



The Diversity of Terrestrial Ferns in the Customary Forest of Depati Karo Jayo Tuo, Jambi

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Abstract

The Depati Karo Jayo Tuo Customary Forest represents a rich ecosystem within the Sumatran rainforest, characterized by its biodiversity. Observations reveal dense canopy cover and a variety of terrestrial fern species. However, information on the diversity of terrestrial ferns in this area remains limited. Exploratory research is essential to uncover the biodiversity of these ferns, as well as to support effective conservation strategies aimed at protecting species and ecosystems. Correspondingly, this study aimed to identify the diversity of terrestrial fern species and evaluate their conservation status. The research employed the cruise method along trekking paths in the forest. Environmental factors measured included soil temperature, soil moisture, pH, air temperature, humidity, and light intensity. Species identification was conducted using fern identification keys. Conservation status was analyzed based on IUCN and CITES criteria. The study identified 49 species, classified into the *Filicinae* class (45 species, 24 genera, 18 families, 5 orders) and the *Lycopodiinae* class (4 species, 1 genus, 1 family, 1 order). According to the IUCN, 32 species were categorized as Not Evaluated, 2 as Least Concern (LC), and 15 as Uncategorized. CITES data revealed that one species was listed under Appendix II, highlighting the importance of protecting the biodiversity in the Depati Karo Jayo Tuo Customary Forest.

Keywords: Diversity, Terrestrial Ferns, Customary Forest, Jambi

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Introduction

Ferns provide significant benefits and play crucial roles for both humans and ecosystems. Their presence indicates a forest ecosystem's capacity to support various organisms (Fauziah et al., 2022). Additionally, ferns contribute to maintaining soil moisture, act as pioneer plants in the succession process, serve as producers in the food chain, and assist in the formation of soil nutrients (Fauziah et al., 2022; Majid et al., 2022; Pradipta et al., 2020). They also have potential applications as medicinal materials, food ingredients, and ornamental plants (Mowata et al., 2020).

The global diversity of fern species is estimated at approximately 10,000, with about 3,000 species found across Indonesia (Pradipta et al., 2023). Ferns can thrive in various environments, including soil (terrestrial), water (aquatic), and as epiphytes attached to trees or rocks. One notable habitat that supports fern growth is highland areas, such as the Depati Karo Jayo Tuo Customary Forest in Jambi Province. This region boasts high floral diversity (Wardiah et al., 2019) and well-preserved vegetation.

The Depati Karo Jayo Tuo Customary Forest features a typical Sumatran forest ecosystem rich in natural biodiversity. It is preserved by the Serampas indigenous people of Rantau Kermas Village, Merangin Regency, Jambi Province. The local community regards the forest as a vital life preserver, a crucial water source, and a safeguard against ecological disasters (Suprpto, 2019). Consequently, they actively maintain and preserve this customary forest. Its utilization is guided by the customary laws of the Serampas community. Observations indicate that the forest has a dense tree canopy cover and serves as a habitat for various fern species, particularly terrestrial ferns. However, information on the diversity of terrestrial

fern species in the Depati Karo Jayo Tuo Customary Forest remains unavailable. Therefore, exploratory research is necessary to uncover the biodiversity of tropical forest plants, especially terrestrial ferns in this forest.

Additionally, understanding the conservation status of terrestrial ferns is essential, as it is closely linked to preservation efforts. Information about the conservation status and lists of threatened species can be obtained from the International Union for Conservation of Nature (IUCN), which publishes data through the IUCN Red List (Ohee et al., 2021), and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), which regulates the international trade of wild animal and plant specimens (Adi, 2017). Recognizing the conservation status of ferns facilitates the development of effective strategies to protect these species, preserve their ecosystems, and support overall biodiversity.

Research Methods

Location

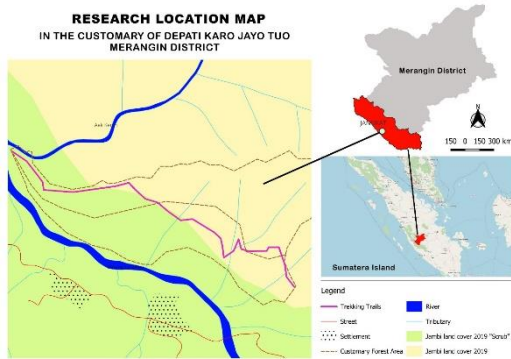
The research was conducted from July to September 2024. The exploration of terrestrial ferns took place in the northern part of the Depati Karo Jayo Tuo Customary Forest, Rantau Kermas Village, Merangin Regency, Jambi Province (see Figure 1). Fern samples were dried and identified at the Laboratory of Agroindustry, Medicinal Plants, and Biotechnology, Faculty of Science and Technology, Universitas Jambi.

