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DIVERSITY AND BIOPROSPECTING OF PTERIDOPHYTE IN THE INDIGENOUS TALANG MAMAK TRIBE, RIAU, INDONESIA

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SUMMARY

The research investigates the diversity, bioprospecting, and conservation status of Pteridophyta in diverse habitats, focusing on the Bukit Tigapuluh National Park, Riau, Indonesia. The current research probes the diversity of pteridophytes and the conservation efforts of the Talang Mamak community in Riau, Indonesia, particularly in bioprospecting. It integrates ethnobotany and field exploration, utilizing ethnobotanical data as the primary database. Ethnobotanical data analysis used Microsoft Excel spreadsheets, incorporating respondent consensus factors and preference ratings. Conservation assessments adhere to the rigorous standards of the International Union for Conservation of Nature (IUCN) Red List Categories and Criteria. It uncovers 39 distinct Pteridophyta species belonging to 19 families. Engaging with the Talang Mamak community reveals nine plant species holding substantial bioprospecting potential, including *Selaginella* sp., *Angiopteris evecta* (G.Forst.) Hoffm., and *Lygodium microphyllum* (Cav.) R.Br. A comprehensive literature review underscores the scientific importance of these findings, highlighting bioactive compounds in 50% of identified species. Conservation assessments, rooted in the IUCN Red List Categories and Criteria, designate five Pteridophyta species as **endangered**. Pteridophytes play a vital role in the daily lives of the community, from traditional medicine to spiritual and cultural practices. This research underscores the imperative of holistic conservation strategies integrating scientific knowledge with community engagement.

Keywords: Polypodiaceae, species, biodiversity, bioprospecting, conservation, IUCN, medicinal plants

Key findings: The study achieved to compile the species diversity of ferns in Bukit Tigapuluh National Park (TNBT), Riau, Indonesia, comprising 39 species belonging to 19 families. In the Pteridophyta potential, nine identified species comprised *Angiopteris evecta,* one of the most prominent species. The latest findings provide a profound understanding of the potential of Pteridophyta and a solid foundation for further biosystematics and bioactive compounds exploration.

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INTRODUCTION

Polypodiaceae is one of the lushest fern families and one of the most diverse and abundant groups of vascular plants in tropical and subtropical forests. Studying the pteridophyte diversity authenticated that its utilization by an ethnic community on Sumatra Island is fundamental information in preserving a region's local wisdom. The Talang Mamak tribe is an Indragiri native tribe thought to have originated from Pagaruyung, West Sumatra, and lives around the Bukit Tigapuluh National Park, Riau, Indonesia. In studying their daily life, the said community interacts directly with nature to have a culture that is in harmony with nature.

This ethnic group has the principle that forests require maintenance and preservation. The preservation process includes behavior that supports efforts to function and sustain the productivity of forests and prevention, mitigation, and recovery activities through taboos and prohibitions led directly by customary leaders (Yunus, 2017). The Talang Mamak tribe already has permanent residences with simple house buildings (Faisal and Wihardyanto, 2014). The Talang Mamak tribe's daily activities include hunting animals and gathering plants. The tribe's wisdom has sustainability dimensions in managing biological resources inherited from their ancestors and conserving for future generations. It is an effort to maintain and conserve natural resources and develop a well-balanced relationship between humans and nature (Titisari *et al*., 2019).

In the Talang Mamak community, the activities that align with nature also support the efforts to better utilize the biodiversity in the area. Useful pteridophytes as medicinal plants appeared to be 442 out of 1200 species (Muhammad *et al*., 2020). Many pteridophytes also serve to treat human diseases (Baskaran *et al*., 2018). Previous studies reported that 77 different species of plants were medicinal materials by the Talang Mamak Tribe, including pteridophytes (Setyowati and Wardah, 2007). Reported pteridophytes used as medicinal plants include *Angiopteris evecta* Hoffm. stems, *Bolbitis heteroclita* (Presl.) Ching roots and *Pronephrium asperum* (Presl.) Holt roots.

Pteridophytes have several other purposes apart from being a medicinal material by the Talang Mamak ethnic group, with the said community authenticating to promote pteridophytes as a group of essential plants for survival. In Pteridophytes, another type that also serves as a medicinal ingredient is *Stenochlaena palustris* (Burm) Bedd as a wound-healing drug (Supiandi *et al*., 2019). Thus, pteridophytes have the opportunity to conduct in-depth studies on their biodiversity utilized by the local communities for pharmacological functions in the form of active compounds contained in these plants.

Based on the above discussion, it is evident that pteridophytes have a massive, diverse species in Indonesia. They have the opportunity to reveal their species diversity and how the utilization of these plants by the local communities with their wisdom becomes a bioprospective approach. The presented research will reveal the pteridophytes species diversity in the Bukit Tigapuluh National Park (TNBT) and their utilization by those ethnic people, which is a continuation of the pteridophytes study in Sumatra, Indonesia. Previous research reported two types of pteridophytes in the TNBT area, namely, *Davallia solida* and *Davallia denticulata*, which were part of a *Davallia* biosystematics study to develop the biodiversity database in the tropics carried out in Sumatra and Mentawai Islands, Indonesia (Mildawati *et al*., 2022a, b).

