Jurnal Biodjati 5(1):107-114, May 2020

e-ISSN : 2541-4208
p-ISSN : 2548-1606

JURNAL BIODJATI

http://journal.uinsgd.ac.id/index.php/biodjati

STUDIES ON FERN OF LESSER SUNDA ISLANDS I: CHECKLIST OF THE GENUS *Adiantum* (PTERIDACEAE)

Wenni Setyo Lestari[1]*, Bayu Adjie[2]

Received : November 07, 2019
Accepted : April 28, 2020

DOI: 10.15575/biodjati.v5i1.6365

[1]Eka Karya Bali Botanic Garden, Research Center for Plant Conservation and Botanic Garden - Indonesian Institute of Sciences, Candikuning, Baturiti, Tabanan, Bali 82191
[2]Purwodadi Botanic Garden - Indonesian Institute of Sciences, Jl. Raya Surabaya - Malang Km. 65, Purwodadi, Pasuruan, Jawa Timur 67163

e-mail:
*[1]wenn001@lipi.go.id
[2]bayu.adjie@lipi.go.id

**Corresponding author*

Abstract. *Adiantum or maidenhair fern is one of the largest genera in Pteridaceae. We survey their species diversity in Lesser Sunda Islands, Indonesia through the living collection and herbarium examination. Seventeen species of Adiantum were recorded. including five species that considered as introduced and naturalized species. One species that grows naturally, Adiantum silvaticum, were previously known as endemic to Australia. However, this study revealed the new distribution of this species on Sumba and Flores.*

Keywords: *Adiantum, maidenhair fern, Lesser Sunda Islands*

Citation
Lestari, W. S. & Adjie, B. (2020). Studies on Fern of Lesser Sunda Islands I: Checklist of the Genus *Adiantum* (Pteridaceae). *Jurnal Biodjati*, 5(1), 107-114.

INTRODUCTION

Adiantum is a fern genus of Pteridaceae in the order of Polypodiales (Smith et al., 2006). Known as a maidenhair fern (or suplir in Indonesia), it consists of about 200 species or more (Tagawa & Iwatsuki, 1985; Zhang et al., 2013). This fern mostly used as an ornamental plant due to its attractive leaf appearance. Some species were reported used as a vegetable or ethnomedicinally due to its phytochemicals compound and biological activities, for example, *Adiantum capillus-veneris*, *A. flabellulatum*, *A. pedatum* and *A. venustum* (Afriastini, 2003; Brahmachari et al., 2003).

The botanical name *Adiantum* (unwetted) refers to how water-drops run off the surface of the pinnae without wetting them (Holttum, 1954). This genus can be recognized by the polished black leaf stalks and specialized reflexed margins of the lamina (false indusia) that covered the sori (Korpelainen et al., 2005). *Adiantum* can be found in many parts of the world, mainly in the tropical and subtropical regions (Hoshizaki & Moran, 2002; Korpelainen et al., 2005). Based on herbarium deposited in Herbarium Bogoriense (BO), the genus is found widely distributed on the island of Indonesia including southeastern archipelago known as Lesser Sunda Islands (LSI). The main Lesser Sunda Islands found from west to east are in Bali, Lombok, Sum-

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bawa, Flores, Sumba, Timor, Alor archipelago, Barat Daya Islands and Tanimbar Islands (Figure 1).

The only study on ferns in this region conducted by Posthumus (Posthumus, 1944). He reported 11 species of *Adiantum* from the Lesser Sunda Islands. Botanical exploration conducted by Bali Botanic Garden that did a notable collection for *Adiantum* was recorded to start in 1984. This study purposed to review diversity and distribution on the genus *Adiantum* after more than seven decades.

Figure 1. Lesser Sunda Islands, Indonesia (Source: Wikipedia, n.d.)

MATERIALS AND METHODS

Materials examined were Bali Botanic Garden's living collection originated from Lesser Sunda Islands (Bali, Lombok, Sumbawa, Timor, Sumba, Flores) that collected in 1984 up to 2013, compared with herbarium specimen stored at Herbarium Bogoriense (BO) and Herbarium Bali Botanic Garden (THBB). Identification of the specimens was referred to some literature (Holttum, 1968; Knapp, 2011; Matsumoto et al., 2008; Posthumus, 1944; Tagawa & Iwatsuki, 1985; Zhang et al., 2013). Any distribution and their habitat were presented based on Posthumus (1944), Zhang et al. (2013) and herbarium records.

RESULTS AND DISCUSSION

Posthumus (1944) reported 11 species of *Adiantum* found in LSI (Bali, Lombok, Sumbawa, Timor, Sumba, Flores, Wetar and Alor Island) (Table 1.). An examination from the Bali Botanic Garden living collection of *Adiantum* also found 11 species originated from Lesser Sunda Islands (Bali, Lombok, Sumbawa, Timor, Sumba, Flores). Unfortunately, there is no collection record from Wetar and Alor.

