *Acanthephippium*, *Corymborkis*, *Crepidium*, *Denia*, *Malaxis*, and *Vanilla*. Genus *Dendrobium* had the highest number of species (9 species), followed by Genus *Oberonia* (6 species). The highest number of orchids was found in Butu Tahuana hillside, Pulliwa Village, Bulu Sub-district (15 species), then in Tapua Village, Matanga Sub-district (12 species) and Mambutapua Village, Matanga Sub-district (12 species).



**Figure 1.** Location of exploration activities in Polewali Mandar District, West Sulawesi Province, Indonesia. 1. Tapua Village, Matanga Sub-district (371 m asl.), 2. Butu Tahuana hillside, Pulliwa Village, Bulu Sub-district (217 m asl.), 3. Kalimbia Village, Tapango Sub-district (246 m asl.), 4. Mambutapua Village, Matanga Sub-district (384 m asl.), 5. Butu Alla hillside, Mapinni-Bulo Village, Bulu Sub-district (175 m asl.), 6. Ba'batapua Village, Matanga Sub-district (392 m asl.), 7. Tubbi Village, Tubbi Sub-district (265 m asl.), 8. Ambo Padang Village, Tutar Sub-district (295 m asl.)

### Epiphytic orchids

The genus *Acriopsis* can be recognized by their crowded egg-shaped pseudobulbs surrounded by nest of erect white roots; each pseudobulb has 2-4 linear leaves at the apex, growing as an epiphyte on trees. This genus has eight or nine species distributed to South East Asia to Australia (O'Byrne 2011). One of them is *Acriopsis liliifolia* (J.Koenig) Seidenf, which is formerly named *Acriopsis javanica* Reinw. ex Blume (Comber 1990). It is very common species found in South East Asia from lowland to highland forest. It has long slender inflorescences with many branches, bearing numerous small cross-shaped flowers. Flowers are 1.2 mm broad, white or pale yellow with median violet streak. The lateral sepals are fused together as synsepalum behind the lip, and the base of the lip is joined to the column margins to form a nectary. Lip is white-violet with distinct side-lobes, each of which is broader than mid-lobe.

Three species of *Aerides* was recorded growing on trees. There was no species found in flowering time, but based on vegetative plant, one of them was identified as *Aerides odorata* Lour. As its name *odorata* implies, it has fragrant flowers. It is a pendant epiphyte, about 60 cm long, high up on the branch of trees. The inflorescence arises out of the leaf axils, semi-pendulous, consisting of 15 cm long peduncle and 25 cm rachis, with many fragrant flowers (20-30 flowers). Flowers are about 2-3 cm broad, white with various pink spotting and blotching. This species is widespread through the Himalayas, Assam, Bangladesh, India, Nepal, Andaman Islands, Myanmar, Thailand, Laos, Cambodia, Vietnam, Peninsular Malaysia, Borneo, Sumatra, Java, Sulawesi and the Philippines, at elevations of 0 to 500 meters (Comber 1990; O'Byrne 2001; Silveira et al. 2008).

There were five species of the genus *Bulbophyllum* found in this area, only one species was flowering and identified as *Bulbophyllum clandestinum* Lindl. which was formerly named *Bulbophyllum sessile* (Kuntze) J.J.Sm. It is widespread from Thailand, Laos, Vietnam, Burma, Malaysia, Indonesia, New Guinea, Philippines, and Fiji. It grows on tree trunks in lowland forests up to 1,000 m above sea level.

Three species of the genus *Cymbidium* were also found in this area. One species of them were identified as *Cymbidium finlaysonianum* Lindl., although they were not in flowering time, but based on vegetative morphology this plant has thick, hard, long leaves (70 cm) and widest leaves (at least 4.5 cm) among the pendulous inflorescence in this genus (Comber 1990). The leaf tip is unequally bilobed. The flowers are borne on a pendulous inflorescence up to 50-100cm long and are well spaced out. The flowers grow about 5cm in diameter. The sepals and petals are yellow with or without red streaks running along the middle. The flower lip is three-lobed, the lateral lobes is triangular and acute in shape. The middle lobe is recurved and white with red markings. The flower column is dark red and curved.

*Dendrobium*, with an estimated 1400 species, is the second largest genus in South East Asia. It is probably the

most diverse in terms of plant habits and flower shapes (O'Byrne 2011). It has been divided into sections (Comber 1990). Out of nine species of *Dendrobium* found in this area, only five could be identified to species level, namely *Dendrobium acerosum* Lindl., *Dendrobium anosmum* Lindl., *Dendrobium bicaudatum* Reinw. ex Lindl., *Dendrobium clavator* Ridl., and *Dendrobium crumenatum* Sw.

