# A new record of the fern *Syngramma quinata* in Brunei Darussalam

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**Abstract**

In this study, *Syngramma quinata* was newly recorded for Brunei Darussalam. The species is distributed from Peninsular Malaysia to Fiji but absent in Java and southwestern Indonesia. The record confirms the species' preference for forest and its distribution close to streams and in shady habitats. While its distribution is frequent in the eastern part of the region (Papua and Solomon Islands), the species is rare in Borneo, Sumatra and Sulawesi. Therefore, this new record fills a gap in the distribution and ecology of this species.

*Index Terms:* pteridophytes, pteridaceae, *Syngramma*, Borneo

## 1. Introduction

During field investigations of the diversity and ecology of Brunei Darussalam, numerous species of pteridophytes have been collected and identified. Ferns are an ancient group of vascular plants that play a major role in tropical forest biodiversity and plant-animal interactions.[1] In a tropical forest, fern species constitute the richest group of terrestrial herbaceous species, whereas they are the second group of epiphytic species after Orchidaceae.[2] The richness of fern species is high along rivers or in habitats with constant humidity and low light availability.[3] Moreover, a selected number of fern species that are adapted to sunny sites cover a large portion of bare land. This compromises and delays the natural process of forest regeneration. In addition, the thick layer created by these species stops the seeds from reaching and germinating in the soil.[4] Some fern species are disturbance-tolerant, while others are rare inhabitants of the undisturbed forest interiors.[4] Ecological studies have reported that in undisturbed forests, about 50% of the fern species have been recorded once, indicating that many have specific niches and occur in low-density populations.[5]

## 2. Materials and Methods

A long-term project on pteridophyte fern diversity and ecology in Brunei Darussalam was undertaken between 2016 and 2021. The fieldwork, during which the novel specimens were collected, was carried out between December 2020 and May 2021. The present study aimed to assess the pteridophyte diversity in Brunei Darussalam, and hence we visited numerous forested sites within the country. The long-term project included the assessment of pteridophyte species using a standard ecological methodology on a plot size of 20×20 m. To assess the distribution of the new species presented here, the available records from the Global Biodiversity Information Facilities (GBIF.org) were downloaded and used to construct the distribution map and the frequency of occurrence within the species distribution area. The specimens were collected, processed and deposited at the Universiti Brunei Darussalam Herbarium (UBDH).

## 3. Results and Discussion

During the fieldwork in two different localities, two specimens of *Syngramma quinata* (Hook.)

Carruth, (Athyriaceae, Alston) were collected (see ***Figure 1***). *S. quinata* was first described by Hooker (Sp. Fil. Vol. V. p. 152, t. 297) and revised by Carruth (1873). The etymology of *quinata*, which means "consisting of five parts", is based on the morphology of the fronds. It was first mentioned as distributed on the Solomon Islands (Milne n. 579).[6] The specimens examined from Brunei Darussalam were collected by Daniele Cicuzza in the Tutong district (Lat 4.63518, Lon 114.743, 2020-12-29; D. Cicuzza 2800), and the Sungai Ingei Conservation Area, Belait district (Lat. 4.1275, Long 114.743; 2021-05-10; D. Cicuzza 3007). The sample collected in the first locality resulted from a general collection, whereas the second specimen was found during a plot-based ecological study. These specimens contribute to our understanding of the spatial distribution of rare pteridophytes in Brunei.

The genus *Syngramma* J. Smith (1845) is characterized by a bristly rhizome and tough fronds, usually simples, with sori running along the veins as in *Asplenium* but without indusia. The genus *Syngramma* consists of 25 species, mostly stream-side or rock ferns, growing in the shady forest. The species *S. quinata* has a creeping rhizome and the fronds are close together with dark brown bristles 2-3 mm long. Purplish stipes, 60cm long, are grooved on the adaxial side. The fronds are usually three to five partite with apical lamina 20–35 cm long, 5.5 cm wide, narrowly elliptical, base narrowly cuneate. The palmate frond is a diagnostic characteristic of this species. The lateral leaflets are similar to the apical but smaller in size. The leaves do not present buds at the lamina bases. Sori, with slender short paraphyses, have slightly enlarged reddish apical cells. The individual specimens documented here have the typical form of five pinnae, and not a single one had three pinnae (see ***Figure 2***).