No endemics found in the Lesser Sunda Islands. Most of the species have a wide distributional range, especially in Asia. Five species of *Adiantum* were recognized as the common species and also mentioned in the previous study by Posthumus (1944), i. e. *Adiantum caudatum*, *A. diaphanum*, *A. edgeworthii*, *A. hispidulum* and *A. philippense*. Those species quite easy to find and abundant, however, *A. edgeworthii* only collected from the high altitude of Timor.

Table 1. List of *Adiantum* Species from Lesser Sunda Islands

Species	Locality	Posthumus (1944)	Bali Botanic Garden Living Collection
Adiantum sp.[2]	Bali	-	+
A. capillus-veneris L.[1]	Lombok	+	-
	Timor	+	-
	Sumba	+	-
A. caudatum L.[1]	Bali	+	+
	Lombok	+	-
	Sumbawa	+	-
	Flores	+	-
	Wetar	+	-
	Sumba	+	-
	Timor	+	-
A. concinnum Humb. & Bonpl. ex Willd.[2]	Bali	-	+
	Lombok	-	+
A. cuneatum Langsd. & Fisch.[1]	Alor	+	-
A. diaphanum Blume[1]	Bali	+	+
	Lombok	+	-
	Flores	+	-
	Timor	+	-
A. edgeworthii Hook.[1]	Timor	+	+
A. flabellulatum L.[1]	Bali	+	-
	Sumbawa	+	-
	Flores	+	-
A. hispidulum Sw.[1]	Sumba	+	+
	Lombok	+	+
	Bali	+	+
	Timor	+	+
	Flores	+	-
	Alor	+	-
A. peruvianum Klotzsch[3]	Bali	-	+
A. philippense L.[1]	Bali	+	+
	Lombok	+	+
	Wetar	+	-
	Sumbawa	+	-
	Sumba	+	-
	Timor	+	-
	Alor	+	-
A. pulchellum Blume[1]	Sumbawa	+	-
	Flores	+	-
A. raddianum C. Presl.[2]	Bali	-	+
A. mettenii Kuhn.[1]	Bali	+	-
	Flores	+	-
	Timor	+	-
A. tinctum Moore[1]	Lombok	+	-
	Timor	+	-
A. trapeziforme L.[2]	Sumbawa	-	+
A. silvaticum Tindale	Sumba	-	+
	Flores	-	+

[1]Native species; [2]Introduced and naturalized species; [3]Introduced and cultivated species

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Adiantum caudatum Linnaeus, Mant. Pl. 308. 1771.

Specimen Examined

In rocks crevices on lowland area at Tenganan Village, Manggis District, Karangasem Regency, Bali *WN132* and *WN136*; terrestrial on slope and roadside of Dawan Village, Dawan District, Klungkung Regency, Bali *WN140*; on limestone rock at Mount Prapat Agung, North West Bali *KK + SS 38*; Mount Kelatakan, Bali R. *Maier Sarip 160*; Mount Ndeki, West Flores *Kosterman & Wirawan 156*; Soemba *Iboet 304*; Soembawa *Rensch 835*.

Habitat

Occurs in full sun habitat on exposed sandstone.

General Distribution

Bhutan, Cambodia, China, India, Indonesia, Laos, Malaysia, Myanmar, Nepal, Philippines, Thailand, Vietnam; throughout Old World Tropics (Zhang et al., 2013).

Adiantum diaphanum Blume, Enum. Pl. Javae 2: 215. 1828.

Specimen Examined

Bali Botanic Garden (1250 m asl), Baturiti District, Tabanan Regency, Bali *WN112*; Lake Buyan (1215 m asl), Sukasada District, Buleleng Regency, Bali *WN121*; Munduk Pengubengan (1060 m asl), Karangasem Regency, Bali *BA754a*; the west slope of Mount Inie Lika *Posthumus 3130*; along a trail between Wolu (sea level) and Batu (Mount) Kokan, southern slope of Manusela Ridge, District Tehoru, Manusela National Park, C. Seram *M. Kato, K. Ueda, M. Okamoto, H. Akiyama, B. Sunarno, U. W. Mahjar 6546*; Halmahera, Moluccas *Idjan/Mochtar 171*; Bali *Posthumus 3667*.

Habitat

Occurs in full sun habitat on an exposed stone fence, on the rocky slope, road, or riverside.

General Distribution

China, Indonesia, Malaysia, Vietnam; Australia, Pacific Islands (New Zealand, Polynesia) (Zhang et al., 2013).

Adiantum edgeworthii Hooker, Sp. Fil. 2: 14. 1851.