*Dendrobium acerosum* is included in section *Strongyle*. It forms tufts of stems. Leaves are thick and fleshy, with short curved terete, sharply pointed, distichous spaced widely apart. The upper part of the stem has many inflorescences, each producing 1-4 flowers at a time. It is epiphytic at elevations of 50 m to 1600 m in lowland open spaces and swamps on trees and rock faces often in full sunlight. It is found in the Philippines, Borneo, Sulawesi, Sumatra, Malaysia, Singapore, Thailand and Myanmar (O'Byrne 2001).

*Dendrobium anosmum* is included in section *Dendrobium*. It is hot to cool growing orchid that needs a distinct dry period for flowering. Many inflorescences are formed on the leafless stems, each with 1-2 large flowers which are about 5 to 10 cm broad. Flowers are fragrant and variable in color from light purple to violet. It grows as epiphyte in lowland forest at altitudes up to 1300 m. It is a native to Myanmar, Thailand, Laos, Vietnam, Malaysia, Philippines, Indonesia to New Guinea (O'Byrne 2001).

*Dendrobium bicaudatum* is included in section *Spatulata*. It has long stems, about 40 cm, which are slightly swollen in the lower leafless then taper to the apex. Inflorescence arises from the nodes near the apex of the pseudobulb. It is about 10-20 cm, bearing 8-10 flowers which are 5 cm broad. It is an epiphyte in the lowland forest, at altitudes of 0 m-300 m, and in this study area, it was found at 217 m. It is endemic to the Wallacea region mainly in Sulawesi and Moluccas (O'Byrne 2001).

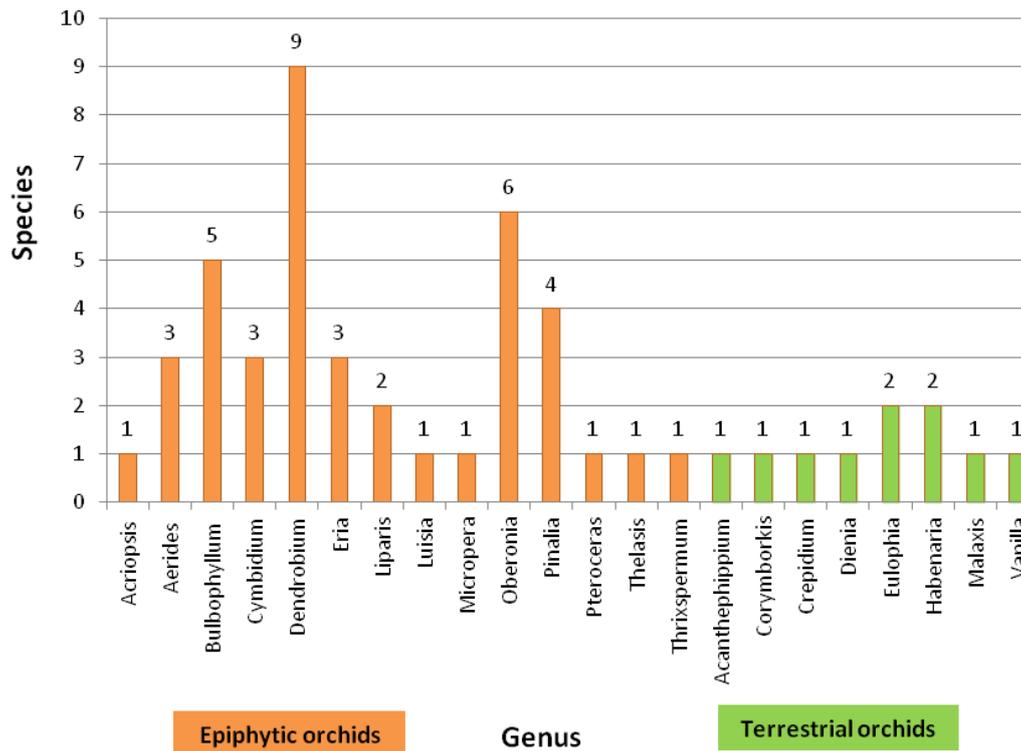
*Dendrobium clavator* is included in section *Crumenata*. It is an epiphyte with slender pseudobulbs, with 1-2 internodes swollen. It has 2 to 4 terete leaves, widely spaced, deciduous. A single flower is about 1 cm broad, arising opposite the leaves near the apex, white. *D. clavator* was recorded in the Malay Peninsula and Thailand, thus Sulawesi is a new record for its distribution (Sulistiarini and Mahyar 2003). It grows in the lowlands to the highlands, at altitudes of 371 m-1,300 m.

*Dendrobium crumenatum*, commonly called pigeon orchid, is included in section *Rhopalanthe*. It is an epiphytic orchid, producing upright, sympodial, pseudobulbs that are swollen at the first three or four lower nodes of stem. Leaves are oblong to egg-shaped, placed alternate into two rows. Strongly scented white flowers are borne on leafless stem on the apex. It is the most common orchid species in South East Asia, growing everywhere as a cosmopolitan orchid. It usually grows in exposed positions, often in lowland rainforest or along roadsides, at altitudes of sea level to 500 m.