Data Collection

Research data were collected utilizing the cruise method (Pradipta et al., 2023) by walking along the trekking path in the northern part of the Depati Karo Jayo Tuo Customary Forest area, starting from the jungle entrance to the end of the Customary Forest area near the river. Environmental factors measured included soil temperature, soil moisture,

soil pH, air temperature, air humidity, and light intensity.

Figure 1. Research location map



Identification

The identification of ferns was based on their morphological characteristics, using reference materials such as *Flora Malesiana Series II-Pteridophyta: Fern & Fern Allies Vol. 1 part 3: Lindsaea Group* (Holttum, 1991), *Plant Resources of South-East Asia 15, Cryptogams: Ferns and Fern Allies* (Jansen et al., 2003), as well as online identification keys such as the e-flora of China (<http://www.efloras.org>) and the e-flora of Thailand

(<https://botany.dnp.go.th/eflora/index.html>). The identification process was further assisted by fern experts. Verification of species names and classification was carried out using the Global Biodiversity Information Facility (GBIF) website (<https://www.gbif.org/>).

Conservation Status

The conservation status of ferns was determined through literature studies using the IUCN Red List and CITES data. The distribution map of terrestrial ferns was created using QGIS 3.34 (Quantum Geographic Information System) software.

Research Results and Discussion

The diversity of terrestrial fern in the Depati Karo Jayo Tuo Customary Forest (Figure 2) is classified into two main groups, from the Filicinae and Lycopodiinae classes. The Filicinae class ferns found consisted of 45 species from 24 genus, 18 families and 5 orders. The Lycopodiinae class found 4 species from 1 genus, 1 family and 1 order (see Table 1).

Table 1
Terrestrial fern species found in the Depati Karo Jayo Tuo Customary Forest

No	Order	Family	Species	Conservation Status	
				IUCN	CITES
1	Cyatheales	Cyatheaceae	<i>Gymnosphaera gigantea</i> (Wall. ex Hook.) J. Sm.	NE	Appendix II
2		Metaxyaceae	<i>Metaxya</i> sp.	-	-
3	Gleicheniales	Dipteridaceae	<i>Cheiropleuria bicuspis</i> C. Presl.	NE	N/A
4			<i>Dipteris conjugata</i> Reinw.	NE	N/A
5		Gleicheniaceae	<i>Dicranopteris linearis</i> (Burn. fil.) Underw.	LC	N/A
6			<i>Diplopterygium longissimum</i> (Blume) Nakai.	NE	N/A
7			<i>Sticherus truncatus</i> (Willd.) Nakai	NE	N/A
8	Marattiales	Marattiaceae	<i>Christensenia aesculifolia</i> (Blume) Maxon	NE	N/A
9	Polypodiales	Aspleniaceae	<i>Athyrium asperum</i> (Blume) Milde	NE	N/A
10			<i>Athyrium</i> sp. 1	-	-