Specimen Examined

Mount Mutis Natural Reserve (1600 m asl), Fatumnasi Village, Fatumnasi District, Timor Tengah Selatan Regency, Timor *BA742*; Timor *S. Bloembergen 3534* (*Adiantum caudatum* var. *edgeworthii*).

Habitat

Occurs in full sun habitat on roadside.

General Distribution

Bhutan, China, India, Indonesia, Japan, Malaysia, Myanmar, Nepal, Philippines, Thailand, Vietnam (Zhang et al., 2013).

Adiantum hispidulum Swartz in Schrader, J. Bot. 1800: 82. 1802.

Specimen Examined

Giriloka Sub Village (1200 m asl), Pancasari Village, Sukasada District, Buleleng Regency, Bali *WN120*; Laiwangi Wanggameti National Park (1300 m asl), Sumba Timur Regency, Sumba *BA809*; near spring, Mount Mutis Natural Reserve (1665 m asl), Fatumnasi Village, Fatumnasi District, Timor Tengah Selatan Regency, Timor *BA706*; Lombok Timor Regency, Lombok *WT797*; farm area of Junrejo District, Batu City, Java *WN144*; Gunong Kumapodahu, District Kolaka, Southeast Sulawesi *J. Wen 10243 and Abdul Kartonegoro*.

Habitat

Occurs on exposed slope or roadside.

General Distribution

China, India, Indonesia, Malaysia, Philippines; tropical and subtropical regions : Africa, Asia, Pacific Islands (Zhang et al., 2013).

Adiantum philippense Linnaeus, Sp. Pl. 2: 1094. 1753.

Specimen Examined

Padangbulia Village, Buleleng Regency, Bali *WN128*; Suranadi Village, Lombok Barat Regency, Lombok *WN142*; Mount Rinjani National Park (674 m asl), Senaru Village, Bayan District, Lombok Utara Regency, Lombok *SH1130*; Malang City, Java *WN153*; based of Gunong Pondunaa in Mount Watu Wila, District Kolaka, Southeast Sulawesi *J. Wen 10206 and Abdulkartonegoro*.

Habitat

Occurs on exposed rocks crevices or roadside.

General Distribution

Bhutan, China, India, Indonesia, Kashmir, Malaysia, Myanmar, Nepal, Philippines, Thailand, Vietnam; tropics and subtropics of Africa, Oceania (Zhang et al., 2013).

Another four *Adiantum* species, i. e. *Adiantum concinnum* Humb. & Bonpl. ex Willd., *A. peruvianum* Klotzsch, *A. raddianum* C. Presl. and *A. trapeziforme* L., did not mention by Posthumus in his publication. It is probably because those species were Neotropics origin and considered as introduced species that become naturalized or cultivated recently. *Adiantum concinnum* was found in Bali and Lombok. Specimen from Bali grows on rocky habitat and the size is smaller than Lombok's specimen. This species can be recognized by the innermost segments of the pinnae overlapping the rachis. *Adiantum concinnum* is reported native to tropical America (Hoshizaki & Moran, 2002). *Adiantum peruvianum* was found in Bali, cultivated at a home yard as an ornamental plant. This species is native to Ecuador, Peru and Bolivia (Hoshizaki & Moran, 2002).

Adiantum raddianum from Bali grows on the same habitat as *A. concinnum*. This species is native to the American tropics and becomes the most commonly cultivated maidenhair in the United States with numerous, poorly defined and confusing cultivars (Hoshizaki & Moran, 2002). *Adiantum trapeziforme* is a native species in America and the West Indies (Hoshizaki & Moran, 2002). Bali Botanic Garden living collection originated from Sumbawa and grows on a rocky habitat, at the open area near the stream, far from civilization. Its originality in LSI still needs to be confirmed.

Another unidentified specimen, *Adiantum* sp., also considered as non-native species. This specimen found in Bali on rocky habitat together with *A. concinnum* and *A. raddianum*. The morphology of this species is similar to an *Adiantum* species found in Hawaii with less information.

Some species found by Posthumus (1944) in the Lesser Sunda Islands have not been collected by Bali Botanic Gardens yet, i. e. *A. capillus-veneris* L., *A. cuneatum* Langsd. & Fisch., *A. flabellulatum* L., *A. pulchellum* Blume, *A. mettenii* Kuhn. and *A. tinctum* Moore. *Adiantum cuneatum* and *A. tinctum* were recorded as a synonym of *A. raddianum*. Based on herbarium examination on BO, *A. cuneatum* and *A. tinctum* from the previous records have a bigger leaflet, while *A. raddianum* from Bali Botanic Gardens collection has a smaller leaflet. In this paper, those specimens then threatened as different specimens. *Adiantum pulchellum* and *A. mettenii* recorded as the unresolved name.