This study significantly contributes to deepening the understanding of Pteridophyta biodiversity in Bukit Tigapuluh National Park, Indonesia, to conserve rare and biologically important species. The discovery of high bioprospect potential indicates excellent potential in developing new medicines or valuable natural products. Through careful conservation assessment, this study offers a solid framework for protecting endangered Pteridophyta species while providing valuable new insights for global conservation scientists and practitioners. The latest research sought to study the diversity and efforts made by the Talang Mamak community in Riau, Indonesia,

for pteridophyte bioprospecting and conservation.

MATERIALS AND METHODS

Study area

The presented research transpired in the core zone area of Bukit Tigapuluh National Park, located in Bengayoan Hamlet, Rantau Langsat Village, Belilas District, Riau Province, Indonesia. The Bukit Tigapuluh National Park is geographically set at 00°40′ - 10°25′ N and 102°30′ - 102°50′ E, with an area of 144.223 ha. Administratively, this area traverses two provinces, namely, Riau Province and Jambi Province. Bukit Tigapuluh National Park is a representative natural ecosystem categorized as lowland tropical rainforest. The ecosystem has an always-wet climate, with dry soil and altitudes below 1.000 meters above sea level with high plant diversity. TNBT is a hilly area with altitudes ranging from 60 to 843 mdl. The Talang Mamak tribe occupies Bengayoan Village and other villages along the Batang Gangsal River (Figure 1).

Specimen collection and Identification

Collecting pteridophyte specimens came from the field. The specimen collection remained at the Herbarium of Andalas University, Indonesia. Pteridophyte specimens identification progressed by their scientific names based on the shape of the spores and their habitat and with the help of past literature in previous research on pteridophytes in Indonesia. Then, the verification used online databases, Plants of the World Online or POWO, Plantamor https://www.britannica.com/topic/Species-Plantarum), Global Biodiversity Information Facility (https://www.gbif.org/), and the book 'Pteridophytes of Solomon Islands' (Chen *et al*., 2017).

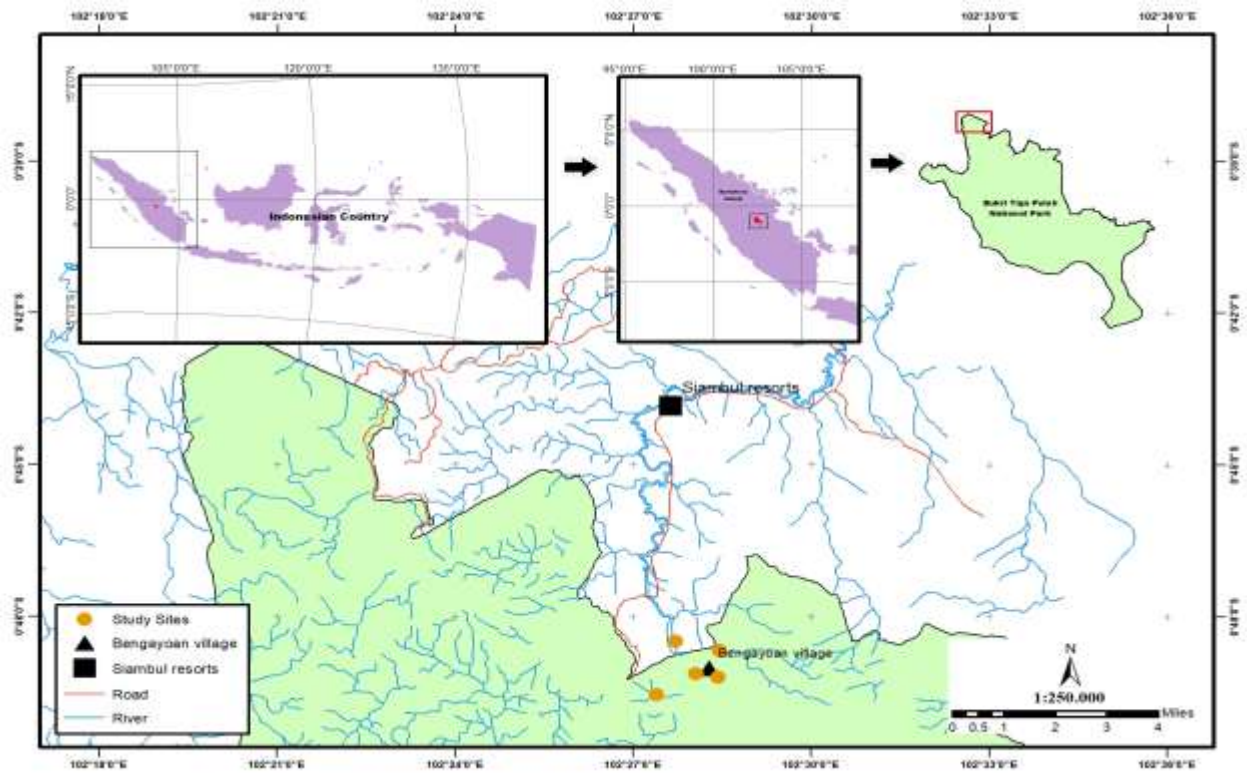

Figure 1. Map of pteridophyte diversity and bioprospection research location in Bukit Tiga Puluh National Park (Database of Bukit Tigapuluh National Park).