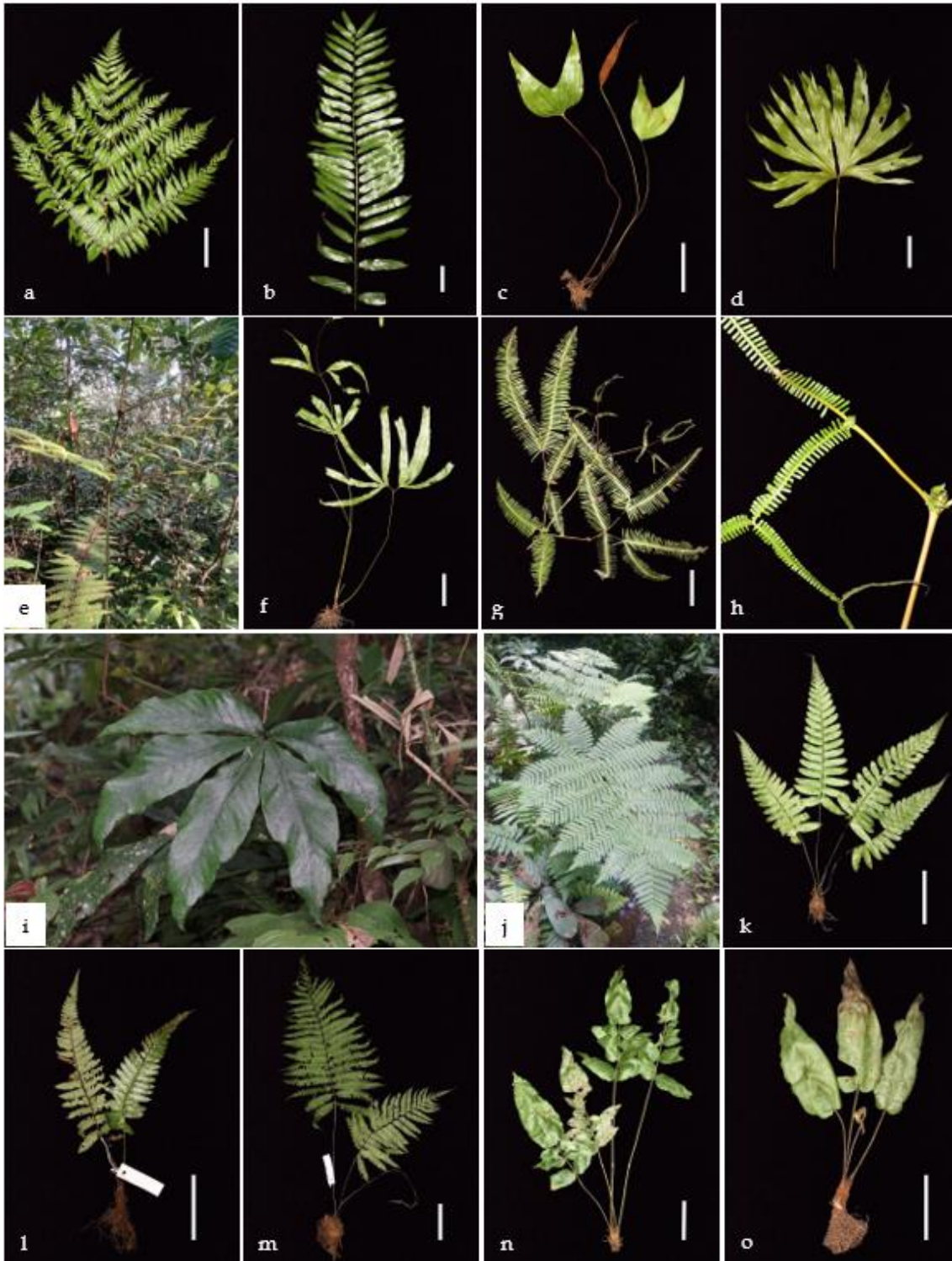
No	Order	Family	Species	Conservation Status	
				IUCN	CITES
11			<i>Athyrium</i> sp. 2	-	-
12			<i>Athyrium</i> sp. 3	-	-
13			<i>Diplazium cordifolium</i> Blume	NE	N/A
14			<i>Diplazium donianum</i> (Mett.) Tardieu	NE	N/A
15			<i>Diplazium ketagalaniorum</i> T. C. Hsu	NE	N/A
16			<i>Diplazium megaphyllum</i> (Copel.)	NE	N/A
17			<i>Diplazium pallidum</i> (Blume) T. Moore	NE	N/A
18			<i>Diplazium subserratum</i> (Blume) T. Moore	NE	N/A
19			<i>Diplazium xiphophyllum</i> (Baker) C. Chr.	NE	N/A
20		<i>Blechnaceae</i>	<i>Blechnum melanocaulon</i> (Brack.) T. C. Chambers & P. A. Farrant	NE	N/A
21			<i>Blechnum orientale</i> L.	NE	N/A
22		<i>Davalliaceae</i>	<i>Davallia</i> sp.	-	-
23		<i>Dennstaedtiaceae</i>	<i>Microlepia strigosa</i> (Thunb.) C. Presl	NE	N/A
24		<i>Didymochlaenaceae</i>	<i>Didymochlaena truncatula</i> (Sw.) J. Sm.	LC	N/A
25		<i>Dryopteridaceae</i>	<i>Dryopteris</i> sp.	-	-
26			<i>Pleocnemia</i> sp.	-	-
27			<i>Teratophyllum ludens</i> (Fée) Holtum	NE	N/A
28		<i>Lindsaeaceae</i>	<i>Lindsaea ensifolia</i> Sw.	NE	N/A
29			<i>Lindsaea cultrata</i> (Willd.) Sw.	NE	N/A
30			<i>Lindsaea obtusa</i> (J. Sm.)	NE	N/A
31		<i>Nephrolepidaceae</i>	<i>Nephrolepis davallioides</i> (Sw.) Kunze	NE	N/A
32			<i>Nephrolepis falciformis</i> J. Sm.	NE	N/A
33		<i>Tectariaceae</i>	<i>Tectaria decurrens</i> (C. Presl) Copel.	NE	N/A
34			<i>Tectaria melanocaulos</i> (Blume) Copel.	NE	N/A
35			<i>Tectaria</i> sp. 1	-	-
36			<i>Tectaria</i> sp. 2	-	-
37		<i>Thelypteridaceae</i>	<i>Thelypteris crassifolia</i> (Blume) Ching	NE	N/A
38			<i>Thelypteris heterocarpus</i> (Blume) C. V. Morton	NE	N/A
39			<i>Thelypteris</i> sp. 1	-	-