**Table 1.** Orchids in Polewali Mandar District, West Sulawesi Province, Indonesia

Scientific Names	Habitus	Location							
		1	2	3	4	5	6	7	8
<i>Acriopsis liliifolia</i> (J.Koenig) Seidenf.	Ep.		x						
<i>Aerides odorata</i> Lour.	Ep.		x	x	x				
<i>Aerides</i> sp.1 TR 01	Ep.					x			
<i>Aerides</i> sp. 2 TR 26	Ep.			x					
<i>Bulbophyllum</i> sp. 1 TR 03	Ep.					x			
<i>Bulbophyllum</i> sp. 2 TR 17	Ep.		x						
<i>Bulbophyllum</i> sp. 3 TR 18	Ep.		x						
<i>Bulbophyllum</i> sp. 4 TR 32	Ep.	x							
<i>Bulbophyllum clandestinum</i> Lindl.	Ep.	x							
<i>Cymbidium finlaysonianum</i> Lindl.	Ep.		x		x				
<i>Cymbidium</i> sp. 1 TR 19	Ep.		x						
<i>Cymbidium</i> sp. 2 DM 2782	Ep.								x
<i>Dendrobium acerosum</i> Lindl.	Ep.	x	x						
<i>Dendrobium anosum</i> Lindl.	Ep.		x						
<i>Dendrobium bicaudatum</i> Reinw. ex Lindl.	Ep.		x						
<i>Dendrobium clavator</i> Ridl.	Ep.	x				x			
<i>Dendrobium crumenatum</i> Sw.	Ep.		x						
<i>Dendrobium</i> sp. 1 TR 50	Ep.				x				
<i>Dendrobium</i> sp. 2 TR 40	Ep.				x				
<i>Dendrobium</i> sp. 3 TR 47	Ep.				x				
<i>Dendrobium</i> sp. 4 DM 2778	Ep.								x
<i>Eria javanica</i> (Sw.) Blume	Ep.				x				
<i>Eria</i> sp. 1 TR 14	Ep.		x						
<i>Eria</i> sp. 2 TR 20	Ep.		x						
<i>Liparis condylobulbon</i> Rchb.f.	Ep.				x				
<i>Liparis parviflora</i> (Blume) Lindl.	Ep.								x
<i>Luisia celebica</i> Schltr.	Ep.		x						
<i>Micropera</i> aff. <i>sterrophylla</i> (Schltr.) Garay	Ep.								x
<i>Oberonia costeriana</i> J.J.Sm.	Ep.	x							
<i>Oberonia lycopodioides</i> (J.Koenig) Ormerod	Ep.		x						
<i>Oberonia padangensis</i> Schltr.	Ep.								x
<i>Oberonia</i> sp. TR 35	Ep.	x							
<i>Oberonia</i> sp. TR38/DM2765	Ep.	x							
<i>Oberonia</i> sp. DM 2779	Ep.								x
<i>Pinalia bicristata</i> (Blume) Kuntze	Ep.							x	
<i>Pinalia bractescens</i> (Lindl.) Kuntze	Ep.	x	x			x			
<i>Pinalia quinquangularis</i> (J.J.Sm.) Ormerod	Ep.	x							
<i>Pinalia xanthocheila</i> (Ridl.) W.Suarez & Cootes	Ep.	x							
<i>Pteroceras</i> sp.	Ep.							x	
<i>Thelasis pygmaea</i> (Griff.) Lindl.	Ep.					x			
<i>Thrixspermum centipeda</i> Lour	Ep.								x
<i>Acanthephippium splendidum</i> J.J.Sm.	Tr.	x							
<i>Corymborkis veratrifolia</i> (Reinw.) Blume	Tr.							x	
<i>Crepidium carinatifolium</i> (J.J.Sm.) Szlach.	Tr.	x							
<i>Dienia ophrydis</i> (J.Koenig) Seidenf.	Tr.				x				
<i>Eulophia spectabilis</i> (Dennst.) Suresh	Tr.			x					x
<i>Eulophia zollingeri</i> (Rchb.f.) J.J.Sm.	Tr.				x				
<i>Habenaria beccarii</i> Schltr.	Tr.				x				x
<i>Habenaria</i> sp.	Tr.								x
<i>Malaxis trigonopetala</i> (J.J.Sm.) S.Thomas, Schuit. & de Vogel	Tr.				x				
<i>Vanilla</i> aff. <i>planifolia</i> Jacks. ex Andrews	Tr.				x				
Total species	60	12	15	3	12	5	3	7	3

Note: x: exist. Ep.: Epiphytic, Tr.: Terrestrial. 1. Tapua Village, Matanga Sub-district (371 m asl.), 2. Butu Tahuana hillside, Pulliwa Village, Bulu Sub-district (217 m asl.), 3. Kalimbia Village, Tapango Sub-district (246 m asl.), 4. Mambutapua Village, Matanga Sub-district (384 m asl.), 5. Butu Alla hillside, Mapinni-Bulu Village, Bulu Sub-district (175 m asl.), 6. Ba'batapua Village, Matanga Sub-district (392 m asl.), 7. Tubbi Village, Tubbi Sub-district (265 m asl.), 8. Ambo Padang Village, Tutar Sub-district (295 m asl.)