Adiantum silvaticum Tindale (Figure 2.)

Contr. New South Wales. Natl. Herb. 3: 246 (1963). Type: E. F. *Constable* (NSW); iso: KYO, TI.

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Figure 2. *Adiantum silvaticum* Tindale from Sumba : habitus (a); sporangia (b); fiddlehead (c); base of fronds (d); herbarium specimen (e); spores, MAG 40 (f)

Rhizome creeping, much-branched, c. 5 mm diam.; scales golden brown, concolorous, with shortly ciliate margins and setose apices. Fronds scattered, to 80 cm long. Stipe to 65 cm long, glossy, sometimes scabrous proximally. Lamina 2- or 3-pinnate at the base, triangular to pentagonal, 15–30 cm long, 15–30 cm wide, herbaceous to coriaceous, bright green or bluish-green; rachis glossy and glabrous abaxially, black or with a dark purple hue, densely clothed with antrorse red-brown hairs adaxially (rarely partially or completely glabrous). Higher-order segments hastate or narrowly to broadly triangular. Primary pinnae all ±same length and degree of branching. Pinnules symmetric and flabellate, or dimidiate and trapeziform to rectangular with blunt or upcurved apices, glabrous, often glaucescent but never glaucous abaxially; veins arising in part from a basiscopic submarginal vein. Sori 1–10 along the distal margins, commonly 1 per lobe; soral flaps rectangular to subreniform, glabrous. Spores yellow; perine finely granulose, loosely adhering to exine; largest diam. (31–) c. 42 (–52) µm.

Adiantum silvaticum Tindale was known as endemic to eastern Queensland and New South Wales south to about Ulladulla, Australia (Bostock, 1998). This specimen first described as *A. affine* Willd. var. intermedium, but the name of *A. affine* then known as synonym of *A. capillus-veneris* L. The Australia's specimen latter given name as *A. cunninghamii* Hook., but since the differences on spore size and the colour of the rachis scales, the Australia's specimen then given name as *A. silvaticum* Tindale (Parris & Croxall, 1974). In Australia, this species grows terrestrial in the rainforest and tall hardwood forests, often showing a preference for poorer soils; occasionally lithophytic on sandstone cliffs along creeks or rivers; 20 to over 1100 m asl. Its lowland occurrences, particularly in southern Queensland, are usually in palm-dominated rainforest some distance from the coast (Bostock, 1998).

Field work to Laiwangi-Wanggameti National Park on Sumba and Lake Ranamese on Flores found an *Adiantum* species that considered to *A. silvaticum* Tindale (Figure 1). Morphologically, *A. silvaticum* Tindale is similar to another three *Adiantum* species endemic to New Zealand, *A. cunninghamii* Hook., *A. fulvum* Raoul and *A. viridescens* Col. (Parris & Croxall, 1974). The sequence of the trnL-F region from Sumba's specimen (GenBank accession number: LC004395 and LC004396) (Lestari et al., 2014) confirmed that this specimen is closely related to those three *Adiantum* species. Unfortunately, no DNA record from the Australian specimen in GenBank yet.

Record Voucher from the Lesser Sunda Islands localities. INDONESIA.

Sumba

River banks or mountain slope, humus soil, shaded areas at 1010 – 1300 m asl, Sumba Timur Regency, Laiwangi-Wanggameti National Park, Sumba Island, Nusa Tenggara Timur.

Living Collection: Three specimens, previously identified as *Adiantum* sp. (Collector: Drapemmu.103, Accession number: E199610136). Four specimens; previously identified as *A. polyphyllum* Willd. (Collector: PEN539, Accession Number: E200610284). Two specimens; previously identified as *A.hispidulum* Sw. (Collector: BA808, Accession number: E20111147) and *Adiantum* sp. (Collector: BA817, Accession: E20111156).

Herbarium Specimen: THBB.

Flores

1115 m asl, Lake Ranamese, Taman Wisata Alam Ruteng, Manggarai District, Flores Island, Nusa Tenggara Timur.

Living Collection: one specimen (Collector: SH 1925, Accession: E2014120073).

Herbarium Specimen: THBB.

Based on living collection and herbarium examination, seventeen species of *Adiantum* recorded from Lesser Sunda Islands of Indonesia. One of the specimens, *A. silvaticum*, is a new record for Lesser Sunda Islands of Indonesia. *Adiantum* was distributed almost on every island of Lesser Sunda and cosmopolite. Since the islands have a very unique size and ecological features, we encourage to survey more islands and genera in the future.

ACKNOWLEDGEMENTS

We would like to thank the Head of the Botany Division-Research Center for Biology-Indonesian Institute of Sciences for the permission of the herbarium examination and also Bali Botanic Garden's Plant Registration Unit for the data of the *Adiantum* collection.

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