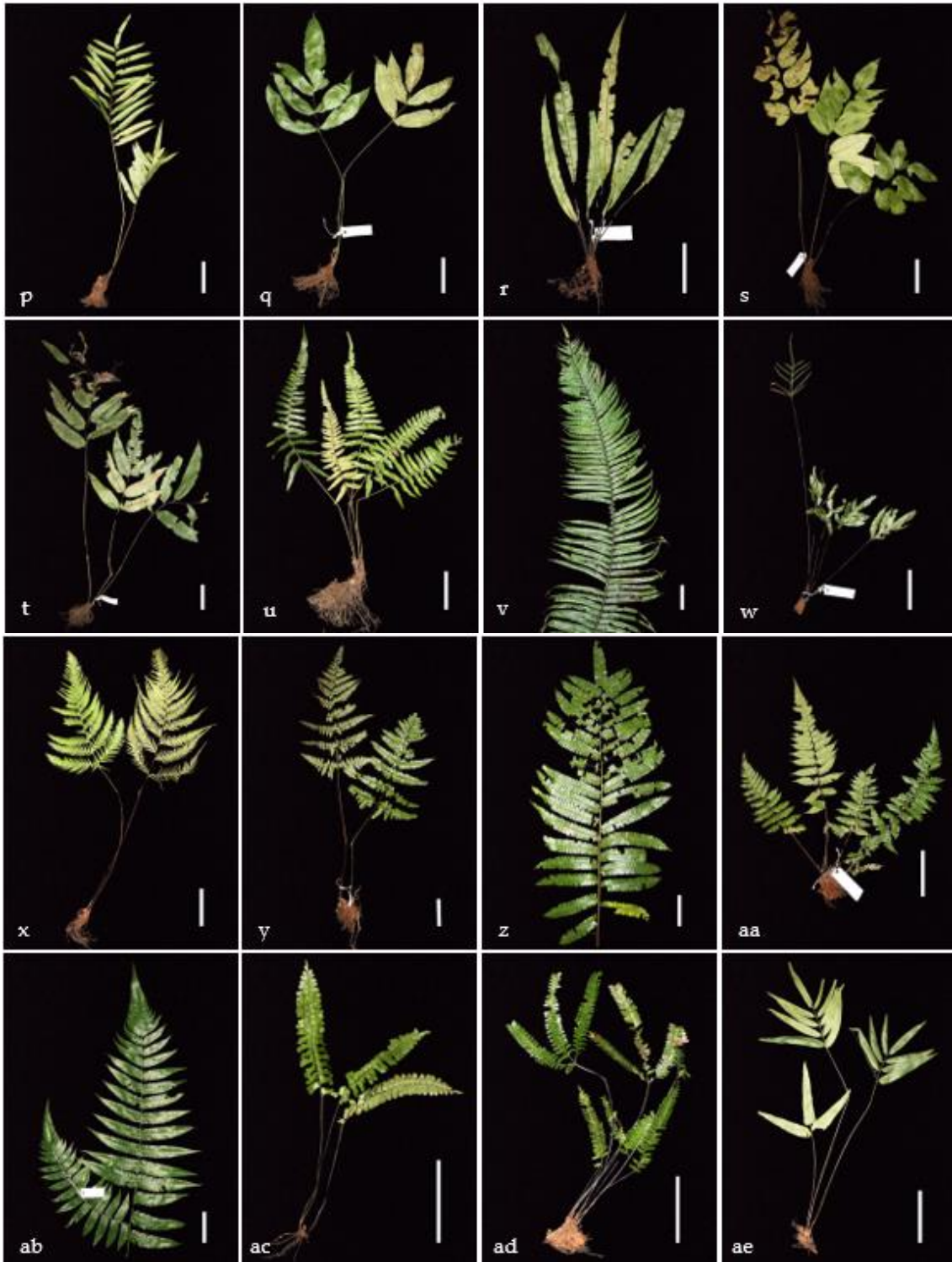
No	Order	Family	Species	Conservation Status	
				IUCN	CITES
40			<i>Thelypteris</i> sp. 2	-	-
41			<i>Thelypteris</i> sp. 3	-	-
42			<i>Thelypteris</i> sp. 4	-	-
43		<i>Polypodiaceae</i>	<i>Leptochilus henryi</i> X. C. Zhang	NE	N/A
44		<i>Pteridaceae</i>	<i>Pteris longipinnula</i> Wall. ex J. Agardh	NE	N/A
45	<i>Schizaeales</i>	<i>Lygodiaceae</i>	<i>Lygodium</i> sp.	-	-
46	<i>Selaginellales</i>	<i>Selaginellaceae</i>	<i>Selaginella</i> sp.	-	-
47			<i>Selaginella biformis</i> A. Braun	NE	N/A
48			<i>Selaginella doederleinii</i> Hieron.	NE	N/A
49			<i>Selaginella intermedia</i> (Blume) Spring	NE	N/A