**Figure 2.** Number of orchid species for each genus found in Polewali Mandar District, West Sulawesi, Indonesia

There were three species of *Eria* found in this area, one of which was *Eria javanica* (Sw.) Blume. and the others were still unidentified species because they had no flower. *E. Javanica* has fat pseudobulbs formed from a single internode, each supports two lanceolate leaves, size about 50x10 cm, quite thick and fleshy. Inflorescence is about 60 cm long, emerging from near the apex of pseudobulbs, each bearing 40-50 flowers, most of which open at once. Flowers are sweetly fragrant, about 4 cm broad. There is a lot of variation in flower color and size, pale yellow, sometimes with purple or red veining. The distribution is widespread in South and Southeast Asia from sea level to 2400 m altitude.

Two species of the genus *Liparis* were found in this area, namely *Liparis condylobulbon* Rchb.f. and *Liparis parviflora* (Blume) Lindl. They are epiphytes, having pseudobulbs which support two leaves. They are very distinctive because they have different forms on the pseudobulb and leaves. *L. condylobulbon* has an obovate pseudobulb with long terete tip, linear leaves, and an erect inflorescence. *L. parviflora* has a conical pseudobulb, lanceolate leaves, and a pendulous inflorescence.

*Luisia celebica* Schltr. is one of endemic orchids to Sulawesi found in this area. Luisia's name comes from the name of a Portuguese botanist Don Luis de Torres, in recognition of his love for orchids, while the celebica comes from Celebes, the island of Sulawesi, where it was first discovered. At present, the distribution is limited to Sulawesi (O'Byrne 2001).

Genus *Micropera* consists of about 21-22 species, distributed from India, Indochina, Vietnam, Malaysia, Indonesia, Philippines, Australia to the Pacific Islands. There was only one species of *Micropera* found in this study area, which was *Micropera sterrophylla* (Schltr.) Garay which is endemic species to Sulawesi (O'Byrne 2011; Pfahl et al. (2019). In this area, this species was found at an altitude of 265 m, but O'Byrne (2011) stated that it was found in Sulawesi at elevations of 600 m to 1200 m. This plant is an epiphyte on branches of roadside trees with branching stems carrying rigid, strap-shaped leaves. The inflorescences curve upwards and can reach 40 cm long with up to 30 flowers, only a few are open at a time.

Six species of the genus *Oberonia* were recorded in this area, namely *Oberonia costeriana* J.J.Sm., *Oberonia lycopodioides* (J.Koenig) Ormerod, *Oberonia padangensis* Schltr., *Oberonia* sp. TR 35, *Oberonia* aff. *fungumolens* Burkill, and *Oberonia* sp. DM 2779. This genus is mostly characterized by stemless and distichous leaves which are bilaterally flattened and often fleshy. Inflorescence is terminal with numerous very small flowers arranged in whorls in a raceme. Two species of them could not be identified to species names because there was no flower, namely *Oberonia* sp. TR 35, *Oberonia* sp. TR 38/DM2765 and *Oberonia* sp. DM 2779. *Oberonia* sp. TR 35 is similar to *Oberonia* aff. *imbricata* (Blume) Lindl. or *Oberonia* aff. *lycopodioides* (J.Koenig) Ormerod, while *Oberonia* sp. TR 38/DM2765 is similar to *Oberonia* aff. *fungumolens*

Burkill or *Oberonia* aff. *lycopodioides* (J.Koenig) Ormerod. Only with their flowers can these species be distinguished from one another. *Oberonia fungumolens* is recorded only in Thailand and Peninsular Malaysia (Seidenfaden and Wood 1992; Govaerts 2019). However, Puspitaningtyas (2017) has found this species in Sulawesi. If *O. fungumolens* was found in this area, it could be new record in Sulawesi.

*Pinalia* was formerly included in genus *Eria* section *Pinalia*, but it was recently reinstated as distinct from *Eria* based on thin filamentous roots, large, laterally flattened pseudobulbs of several nodes, each node with a papyraceous bract, leaves with obscure venation, racemes with a cylindrical peduncle and rachis, cupulate flowers and narrow column with obscure wings (Clements and Jones 2002). Furthermore, O'Byrne et al. (2018) proposed *Pinalia* as a genus especially for the Sundaic orchids, particularly those of Sulawesi and Moluccas. Some species of genus *Eria* section *Pinalia* are now become members of a new genus *Pinalia*, such as *Pinalia bractescens* (Lindl.) Kuntze which was formerly named *Eria bractescens* Lindley; *Pinalia quinquangularis* (J.J.Sm.) Ormerod which was formerly named *Eria quinquangularis* J.J.Sm.; *Pinalia xanthocheila* (Ridl.) W.Suarez & Cootes which was formerly named *Eria xanthocheila* Ridl. However, some species of genus *Eria* section *Eria* are still within the genus *Eria*, such as *Eria javanica* (Sw.) Blume.