*S. quinata* is widespread in the Malaysian region (Hooker 1854); although the type specimens of this species originate from Vanikoro island, the species has been recorded in tropical Polynesia,[6] Borneo,[7] Indonesia: central Kalimantan,[8] Malaysia: Sarawak, Madir district, Gunung Mulu,[9] Ambon Island, Papua New Guinea, the Solomon Islands and Vanuatu.[10] Based on the frequency of GBIF records (see ***Figure 3***), the centre of distribution is in the far southeastern region, with Papua, Solomon and Fiji having the highest record of specimens collected, whereas Indonesia and Malaysia have only nine records. It is unlikely that the northern and western islands and land masses have experienced a low sampling effort, and thus the low frequency of this species in the northern and western part of its natural distribution is likely accurate.

The species is distributed from lowland forests up to 1200 m. The ecology of the species is strictly linked to small streams, with slow running water and in shady and humid habitats. The specimens were collected from two forest sites. One was Kampong Bukit Sulang, Ladan Hill Forest Reserve, Compartment 37, Tutong, a freshwater flat swamp area with soil saturated with water. The individuals were only located in the flooded area and absent in the nearby dry sites where topography allowed water drainage due to a gentle slope. The population observed was relatively abundant, with over 20 fertile individuals. The second specimen was collected in Sungai Ingei, near the southern border of Brunei with Sarawak, Malaysia. It was a pristine mixed-dipterocarp rainforest with a temporary stream and abundant small rocks along the stream bed. The population encountered here was smaller than the previous one with only ten fertile individuals.

The genus *Syngramma* has a dynamic taxonomic history, closely related to *Taenitis*[11] and *Austrogramme*, as part of which the last updated PPG (Pteridophyte Phylogeny Group) system[12] classifies these genera to suborder Pteridineae J. Prado et. Schuettp., family Pteridaceae and subfamily Pteridoideae Link sensu.[13] The molecular-phylogenetic studies confirmed the close correlation among the three paleotropic genera, *Syngramma*, *Taenitis* and *Austrogramme*. The spores of *Syngramma* and *Austrogramme* are the simplest in ornamentation and similar to each other, whereas the spores of *Taenitis* species differ markedly. This phenomenon corresponds to the molecular-phylogenetic studies, in which *Austrogramme* and *Syngramma* correlate, while

*Taenitis* takes a secondary position to both species.[13] However, *S. quinata* is the only species that has palmate leaves with five pinnae, whereas the rest of the species have simple leaves.

This new record of *S. quinata* in the forests of Brunei Darussalam increases our knowledge of its species distribution, especially in its north-western range. Furthermore, this study highlights the low frequency of this species in Brunei. This underlines the need for further study to understand the frequency of this species and other ferns on the island of Borneo and provide data on its conservation status.

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***Figure 1***. *S. quinata* sample from one of the new record locations, Tutong.