Data collection

Data collection explored Pteridophyta in Bukit Tigapuluh National Park, Riau, Indonesia, using land and river trails after obtaining results from interviews with key informants in the Bengayoan Village. Collecting ethnobotany of pteridophytes used for various community purposes in the Bukit Tigapuluh National Park area ensued in June 2023. Purposive sampling was the method of selecting informants, also known as key informants. The key informants consisted of two key informants comprising two groups: healers/shamans and indigenous community leaders. This study interviewed 15 key informants, of which 80% were men (12 persons), and the remaining 20% were women (three persons). All informants are above 45 years old and are either farmers or homemakers in their daily activities. Semi-structured interview methods obtained the utilization of pteridophytes through randomly selected key participants (Khoja *et al.,* 2022) and discussions with traditional leaders of the Talang Mamak tribe. Furthermore, data collection continued regarding plant local names and parts used, how to process these plants, their habitat, and their wild and cultivated status.

Data analysis

The analysis of species diversity data relied on a classification approach, while respondent consensus factors and preference ratings serve to analyze ethnobotanical data using Microsoft Excel spreadsheets. Species suitability analysis used the web (https://mk.bcgsc.ca/tableviewer/visualize/) and the IUCN Red List criteria (https://www.iucnredlist.org/) to assess the conservation status values of the pteridophytes species.

RESULTS

Pteridophytes species diversity

The latest research occurred in the Bukit Tigapuluh National Park (TNBT) area, Indonesia, which generated interesting insights into the plant species diversity in this unique ecosystem. Thirty-nine species belonging to 19 families of Pteridophyta have surfaced, as detailed in Table 1, which resulted from interviews with the Talang Mamak tribe of Riau. These resilient plants flourish in diverse regional habitats, including valley ecosystems along the Gangsal River, mountain slopes, communal plantations, and the vicinity of Bengayoan Village in Batang Gangsal, Riau Province, Indonesia. In this area, pteridophytes exhibited an adaptability spanning epiphytic (25%) and terrestrial (75%) growth patterns. Polypodiaceae is a fern plant with the highest species number—eight species. These include *Aglaomorpha drynarioides* (Hook.) M.C. Roo, *Aglaomorpha heraclea* (Kunze) Copel., *Aglaomorpha rigidula* (Sw.) Hovenkamp & S.Linds., *Aglaomorpha sparsisora* (Desv.) Hovenkamp & S.Linds., *Calymmodon* sp., *Goniophlebium subauriculatum* (Blume) C.Presl, and *Platycerium bifurcatum* (Cav.) C.Chr (Table 1).

An outstanding lack of diversity among the fern species is within the TNBT area. On average, each botanical family boasts merely one to two fern species, analytical of this locale's severely limited species richness (Figure 2). This scarcity of fern species refers to the extensive land cleanness activities undertaken by the local community in the conservation zone surrounding the Talang Mamak Community settlement. However, if these unchecked land-cleanness practices persist, a tangible concern indicates that the broader diversity of wild plant species will suffer decline in this region. Such a development contrasts the ancestral heritage of the Talang Mamak tribe, whose predecessors lived in harmony with nature, possessed indigenous wisdom, and actively safeguarded the natural environment (Titisari *et al*., 2019).

The Talang Mamak tribe is an indigenous ethnic community residing within Indonesia's Riau Province, boasting a wealth of distinctive and profound local wisdom. This rich cultural heritage has intricately woven into various factors of their lives, encircling their customs, traditions, beliefs, and vibrant

Table 1. Diversity of pteridophytes based on local knowledge in Bukit Tigapuluh National Park.