The name *Eria bractescens* contains *Eria* orchids which have 'bractea' (foliage), which can be seen from each stalk of flower buds followed by *bractea*. This epiphytic orchid has pseudobulb, with each pseudobulb supports 2 leaves. Leaves are rather thick and leathery, elliptical to oblong, tip obtuse to rounded, unequally bilobed, 7-20 cm long and 2-3,5 cm wide. Inflorescence arises from the upper node of pseudobulb below the leaves, about 20 cm supporting 10-15 flowers, each flower has a *bractea*. The flowers are creamy white with white lip or white pinkish midlobe with red blotches sidelobes (O'Byrne 1994). This species is widespread through Assam, Bangladesh, Himalayas, Nepal, Andaman Islands, Myanmar, Thailand, Laos, Cambodia, Vietnam, Malaysia, Borneo, Java, Sumatra, Maluku, Sulawesi and the Philippines (Pfahl et al. 2019). Generally, it grows in lowlands to highlands, ranging from sea level to at least 650 m altitude (O'Byrne 1994).

*Pinalia quinquangularis* (J.J.Sm.) Ormerod is found in Ambon Island of the Moluccas as a miniature sized, hot growing epiphyte with a stout creeping rhizome, pseudobulbs 4 to 5 cm, carrying 5 to 6 leaves. Inflorescence is 12 cm long, which bear up to 90 crowded small flowers. It is also found in Sulawesi as new record (O'Byrne 2001; O'Byrne 2011/errata 2001).

*Pinalia xanthocheila* (Ridl.) W.Suarez & Cootes is widespread to Burma, Thailand, Malaysia, Sumatra, Java, Borneo to the Philippines (Comber 1990; O'Byrne 2001). Sulawesi has never been mentioned as distribution area, so Sulawesi becomes a new record for its distribution. It generally grows in the lowlands at altitudes of 300 m to 1,600 m. It is an epiphyte or lithophyte with a clavate pseudobulb, carrying several inflorescences (5 to 9 cm) with up to 25 fragrant flowers.

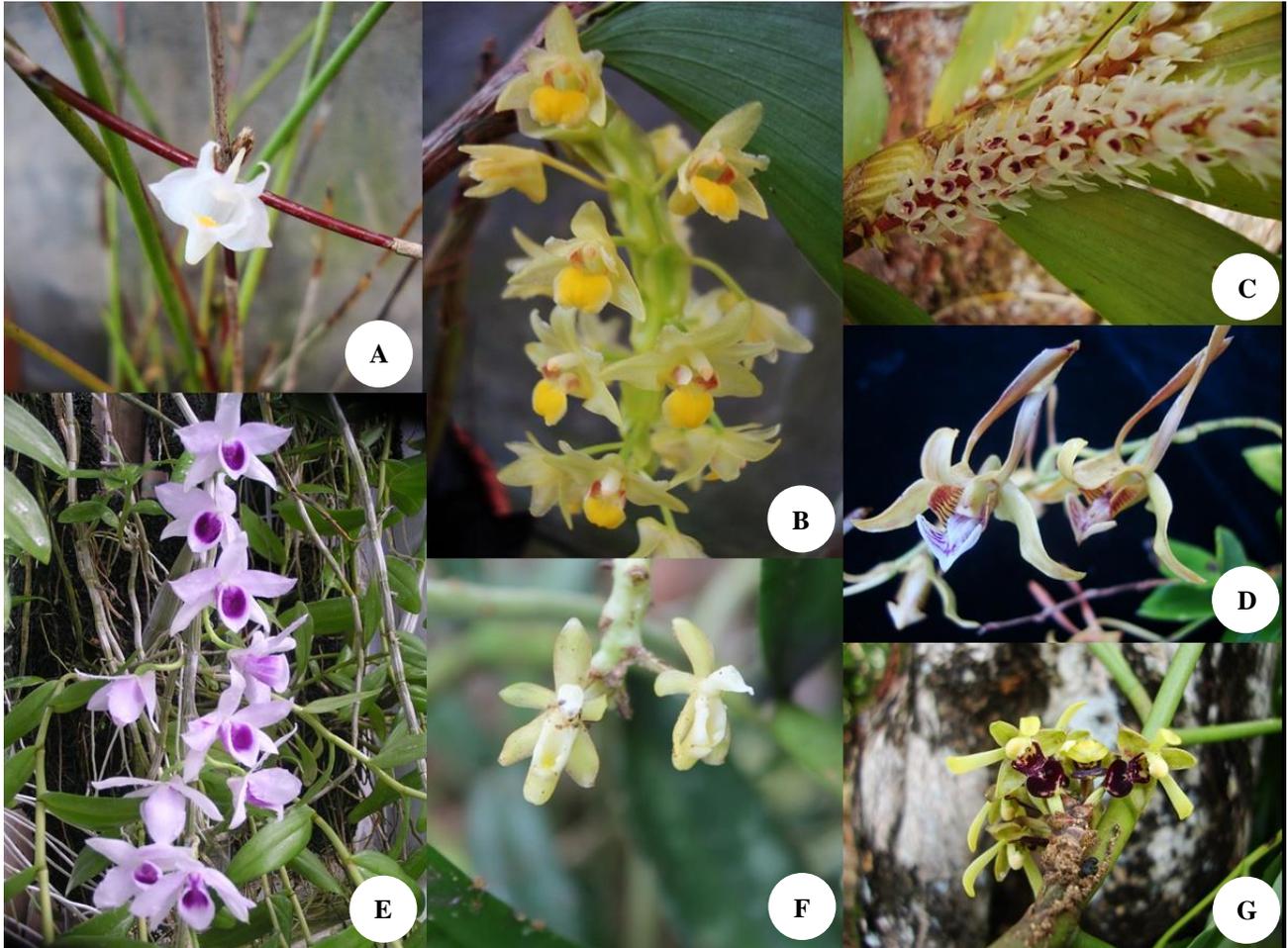
Only one species of *Pteroceras* was found in this area. However, this plant had no flower, so it could not be identified to species. The genus *Pteroceras* consist of 19 species distributed from India to Philippines, Maluku and the Lesser Sunda Islands (O'Byrne 2001; O'Byrne 2011). There are two species of *Pteroceras* recorded in Sulawesi, *Pteroceras cladostachyum* (Hook.f.) H.A.Pedersen (O'Byrne 2001) and *Pteroceras teres* (Blume) Holttum (O'Byrne 2011). So, the *Pteroceras* sp. which found in this area, could be as one of them.