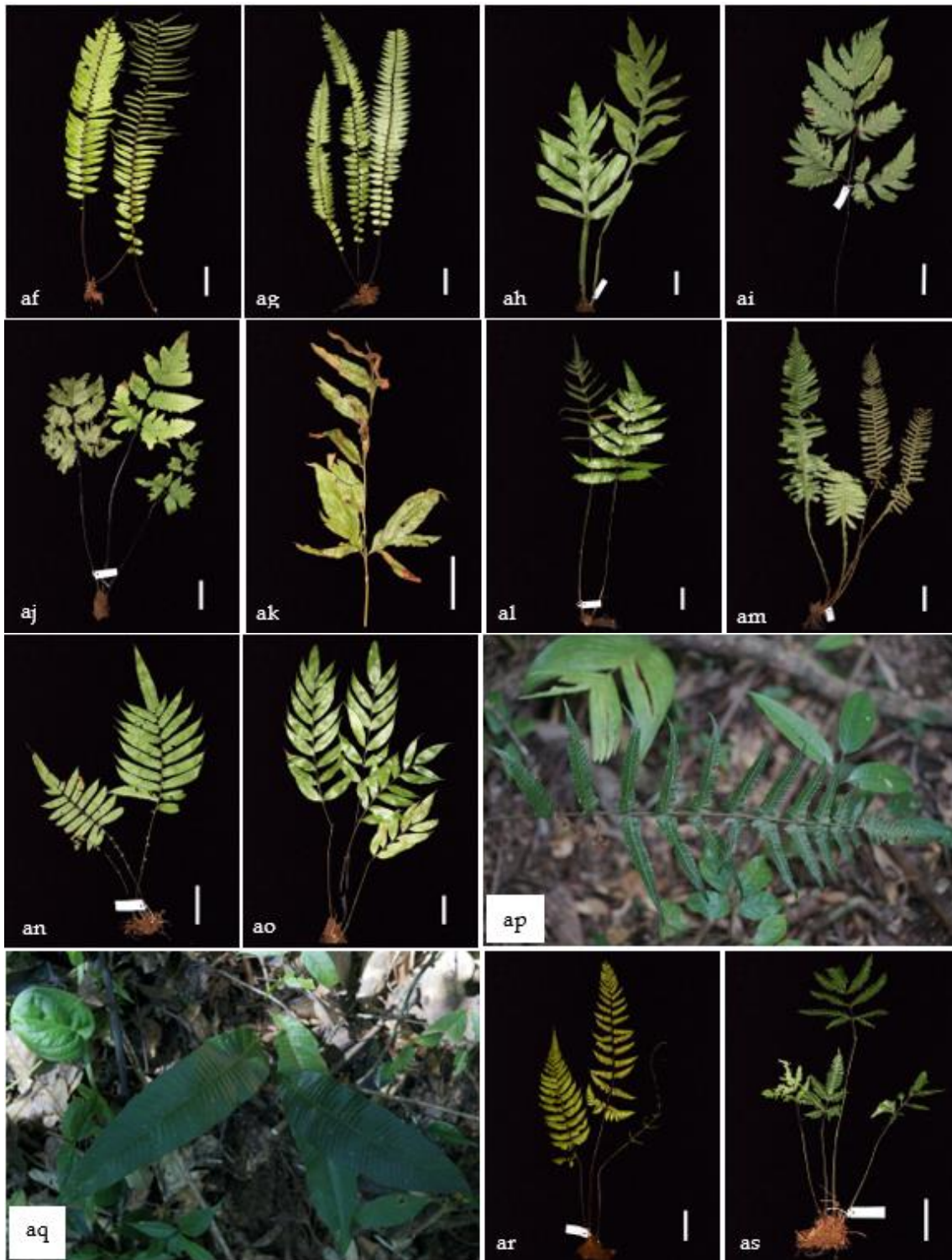
Notes= NE: not evaluated; LC: least concern; N/A: not available