No.	Family	Species	Habitat	Vername/ Local Name
1	Lycopodiaceaea	*Phlegmariurus carinatus* (Desv. ex Poir.) Ching	Epiphytic	Kumpai lubang
2	Selaginellaceae	*Selaginella* sp	Terrestrial	Lingkonai
3	Marattiaceae	*Angiopteris microura* Copel.	Terrestrial	Paku sayur
4		*Angiopteris evecta* (G.Forst.) Hoffm.	Terrestrial	Paku Hanjuang
5	Dipteridaceae	*Dipteris conjugata* Reinw.	Terrestrial	Paku Payung
6	Gleicheniaceae	*Dicranopteris linearis* (Burm.f.) Underw. var. *altissima* Holttum	Terrestrial	Paku Resam/ paku andam
7	Lygodiaceae	*Dicranopteris linearis (Burm.f.) Underw. var. linearis*	Terrestrial	Paku Resam
8		*Lygodium circinnatum* (Burm.f.) Sw.	Epiphytic	Paku ata
9		*Lygodium microphyllum* (Cav.) R.Br.	Epiphytic	Akar kawek
10	Cyatheaceae	*Sphaeropteris vittata* (Copel.) R.M.Tryon	Terrestrial	Paku sayur
11	Lindsaeaceae	*Odontosoria retusa* (Cav.) J.Sm.	Epiphytic	Paku sayur
12		*Odontosoria chinensis (L.) J.Sm.*	Epiphytic	Paku Sayur
13	Pteridaceae	*Pteris ensiformis* Burm.f.	Terrestrial	Paku Pedang
14		*Pteris werneri* (Rosenst.) Holttum	Terrestrial	Paku sayur
15		*Taenitis blechnoides* (Willd.) Sw.	Terrestrial	Paku ringin
16	Davalliaceae	*Davallia solida* (G.Forst.) Sw.	Epiphytic	Pakis kaki kelinci
17	Denstaedtiaceae	*Hypolepis elegans* Carruth.	Terrestrial	Paku sayur
18		*Pteridium aquilinum* (L.) Kuhn subsp. *wightianum* (J.Agardh)	Terrestrial	Paku elang
19	Aspleniaceae	*Asplenium nidus* L.	Epiphytic	Paku sakat
20	Blechnaceae	Blechnum orientale L.	Terrestrial	Cencibuk
21		*Stenochlaena palustris* (Burm.f.) Bedd.	Terrestrial	Lemidi
22	Athyriaceae	*Diplazium cominsii* (Baker) C.Chr.	Terrestrial	Paku sayur
23		*Diplazium esculentum (Retz.) Sw.*	Terrestrial	Paku sayur
24	Thelypteridaceae	*Pneumatopteris costata* (Brack.) Holttum	Terrestrial	Paku sayur
25		*Pneumatopteris glandulifera* (Brack.) Holttum	Terrestrial	Paku sayur
26		*Sphaerostephanos invisus* (G.Forst.) Holttum	Terrestrial	Paku sayur
27	Nephrolepidaceae	*Nephrolepis biserrata* (Sw.) Schott	Terrestrial	Paku larat
28		*Nephrolepis brownii* (Desv.) Hovenkamp & Miyam.	Terrestrial	Pakis Pedang Asia
29	Tectariaceae	*Tectaria ferruginea* (Mett.) Copel.	Terrestrial	Pakis besi
30		*Tectaria menyanthidis* (C.Presl) Copel.	Terrestrial	Paku sayur
31		*Tectaria bamleriana (Rosenst.) C.Chr.*	Terrestrial	Paku sayur
32	Davalliaceae	*Davallia solida* (G.Forst.) Sw.	Epiphytic	Pakis kaki kelinci
33	Polypodiaceae	*Aglaomorpha drynarioides* (Hook.) M.C.Roo	Epiphytic	Paku sayur
34		*Aglaomorpha heraclea* (Kunze) Copel.	Terrestrial	Paku ular
35		*Aglaomorpha rigidula* (Sw.) Hovenkamp & S.Linds.	Epiphytic	Paku pasilan kelapa
36		*Aglaomorpha sparsisora* (Desv.) Hovenkamp & S.Linds.	Terrestrial	Paku simbar layangan
37		*Calymmodon* sp.	Terrestrial	Paku sayur
38		*Goniophlebium subauriculatum* (Blume) C.Presl	Terrestrial	Paku sayur
39		*Platycerium bifurcatum* (Cav.) C.Chr.	Epiphytic	Paku tanduk rusa

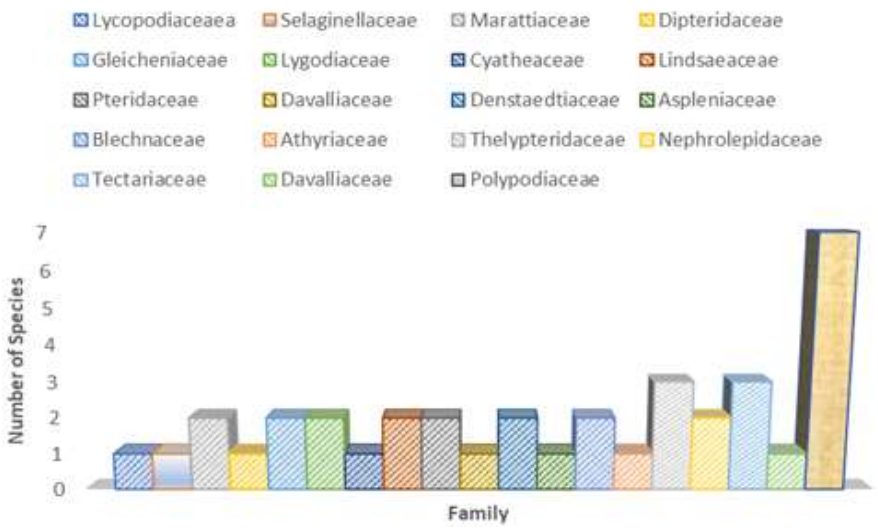

Figure 2. Comparison of the number of species and families of TNBT Pteridophytes.

cultural expressions. Notably, within the lush tapestry of Talang Mamak tradition in Riau, Indonesia, lays a remarkable facet of local wisdom—the judicious utilization of pteridophytes. One convincing example of this prevails within the Rantau Langsat Village. This settlement includes six hamlets, each with its own unique identity, i.e., Bengayoan (12 family heads), Siamang (11 family heads), Lemang (80 family heads), Nunusan (20 family heads), Air Bomban (30 family heads), Suit Sadan (30 family heads), and Datai (90 family heads). This vibrant village is in the heart of the Bukit Tigapuluh National Park, a pristine natural sanctuary. The people of Rantau Langsat Village have cultivated an enduring relationship with pteridophytes, recognizing their multifaceted utility in meeting their daily needs. Among all these uses, pteridophytes serve as a vital food source. The thoughtful harvest and incorporation of tender, youthful shoots of various *Pteridophytes* species into the local cuisine elevates the flavors of traditional dishes.