Genus *Thelasis* consists of 20 species, distributed from eastern India to New Guinea and the Pacific Islands (O'Byrne 2001; O'Byrne 2011). Only one species of *Thelasis* was found in this area, which was *Thelasis pygmaea* (Griff.) Lindl. It is a small epiphyte with onion-shaped green pseudobulbs which support one large and one small leaf at the apex. The inflorescences emerge at the pseudobulb base, on a 6 cm long peduncle with many tiny flowers, only a few of which are open at once. This species is widespread from China, Taiwan, Assam, eastern Himalayas, India, Nepal, Bhutan, Andaman Islands, Myanmar, Thailand, Laos, Vietnam, Borneo, Java, Lesser Sunda Islands, Malaysia, Moluccas, the Philippines, Sulawesi, Sumatra, Bismark Archipelago, Solomon Islands and New Guinea (Comber 1990; O'Byrne 2011).

Only one species of genus *Thrixspermum* was found in this area, which was *Thrixspermum centipeda* Lour. Seidenfaden and Wood (1992) revised the formerly named *Thrixspermum arachnites* (Blume) Rchb.f. as a synonym of *Thrixspermum centipeda* Lour. which is a valid name. Both the names of *centipeda* and *arachnites* refer to the shape of spiders. It is an epiphytic orchid, stems 10-15 cm long, bearing 5-7 leaves at 1 cm apart, lanceolate shaped, bilobed apically, and slightly thick. The inflorescence reaches 20 cm long, the rachis gradually extending up to 15 cm long, supporting 2-3 flower. Flowers pale yellow, 4-5 cm broad, and smell softly fragrant. The pouch lip is about 9 mm long, white with reddish-brown dots. It generally grows at altitudes of 0 m-1,300 m, both in primary and secondary forests. It grows mainly in the region of India to Southeast Asia, from Laos, Myanmar, Thailand, Peninsular Malaysia, Sumatra Borneo, Java, Sulawesi and the Philippines (Comber 1990; O'Byrne 2001).

#### Terrestrial orchid

There were 10 species of terrestrial orchid found in this area, namely *Acanthephippium splendidum* J.J.Sm., *Corymborkis veratrifolia* (Reinw.) Blume, *Crepidium carinatifolium* (J.J.Sm.) Szlach., *Dienia ophrydis* (J.Koenig) Seidenf., *Eulophia spectabilis* (Dennst.) Suresh, *Eulophia zollingeri* (Rchb.f.) J.J.Sm., *Habenaria beccarii* Schltr., *Habenaria* sp., *Malaxis trigonopetala* (J.J.Sm.) S.Thomas, Schuit. & de Vogel, and *Vanilla* aff. *planifolia* Jacks. ex Andrews. These terrestrial orchids found growing on the forest floor were generally not abundant; they grew in small groups and spread. The orchids were not found in flowering time, so they could not be identified to the species name, except if there was a specific character in vegetative organs.