Figure 2

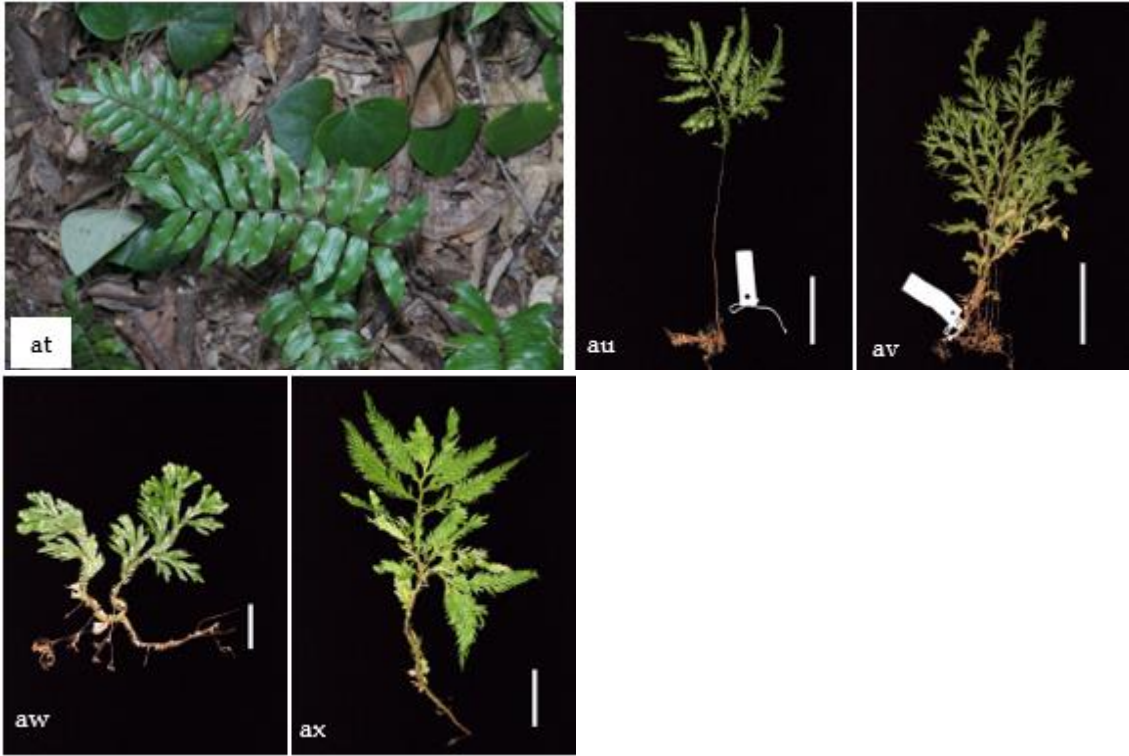
Fern diversity in the Depati Karo Jayo Tuo Customary Forest: (a) *Gymnosphaera gigantea* (Wall. ex Hook.) J. Sm., (b) *Metaxya* sp., (c) *Cheiropleuria bicuspis* C. Presl, (d) *Dipteris conjugata* Reinw., (e) *Diplazium longissimum* (Blume) Nakai, (f) *Lygodium* sp., (g) *Dicranopteris linearis* (Burn. fil.) Underw., (h) *Sticherus truncatus* (Willd.) Nakai, (i) *Christensenia aesculifolia* (Blume) Maxon, (j) *Athyrium asperum* (Blume) Milde, (k) *Athyrium* sp. 1, (l) *Athyrium* sp. 2, (m) *Athyrium* sp. 3, (n-o) *Diplazium cordifolium* Blume, (p) *Diplazium xiphophyllum* (Baker) C. Chr., (q) *Diplazium ketagalaniorum* T. C. Hsu, (r) *Diplazium subserratum* (Blume) T. Moore, (s) *Diplazium donianum* (Mett.) Tardieu, (t) *Diplazium megaphyllum* (Copel.) Tagawa, (u) *Diplazium pallidum* (Blume) T. Moore, (v) *Blechnum orientale* L., (w) *Blechnum melanocaulon* (Brack.) T. C. Chambers & P. A. Farrant, (x) *Davallia* sp., (y) *Microlepia strigosa* (Thunb.) C. Presl, (z) *Didymochlaena truncatula* (Sw.) J. Sm., (aa) *Dryopteris* sp., (ab) *Pleocnemia* sp., (ac) *Lindsaea cultrata* (Willd.) Sw., (ad) *Lindsaea obtusa* J. Sm., (ae) *Lindsaea ensifolia* Sw., (af) *Nephrolepis davallioides* (Sw.) Kunze, (ag) *Nephrolepis falciformis* J. Sm., (ah) *Tectaria decurrens* (C. Presl) Copel., (ai) *Tectaria melanocaulos* (Blume) Copel., (aj) *Tectaria* sp. 1, (ak) *Tectaria* sp. 2, (al) *Thelypteris crassifolia* (Blume) Ching, (am) *Thelypteris heterocarpus* (Blume) C. V. Morton, (an) *Thelypteris* sp. 2, (ao) *Thelypteris* sp. 3, (ap) *Thelypteris* sp. 1, (aq) *Leptochilus henryi* X. C. Zhang, (ar) *Thelypteris* sp. 4, (as) *Pteris longipinnula* Wall. ex J. Agardh, (at) *Teratophyllum ludens* (Fée) Holttum, (au) *Selaginella biformis* A. Braun, (av) *Selaginella doederleinii* Hieron., (aw) *Selaginella intermedia* (Blume) Spring, and (ax) *Selaginella* sp. Bar = 10 cm.