Bioprospecting study

Among the pteridophytes species thriving in the Bukit Tigapuluh National Park area, nine have unveiled their bioprospection potential, evidence of their intrinsic values and utility within the ecosystem (Table 2). The pteridophytes embraced by the Talang Mamak Community are repositories of bioactive compounds with diverse applications spanning medicine, culinary arts, and industry (Teoh *et al*., 2023). The investigations comprising the species diversity and bioprospection within the Talang Mamak tribe include a profound exploration of their traditional botanical and ecological database. The presented study investigated the various factors of their complex relationship with plants, encompassing their utilization, classification, cultivation, gathering, and sustainable management of these invaluable natural resources.

In the Talang Mamak tribe, the focal point of bioprospection extends beyond a mere scientific inquiry; it will decode the cultural material that binds these communities with the plant kingdom. It seeks to resolve the threads of tradition and heritage that interconnect with every leaf, stem, and root (Figure 3). A prominent revelation emerges through an inclusive review of the existing literature, i.e., a remarkable 50% of the pteridophytes species thriving within the expanse of Bukit Tigapuluh National Park bear the potential to serve as invaluable medicinal resources for diverse communities spanning various regions. The profound utilization of pteridophytes as

Table 2. Pteridophytes used as bioprospection plants for the Talang Mamak Community.

No.	Species	Parts used	Treated disease	Processing method
1	*Selaginella* sp.	Leaf	Medicinal herbs for fever in shamanism	The leaves are soaked and then taken as medicine
2	*Angiopteris evecta* (G.Forst.) Hoffm.	Leaf Leaf	Fresh vegetables Skin disease medicine	Used as a vegetable at meals Apply to itchy skin
3	*Dicranopteris linearis* (Burm.f.) Underw. var. altissima Holttum	Leaf	Decoration	Planted in the yard
4	*Dicranopteris linearis* (Burm.f.) Underw. var. linearis	Leaf	Decoration	Planted in the yard
5	*Lygodium circinnatum* (Burm.f.) Sw.	Leaf	Local wisdom	These plants are stored in granaries in the belief that the next harvest will be bountiful
6	*Lygodium microphyllum* (Cav.) R.Br.	Leaf	Local wisdom	These plants are stored in granaries in the belief that the next harvest will be bountiful
7	*Pteridium aquilinum* (L.) Kuhn subsp. wightianum (J.Agardh)	Leaf	Decoration	Planted in the yard
8	*Blechnum orientale* L.	Leaf	Wound medicine	The tip of the leaf is ground and applied to the wound
9	*Diplazium esculentum (Retz.) Sw.*	Leaf	Food	The young leaves are cooked

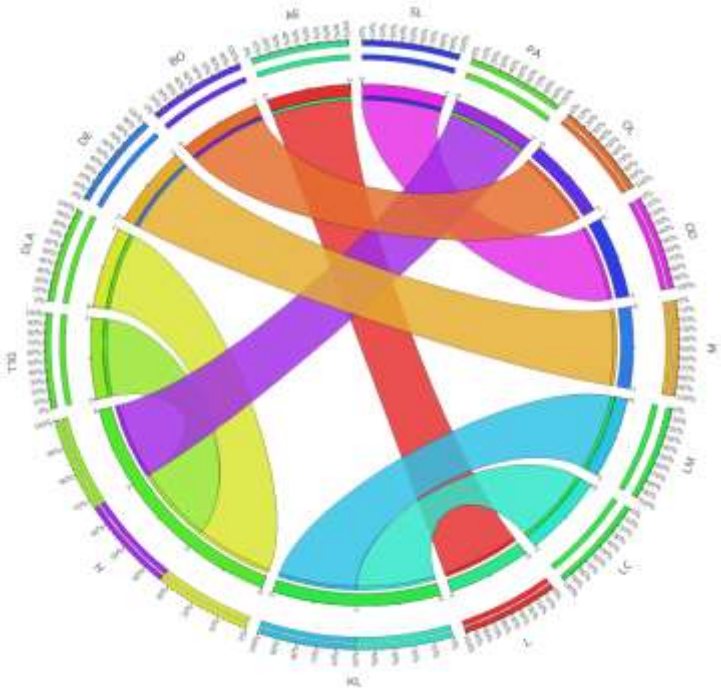

Figure 3. Compatibility of species with the utilization of Pteridophytes by the Talang Mamak Community. *Selaginella* sp (SL), *Angiopteris evecta* (AE), *Dicranopteris linearis* var. altissima (DLA), *Dicranopteris linearis* var. linearis (DLL), *Lygodium circinnatum* (LC), *Lygodium microphyllum* (LM), *Pteridium aquilinum* (PA), *Blechnum orientale* (BO), *Diplazium esculentum* (DE), External Medicine (OL), Internal Medicine (OD), Food (M), Vegetables (L), Local Heritage (KL), and Ornamentation (H).