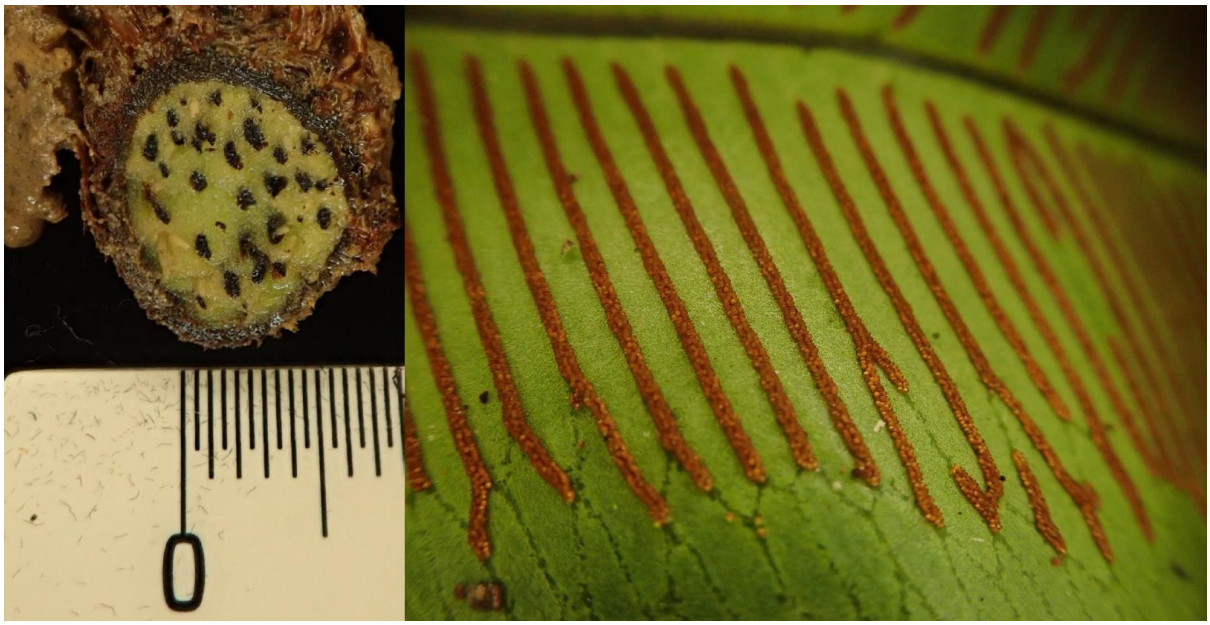

***Figure 2***. View of the vascular system of *S. quinata* with a syphonostele structure, scale in cm (A). Sori, exindusiate, in a parallel line, following the secondary nerves and not reaching the leaf margin.

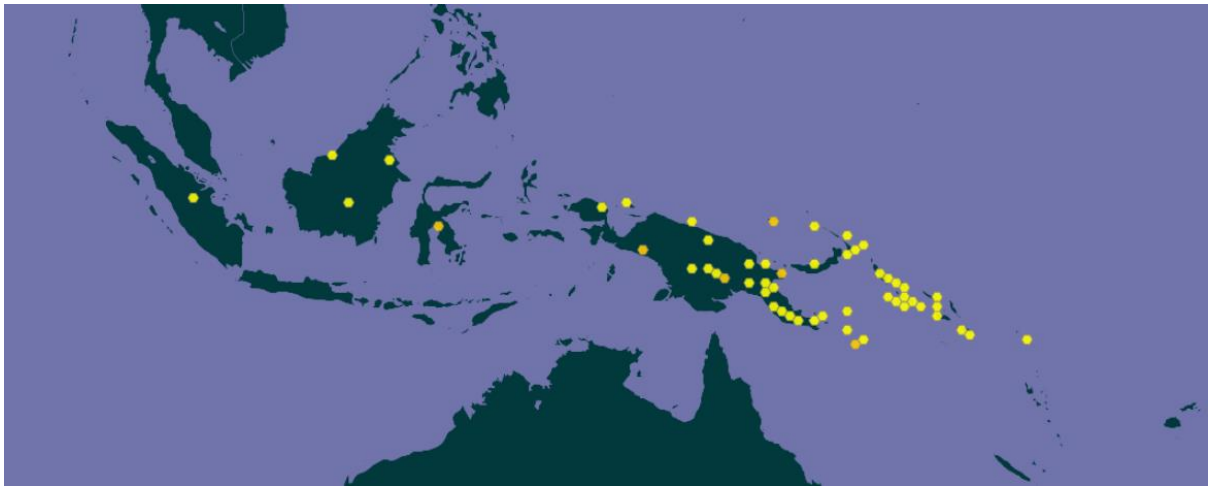

***Figure 3***. Distribution of *S. quinata* from GBIF database. Most of the records are from Papua, Fiji and the Solomon islands, whereas only a few samples have been recorded from the Malay archipelago, of which only three were from Borneo.

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