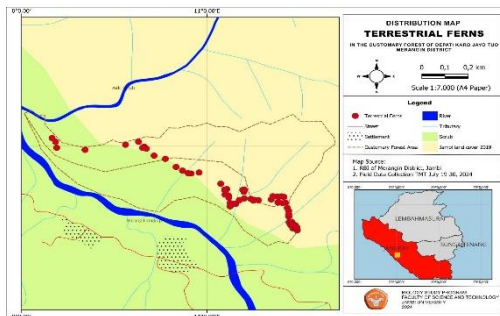
The Diversity of Terrestrial Ferns in the Customary Forest of Depati Karo Jayo Tuo, Jambi



The Customary Forest area in a highland region provides a suitable habitat for various fern species. The abundance of ferns in the Customary Forest is also influenced by the moist soil conditions, the soft texture of the soil, and the presence of leaf litter, serving as a substrate for various fern species (Ruma et al., 2022). Research by Akbar et al. (2023) revealed that fern species are more diverse in highland areas compared to lowland areas, as higher altitudes result in more humidity and lower temperatures. These humid conditions create an ideal habitat for ferns.

The species of terrestrial ferns in the Depati Karo Jayo Tuo Customary Forest demonstrated a higher number compared to similar research by Pradipta et al. (2020), which reported the diversity of ferns (*Pteridophyta*) in Padang Pelasan Village, Seluma Regency, Bengkulu Province, finding 30 species consisting of 12 families. Research by Febriyani et al. (2022) indicated the diversity of ferns in Batang Gadis National Park, Resort 7 Sopotinjak, North Sumatra, identifying 28 species from 16 families, dominated by *Asplenium nidus L.* and the least found being *Oleandra undulata* (Willd.) Ching. Ferns were found along the forest trekking trail. The distribution of terrestrial fern species in the Depati Karo Jayo Tuo Customary Forest can be seen in Figure 3.

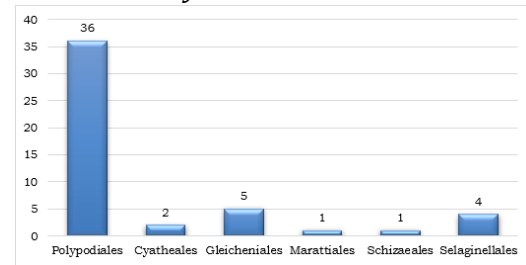
Figure 3. The distribution map of terrestrial fern species in the Depati Karo Jayo Tuo Customary Forest



The most commonly found terrestrial ferns in the Depati Karo Jayo Tuo Customary Forest belong to the order *Polypodiales* (see Figure 4), with 36 species identified. The least common terrestrial ferns found were from the orders *Marattiales* and *Schizaeales*, with each represented by one species: *Christensenia aesculifolia* (Blume) Maxon and

Lygodium sp. The diversity of species within the order *Polypodiales* also dominated the fern vegetation in East Citorek Village, Banten (Nugraheni et al., 2024) and Penggaron Forest, Semarang Regency (Abadiyah et al., 2019) due to their excellent adaptive capabilities.

Figure 4. The number of terrestrial fern species from 6 orders in the Depati Karo Jayo Tuo Customary Forest



Additionally, the environmental conditions of the Customary Forest play a significant role in the growth of these ferns, as the Depati Karo Jayo Tuo forest is located in a highland area with well-preserved forest vegetation, creating a shady and moist soil environment. According to Nasrandi et al. (2022), the order *Polypodiales* has better adaptive abilities compared to other orders, and the species within this order can live cosmopolitanly and do not require high nutrient levels for growth. Research by Pradipta et al. (2023) explains that environmental conditions with high light intensity support the maturation and dehiscence of fern sori, aiding in spore dispersal to the environment.