Table 3. Literature review of bioactive compound pteridophytes in Talang Mamak tribe.

No.	Species	Bioactive compounds	Source (s)
1	*Phlegmariurus carinatus* (Desv. ex Poir.) Ching	fawcettimine-type alkaloid, phlecarinadine A (1), and 12 known ones (2-13)	(Wang *et al*., 2023)
2	*Selaginella* sp	Flavonoid, alkaloid, steroid, tannin, and saponin	(Chikmawati *et al*., 2012)
3	*Angiopteris evecta* (G.Forst.) Hoffm.	Angiopterioside	(Aulakh *et al*., 2019)
4	*Dicranopteris linearis* (Burm.f.) Underw. var. *altissima* Holttum	Methanol	(Zakaria *et al*., 2017)
5	*Lygodium microphyllum* (Cav.) R.Br.	Flavonoids, phenolics, terpenoids, steroids, alkaloids, B vitamins, fatty acids, aromatic compounds, amino acids, lactones	(Teoh *et al*., 2023)
6	*Odontosoria chinensis (L.) J.Sm.*	terpenoids, tannins, coumarins, phenolics and steroids	(Johnson *et al*., 2020)
7	*Pteris ensiformis* Burm.f.	dihydrochalcone enantiomers (+)-1 and (−)-1,	(Shi *et al*., 2017)
8	*Davallia solida* (G.Forst.) Sw.	Hydrocarbons, fatty acids, benzenoids, tocopherols, phytosterols, terpenoids and fatty acids ethyl esters	(Mildawati *et al*., 2022)
9	*Pteridium aquilinum* (L.) Kuhn	flavonoids, phenols, terpenoids, saponins, polysaccharides,	(Zhao *et al*., 2022)
10	*Asplenium nidus* L.	gliricidin 7-O-hexoside, and quercetin-7-O-rutinoside	(Roy *et al*., 2022)
11	*Blechnum orientale* L.	Flavonoid, terpenoid, tannin, chlorogenic acid, and rosmarinic acids	(Waswa *et al*., 2022)
12	*Stenochlaena palustris* (Burm.f.) Bedd.	flavonoids, steroids, and alkaloids	(Roy *et al*., 2022)
13	*Diplazium esculentum (Retz.) Sw.*	phosphorus, potassium, alkaloids, flavonoids, saponins, tannins and terpenoids	(Semwal *et al*., 2021)
14	*Nephrolepis biserrata* (Sw.) Schott	alkaloids, flavonoids, and terpenoids	(Renjana *et al*., 2021)
15	*Nephrolepis brownii* (Desv.) Hovenkamp & Miyam.	alkaloids, flavonoids, and terpenoids	(Renjana *et al*., 2021)
16	*Goniophlebium subauriculatum* (Blume) C.Presl	gliricidin 7-O-hexoside, and quercetin-7-O-rutinoside	(Roy *et al*., 2022)

medicinal agents interweave intricately with the rich material of their bioactive chemical compositions, verification of nature's pharmacopeia (Table 3).

This study sheds light on the bioprospection potential of pteridophytes in Bukit Tigapuluh National Park, mainly through the lens of the Talang Mamak Community. These plants, embraced for generations, hold promise as sources of bioactive compounds with diverse applications. By integrating traditional knowledge with scientific inquiry, we unveil these botanical treasures' cultural and ecological significance, advocating for their conservation and sustainable utilization. Collaboration among Indigenous people, researchers, and policymakers is critical for natural resource conservation (Bryne, 2012). Indigenous knowledge, in particular, tremendously affects biodiversity protection and can supplement scientific knowledge. However, integrating these knowledge systems presents obstacles, and a win-more-lose-less approach is a must recommendation to address this. As a result, a collaborative and respectful approach that values indigenous knowledge is critical for long-term natural resource management.

Pteridophytes conservation

Violations, such as habitat destruction, unchecked deforestation, and persistent habitat disintegration, are primary offenders causing a shadow of decline over numerous species. The conservation strategies stand as protection, fortifying the defense of pteridophyte diversity. Furthermore, the vital role of the various botanical gardens and seed banks in ex-situ conservation efforts is unignorable. Drawing insights from diverse sources, including the authoritative IUCN Red List, the conservation status of pteridophytes within the grounds of the Bukit Tigapuluh National Park Area includes a particular description and presentation in the informative representation displayed in Table 4.

The conservation status of 39 species colonized in the Bukit Tigapuluh National Park has undergone thorough evaluation, drawing upon the rigorous criteria of the IUCN Red List

Table 4. IUCN Red List: The conservation status of pteridophytes.