**Figure 3.** Epiphytic orchid diversity in Polewali Mandar District, West Sulawesi Province, Indonesia. A. *Dendrobium clavator* Ridl., B. *Pinalia xanthocheila* (Ridl.) W.Suarez & Cootes, C. *Pinalia quinquangularis* (J.J.Sm.) Ormerod, D. *Dendrobium bicaudatum* Reinw. ex Lindl., E. *Dendrobium anosmum* Lindl, F. *Micropera sterrophylla* (Schltr.) Garay, G. *Luisia celebica* Schltr.

*Acanthephippium splendidum* J.J.Sm. was found in this area. It is about 80 cm in height and grows on humus soil as terrestrial orchid. Bulbs are ovoid to conical (fusiform), fleshy, 25 cm in length, with 4-6 segments per pseudobulb covered by sheaths, supporting 2-3 leaves. Leaves are elliptic, tip acuminate, pointed ends, plicate, 65 cm long. Inflorescence is lateral, appearing from node bulb of new growth, 13-16 cm long and bearing 3-6 flowers. Flowers are jar-shaped, fleshy, about 4 cm long, pink color base, marked with red lines and spots, bright yellow lips marked with red inside. This species spreads from Sulawesi, Moluccas, New Guinea, Solomon Islands, Fiji, New Caledonia, Tonga, Vanuatu to the Pacific Ocean. It grows in moist and humus forests at altitudes up to 1,300 m asl. (O'Byrne 2011).

*Corymborkis veratrifolia* (Reinw.) Blume is a tough, evergreen, terrestrial orchid without underground storage. It has a hard, erect, unbranched and leafy stem, growing to 1.5-2 m tall. Leaves are lanceolate, plicate and tough, with pointed leaf tip; sessile, leaf position alternately around the stem, about 35 x 10 cm. The inflorescence is axillary, arranged in panicles, branched, each branch bears pure

white flowers with green stipule. Sepals are lanceolate, acute, spreading; petals oblong, spreading wider, apices curled back; lip is trilobed, entire, 3 cm long and 1.5 cm broad, convex, the margins undulate (Comber 1990). It grows in a very broad range of habitats, ranging in altitudes from 0 m to 1,850 m. Therefore, the shapes and colors of flowers are also diverse. It is widespread from Madagascar, India, Southeast Asia, Japan, and Australia, to the Pacific Islands (Comber 1990).

There was one species of *Crepidium* found, which was *Crepidium carinatifolium* (J.J.Sm.) Szlach. which was previously named *Malaxis carinatifolia* (J.J.Sm.) P.F.Hunt. The genus *Crepidium* Blume was reestablished recently (Szlachetko 1995); it differs from the genus *Malaxis* Sw. to which most of its species were classified previously in the gynostemium structure (Szlachetko and Margonska 1998). *C. carinatifolium* spreads from Sulawesi, Papua to New Guinea. It grows at altitudes of 300 m to 1,200 m.

*Dienia ophrydis* (J.Koenig) Seidenf. was formerly named *Malaxis latifolia* J.E. Smith (Comber 1990) or *Malaxis ophrydis* (Koenig) Ormerod (O'Byrne 2011). This plant has stems close together, swollen into pseudobulbs,

each bearing 3-4 leaves. Leaves are broadly lanceolate and acuminate to the tip, up to 30x10 cm. Inflorescence sometimes up to 50 cm tall, bearing many small flowers, about 5 mm broad. Flowers are facing downwards, yellow and green, then fade to red or brown. This common terrestrial orchid is widely distributed from India, China, and South-East Asia to Australia. It occurs in a range of open situations such as grassy roadsides at elevation from 0-1500 m asl. (Comber 1990; O'Byrne 2011).

There were two species of *Eulophia* growing in this area, *Eulophia zollingeri* (Rchb. f.) J.J. Sm. and *Eulophia spectabilis* (Dennst.) Suresh. *E. spectabilis* is a terrestrial orchid, with underground pseudobulbs, slightly rounded, about 3 cm in diameter, giving rise to shoots that emerge at their tips. The plant is 20 cm high, bearing 2 to 4 leaves, oblong-narrowly lanceolate, with pointed tips, plicate, approximately 54 x 10 cm. The inflorescence arises from the base, up to 1 meter tall, bearing 10-20 flower buds. Flowers are about 3 cm broad with many colors. It spreads widely, ranging from India, Myanmar, Sri Lanka, China, Thailand, Peninsular Malaysia, Singapore, Borneo, Sumatra, Java, Sulawesi, and the Philippines, to Papua New Guinea and the Solomon Islands (Seidenfaden and Wood 1992; Comber 1990; Comber 2001). This species prefers full sunlight, and is most often found growing in grassy fields. It is found from lowlands to highlands, with an altitudinal range from 0 m to 1,300 m.