The least common species observed belong to the orders *Marattiales* and *Schizaeales*. This is likely due to the low adaptability of species within these orders to the environmental conditions of the Customary Forest, which impacts their natural distribution. Variations in environmental factors and location significantly influence the growth and distribution of ferns (Tuelah et al., 2023). Research by Hartini (2009) indicated that *Christensenia aesculifolia*, a species from the order *Marattiales*, thrives in moist, shaded conditions near small streams. In contrast, species from the genus *Lygodium*, within the order *Schizaeales*, primarily grow in open habitats (Farina et al., 2024). However, the Depati Karo Jayo Tuo Customary Forest is predominantly shaded and moist, creating

conditions less favorable for the growth of *Lygodium* species.

Environmental factors were measured alongside the sampling of ferns in the Depati Karo Jayo Tuo Customary Forest. The results showed that terrestrial ferns grow in soil temperatures of 21-24.5°C, soil moisture of 25-100%, pH of 5.6-7, air temperature of 21.2-27.1°C, air humidity of 73-99%, and light intensity of 110-721 lux. These environmental conditions are suitable for ferns, as tropical ferns can optimally grow at temperatures of 21-27°C (Yolla et al., 2022), soil moisture of 50-80% (Haribowo et al., 2023), soil pH of 5.5-8 (Naiym & Munir, 2024), air temperature of 21-27°C, air humidity of 60-80%, and light intensity above 500 lux (Listiyani et al., 2022).

Conservation Status

The classification of ferns based on their conservation status is essential to assess their risk of extinction in the wild. Several organizations establish conservation statuses for plants and animals, such as the International Union for the Conservation of Nature and Natural Resources (IUCN) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). The identification results of terrestrial fern species in the Depati Karo Jayo Tuo Customary Forest area revealed that 34 species were identified at the species level. The remaining 15 species were identified only at the genus level. Out of the total 49 terrestrial fern species found, only 34 species could have their conservation status determined (see Table 1). According to the IUCN conservation status, 32 terrestrial fern species were under the "Not Evaluated" (NE) category, meaning they have not been assessed, while two species, *Dicranopteris linearis* (Burn. fil) Underw. and *Didymochlaena trunquatula* (Sw.) J. Sm., were classified as "Least Concern" (LC), indicating a low risk of extinction. The "Not Evaluated" status suggested that data and information regarding these species were incomplete or their conservation status has not yet been determined (Afifah et al., 2023).

Regarding the CITES conservation status, one terrestrial fern species, *Gymnosphaera gigantea* (Wall. Ex Hook.) J. Sm., was listed under Appendix II. Species

listed in Appendix II are not considered endangered but may become so if trade continues to disrupt their natural populations, requiring special attention from the government (Hidayat & Munawaroh, 2019). Based on these two categories, it can be concluded that most terrestrial fern species in the Depati Karo Jayo Tuo Customary Forest area have not been evaluated, except for *Dicranopteris linearis* (Burn. fil) Underw. and *Didymochlaena trunquatula* (Sw.) J. Sm. From a trade perspective, according to CITES, only *Gymnosphaera gigantea* (Wall. Ex Hook.) J. Sm is categorized under Appendix II. These findings highlight the importance of implementing specific conservation strategies for ferns in this area.

Conclusion

Based on the results of the study, it can be concluded that 49 species of terrestrial ferns were identified in the Depati Karo Jayo Tuo Customary Forest. These species belong to two classes: *Filicinae* and *Lycopodiinae*. The ferns in the class *Filicinae* consisted of 45 species classified into 24 genera, 18 families, and 5 orders, while the class *Lycopodiinae* included 4 species grouped into 1 genus, 1 family, and 1 order. According to the IUCN, 32 terrestrial fern species found in the Depati Karo Jayo Tuo Customary Forest were categorized as "Not Evaluated" (NE), 2 species were classified as "Least Concern" (LC), and 15 fern species could not be assigned a specific category. CITES data indicated one species, *Gymnosphaera gigantea* (Wall. Ex Hook.) J. Sm., was involved in international trade and is listed under Appendix II.

Acknowledgment

This study was supported by the grant of Beginner Lecturer Research (PDP) - Non-Tax State Revenue (PNBP) of the Faculty of Science and Technology, Universitas Jambi. The authors express gratitude to the Rantau Kermas expedition team, Geopark Merangin, fern expert Mrs. Afriastini J. J., and the community of Rantau Kermas Customary Village, Merangin Regency, Jambi Province.

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