No.	Species	IUCN Status
1	*Phlegmariurus carinatus* (Desv. ex Poir.) Ching	NE
2	*Selaginella* sp	NE
3	*Angiopteris microura* Copel.	NE
4	*Angiopteris evecta* (G.Forst.) Hoffm.	NE
5	*Dipteris conjugata* Reinw.	NE
6	*Dicranopteris linearis* (Burm.f.) Underw. var. *altissima* Holttum	EN
7	*Dicranopteris linearis (Burm.f.) Underw. var. linearis*	EN
8	*Lygodium circinnatum* (Burm.f.) Sw.	NE
9	*Lygodium microphyllum* (Cav.) R.Br.	EN
10	*Sphaeropteris vittata* (Copel.) R.M.Tryon	EN
11	*Odontosoria retusa* (Cav.) J.Sm.	NE
12	*Odontosoria chinensis (L.) J.Sm.*	NE
13	*Pteris ensiformis* Burm.f.	LC
14	*Pteris werneri* (Rosenst.) Holttum	NE
15	*Taenitis blechnoides* (Willd.) Sw.	NE
16	*Davallia solida* (G.Forst.) Sw.	NE
17	*Hypolepis elegans* Carruth.	NE
18	*Pteridium aquilinum* (L.) Kuhn subsp. *wightianum* (J.Agardh) W.C. Shieh	NE
19	*Asplenium nidus* L.	LC
20	*Blechnum orientale* L.	NE
21	*Stenochlaena palustris* (Burm.f.) Bedd.	EN
22	*Diplazium cominsii* (Baker) C.Chr.	NE
23	*Diplazium esculentum* (Retz.) Sw.	LC
24	*Pneumatopteris costata* (Brack.) Holttum	NE
25	*Pneumatopteris glandulifera* (Brack.) Holttum	NE
26	*Sphaerostephanos invisus* (G.Forst.) Holttum	NE
27	*Nephrolepis biserrata* (Sw.) Schott	LC
28	*Nephrolepis brownii* (Desv.) Hovenkamp & Miyam.	NE
29	*Tectaria ferruginea* (Mett.) Copel.	NE
30	*Tectaria menyanthidis* (C.Presl) Copel.	NE
31	*Tectaria bamleriana* (Rosenst.) C.Chr.	NE
32	*Davallia solida* (G.Forst.) Sw.	NE
33	*Aglaomorpha drynarioides* (Hook.) M.C.Roo	NE
34	*Aglaomorpha heraclea* (Kunze) Copel.	NE
35	*Aglaomorpha rigidula* (Sw.) Hovenkamp & S.Linds.	NE
36	*Aglaomorpha sparsisora* (Desv.) Hovenkamp & S.Linds.	NE
37	*Calymmodon* sp.	NE
38	*Goniophlebium subauriculatum* (Blume) C.Presl	NE
39	*Platycerium bifurcatum* (Cav.) C.Chr.	NE

Note: NE (*Not evaluated*), EN (*Endangered*), LC (*Least Concern*)

(Table 4). Among this verdant assembly, five tenacious species stand on the precipice of endangerment, clasping the Endangered (EN) designation, which includes *Dicranopteris linearis* (Burm.f.) Underw. var*. altissima* Holttum, *Dicranopteris linearis* (Burm.f.) Underw. var. *linearis, Lygodium microphyllum* (Cav.) R.Br., *Sphaeropteris vittata* (Copel.) R.M. Tryon, and *Stenochlaena palustris* (Burm.f.) Bedd. In contrast, four other species find amnesty under the sheltering umbrella of Least Concern (LC), proving their relatively stable populations and the absence of imminent threats. These four species were *Pteris ensiformis* Burm.F., *Asplenium nidus* L., *Diplazium esculentum* (Retz.) Sw., and *Nephrolepis biserrata* (Sw.) Schott.

Remarkably, a significant legion of 30 species within this assemblage remains unassessed and bears no classification as 'have not been evaluated before,' signifying the need for further investigation to measure their conservation status. The present assessment provides a vital estimate of the extent to which each plant species sway on the brink of extinction. A spectrum of factors, ranging from population size to habitat dynamics, geographical distribution, and population trends, converge to inform these classifications.

The IUCN's stratified categories provide an emotional glossary to summarize the perseverance of the conservation efforts. Species classified as Least Concern (LC) exist relatively stable, with populations considered reasonably healthy and free from substantial threats. However, the Endangered (EN) label signals an insecure status, where species stagger on the precipice of extinction without prompt intervention (IUCN. 2014). This crucial data serves as a lodestar for preserving biodiversity and emphasizes the importance of conservation measures for insufficient species.

Pteridophyte conservation efforts by local communities include the designation of forest areas as a form of local wisdom. This area remains undisturbed by human activities, maintaining the sustainability of the forest along the Batang Gangsal River. Most of the knowledge related to this conservation still has oral retention by the local Talang Mamak tribe without written documentation. Collecting and documenting this information is crucial given the limited available knowledge, especially in the context of the first research on ethnopteridology and conservation in the area.