*E. zollingeri* is a mycoheterotrophic terrestrial orchid; green leaves absent. Pseudobulbs are underground, giving rise to an erect inflorescence about 60 cm tall, supporting 15 to 20 flowers, rachis with subulate floral bracts, flowers dull red-brown, not wide opening, and pungently fragrant flowers. It is found in India through Indonesia to New Guinea and Queensland Australia, hill to lower montane forests at elevations of 500 to 1500 m asl. with deep shade or open place with thick humus (Seidenfaden and Wood 1992)

There are two species of *Habenaria* recorded as terrestrial orchids, one of which is identified as *Habenaria beccarii* Schltr. It is a small orchid with 2-20 cm high, bearing 4-5 leaves. The inflorescence is terminal, erect, bearing 5-17 white flowers on a rachis 4-12 cm. It grows on humus soil under shady forest, and in this study, it was found only in Tubbi Village, Tubbi Sub-district. This orchid species is endemic to the Wallacea region mainly in Sulawesi and Moluccas (Puspitaningtyas 2017; Pfahl et al. 2019; Govaerts 2019).

According to Puspitaningtyas (2017), this species from Sulawesi was identified with the wrong name as *Habenaria medioflexa* Turrill (Yuzammi and Hidayat 2002) or *Habenaria medusa* Kraenzl. (Puspitaningtyas et al. 2013; Hartini and Puspitaningtyas 2005). With detailed observation on flower morphology, *H. beccarii* is very distinct from *H. medioflexa* and *H. medusa*, based on the shape of the flower's lip. Furthermore, *H. medioflexa* is commonly distributed in mainland Asia such as Malaysia, Thailand, Laos, Vietnam, and Cambodia (Seidenfaden and

Wood 1992); while *H. medusa* is distributed in Laos, Thailand, Sumatra, Borneo, Java, as well as Sulawesi (Comber 1990; Kurzweil 2009), but according to O'Byrne (2011) *H. medusa* is absent in Sulawesi.

*Malaxis trigonopetala* (J.J.Sm.) S.Thomas, Schuit. & de Vogel is a terrestrial orchid which has been found in Sulawesi at 1100 m to 1200 m altitude, but probably occurs at lower altitudes in the Moluccas (O'Byrne 2011). In Polewali Mandar District, West Sulawesi, it was found at an altitude of 384 m. It has pseudobulbs about 9-10 cm long, with 4-6 narrow lanceolate green leaves. The inflorescence is growing successively erect, terminal, and has up to 12 flower buds, but only a few flowers open at a time. Flowers are small, about 7 mm broad, pale orange with black column in the center. the species name refers to the broad petals which are triangular in shape.

The orchid collections found in Polewali Mandar District are very diverse. The results of the study recorded approximately 51 species of the Orchidaceae family, represented by 22 genera, consisting of 41 epiphytic orchid species and 10 terrestrial orchid species. There are some orchids species found in this area that need special attention for conservation. *Luisia celebica* and *Micropera sterrophylla* are noted as endemic to Sulawesi. Other species, namely *Dendrobium bicaudatum*, *Habenaria beccarii*, *Malaxis trigonopetala*, and *Pinalia quinquangularis* are endemic to the Wallacea region mainly in Sulawesi and Moluccas. Among those orchids found in the study, *Dendrobium clavator*, *Pinalia quinquangularis*, and *Pinalia xanthocheila* are noted as new records in Sulawesi. Many new records of orchids are still to be expected from Sulawesi.

Those threatened and endemic orchids need immediate action for conservation to protect them from extinction in their natural habitat. Unfortunately, most of the forests in Polewali Mandar District as orchid habitat decline rapidly and are turned into cocoa plantations. For their long term survival in nature, they need to be protected through *in situ* and *ex situ* conservation. *In situ* orchid conservation and habitat, preservation is the first line of defense for safeguarding orchid species in the future. *Ex situ* conservation is done as back-up through orchid cultivation outside their habitat. For conservation purpose, cultivation of commercial plant species should be encouraged, in order to avoid overexploitation in the wild. If the populations decline in the wild, then reintroduction program should be carried out to restore the populations in their natural habitat. Therefore, forest degradation must be prevented to avoid the loss of flora and fauna. In addition, botanic garden is one of the solutions to save plants diversity by *ex situ* conservation. Currently, orchid seed bank and germplasm banks need to be established. The conservation of seeds is the most effective means of genetic conservation, whereas *in situ* conservation primarily save the habitat in nature.



**Figure 4.** Terrestrial orchids diversity in Polewali Mandar District, West Sulawesi Province, Indonesia. A. *Acanthephippium splendidum* J.J.Sm., B. *Crepidium carinatifolium* (J.J.Sm.) Szlach., C. *Habenaria beccarii* Schltr., D. *Eulophia spectabilis* (Dennst.) Suresh, E. *Malaxis trigonopetala* (J.J.Sm.) S.Thomas, Schuit. & de Vogel, F. *Eulophia zollingeri* (Rchb.f.) J.J.Sm.

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