DISCUSSION

Pteridophytes are pivotal in temperate forest ecosystems and tropical mountain rainforests. The Bukit Tigapuluh National Park provides an ideal habitat for various fern species. In the presented assessment, 39 identified species belonged to 19 distinct families. In particular, the family Polypodiaceae took the spotlight, boasting seven unique species. These observations highlight the immensity of the family Polypodiaceae, estimated to include approximately 1600 species distributed across the globe, with the highest diversity documented in tropical and subtropical regions, excluding Antarctica (PPG, 2016).

This rich species diversity is quite interesting when contrasted with prior research conducted in the Siberut National Park, which documented only 12 species in the family Polypodiaceae (Mildawati *et al*., 2020). Such a considerable discrepancy in species diversity between these two National Park areas may refer to variations in environmental factors, including climate, topography, and other ecological conditions (Ford *et al*., 2013; Setiawan *et al*., 2022; Aipeisova *et al*., 2023). It is worth mentioning that besides these natural factors, in pteridophytes, the species diversity also has intricate links to spore dispersal mechanisms and their ability to adapt to a wide environmental condition range.

During research in Bukit Tigapuluh National Park, pteridophytes tend to be ample in the watershed and tributaries of the Gangsal River. Some species grew on steep riverbanks, including *Dipteris conjugata* Reine and *Taenitis blechnoides* (Willd.) Sw. These findings align with the literature, enunciating that pteridophytes generally reside in moist habitats. Ecological studies have also shown that pteridophytes are crucial as pioneer plants in forest ecosystems. Pteridophytes also help to maintain soil stability, prevent erosion, and

create microenvironments that support the existence of diverse plant, animal, and human species (Idul and Cayme, 2023).

In this area, pteridophyte diversity also directly contributes to the lifestyle of people who utilize plants for survival and as food, medicine, and ornamentation. The types of plants used include *Selaginella* sp., *Angiopteris evecta* (G.Forst.) Hoffm., *Dicranopteris linearis* (Burm.f.) Underw. var. *altissima* Holttum, *Dicranopteris linearis* (Burm.f.) Underw. var. *linearis*, *Lygodium circinnatum* (Burm.f.) Sw., *Lygodium microphyllum* (Cav.) R.Br., *Pteridium aquilinum* (L.) Kuhn subsp. *wightianum* (J.Agardh), *Blechnum orientale* L., and *Diplazium esculentum* (Retz.) Sw. Thus, the use of pteridophytes by the Talang Mamak tribe reflects their profound knowledge of the surrounding environment and the traditional skills they have inherited from generation to generation. Consuming pteridophyte is integral in their life and culture, reflecting local wisdom in sustainably utilizing natural resources.

In daily life, pteridophyte usage by the people of Talang Mamak has existed since their ancestors. Generally, the plants used have an essential value, where the community widely uses plants, and almost all the consultations found in this study indicated a use, including *Diplazium esculentum* (Retz.) Sw, as proven by past findings (Raina *et al*., 2023). Thus, the pteridophytes could be beneficial further based on the local wisdom of the Talang Mamak Tribe. The utilization of plants as nutritious local food and the potential of plants as medicinal material will potentially influence the economic field, which can help enhance the commercial value of the Talang Mamak Community. It will be an opportunity to develop food and medical materials to enrich local industries in the future (Pal and Suresh, 2016).

A more detailed study of pteridophyte bioprospection necessitates conducting a biochemical analysis of plant samples obtained for further use to identify the compounds found, their extraction methods, and their potential applications. The results obtained will later provide interesting compounds for further optimum utilization. Thus, the results of this study can benefit the community by understanding the importance of traditional botanical knowledge to preserve local communities' natural and cultural resources. It also aims to respect cultural and ethical values and pay special attention to intellectual rights and community participation in scientific studies (Ruiz-Casares, 2014). In addition, local community knowledge is also part of the conservation and protection efforts within the national park (McCarthy *et al*. 2018). Therefore, it can play an essential role in maintaining the diversity of fern species. Thus, national parks can carry out conservation efforts that go hand in hand with the culture of local communities to protect habitats and, hence, maintain plant diversity for future generations (Muhumuza and Balkwill, 2013).

CONCLUSIONS

Research conducted on the diversity of pteridophyte species within the Bukit Tigapuluh National Park (TNBT) region, Indonesia, has successfully identified 39 species belonging to 19 families. Additionally, through direct consultation with community leaders of the Talang Mamak tribe, the study discovered that nine of these pteridophyte species (comprising 25% of the total) exhibited significant bioprospection potential. A comprehensive examination of the IUCN Data site produced considerable information, indicating that most pteridophyte species encountered in the area are still abundantly available in their natural habitat, bearing a conservation status of NE (Not Evaluated). In light of these findings, it becomes evident that further research is imperative to unlock the complete potential of these pteridophytes. Specifically, investigations into the presence and properties of secondary metabolite compounds within these pteridophytes should proceed using advanced analytical techniques, such as GC-MS and LC-MS analysis. The presented study will further enhance our understanding of the valuable resources within TNBT and contribute to the sustainable utilization and conservation of this unique ecosystem.

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