



**MANAGEMENT OF *Pyrrosia* Mirb. (POLYPODIACEAE)
FERN SPECIMENS IN HERBARIUM DEPOKENSIS (UIDEP)
UNIVERSITAS INDONESIA, DEPOK**

**MANAJEMEN KOLEKSI SPESIMEN HERBARIUM PAKU *Pyrrosia* Mirb. (POLYPODIACEAE)
DI HERBARIUM DEPOKENSIS (UIDEP) UNIVERSITAS INDONESIA, DEPOK**

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Abstract

The herbarium harbors collections of preserved plants used for scientific purposes. It is important to keep information about plants in a valid herbarium collection. This study aims to establish a valid collection and database of *Pyrrosia* stored in Herbarium Depokensis (UIDEP) through herbarium management. The management process includes taxonomic validation, specimen revitalization, and digitization. Taxonomic validation results showed there were 3 species of *Pyrrosia* namely *P. piloselloides*, *P. lanceolata*, and *P. longifolia*. These three species can be distinguished by rhizome scales, the shape of the lamina, and soral position. Physical examination throughout specimens showed several problems including loose specimen parts and specimen damage due to insects. Almost all collections (49 out of 59 specimens) did not include fertile lamina which is an important identifying character in *Pyrrosia*. To complete the herbarium data, 10 new *Pyrrosia* samples were collected at Green Spaces (RTHK) in Universitas Indonesia. All valid data and pictures undergo a digitization process. Those digitized data were then uploaded to the Herbarium UIDEP website (ruangkoleksibiotaiui.id). This resulted in a *Pyrrosia* database that can be widely accessed by the public.

Keywords: Digitization; Herbarium; *Pyrrosia lanceolata*; *Pyrrosia longifolia*; *Pyrrosia piloselloides*; UIDEP

Abstrak

Herbarium menyimpan koleksi tanaman yang diawetkan yang digunakan untuk tujuan ilmiah. Penting untuk menyimpan informasi tentang tanaman dalam koleksi herbarium yang valid. Penelitian ini bertujuan untuk membangun koleksi dan database valid *Pyrrosia* yang disimpan di Herbarium Depokensis (UIDEP) melalui pengelolaan herbarium. Proses pengelolaannya meliputi validasi taksonomi, revitalisasi spesimen, dan digitalisasi. Hasil validasi taksonomi *Pyrrosia* menunjukkan terdapat 3 spesies, yaitu *P. piloselloides*, *P. lanceolata*, dan *P. longifolia*. Ketiga spesies ini dapat dibedakan berdasarkan sisik rimpang, bentuk lamina, dan letak soral. Pemeriksaan fisik pada seluruh spesimen menunjukkan beberapa permasalahan antara lain bagian spesimen yang lepas dan kerusakan spesimen akibat serangga. Hampir semua koleksi (49 dari 59 spesimen) tidak mencantumkan lamina subur yang merupakan karakter pengidentifikasi penting pada *Pyrrosia*. Untuk melengkapi data herbarium, dilakukan pengumpulan 10 sampel *Pyrrosia* baru di Ruang Terbuka Hijau (RTHK) Universitas Indonesia. Semua data dan gambar yang valid menjalani proses digitalisasi. Data digital tersebut kemudian diunggah ke website Herbarium UIDEP (ruangkoleksibiotaiui.id). Hal ini menghasilkan database *Pyrrosia* yang dapat diakses secara luas oleh masyarakat.

Kata Kunci: Digitalisasi; Herbarium; *Pyrrosia lanceolata*; *Pyrrosia longifolia*; *Pyrrosia piloselloides*; UIDEP

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INTRODUCTION

A herbarium is a collection of preserved plants stored in a room with specific environmental conditions, such as temperature and humidity. Herbariums are usually managed by scientific institutions that are responsible for storing and administering their use (Bridson & Forman, 1992; Bromberg, 2020). The herbarium is a repository for reference material, a means for identifying species, a source of confirmed taxa names, and a comprehensive data bank. Aside from its traditional role, herbarium nowadays has broader purposes. Digital and traditional collections have been used to document plant ecology such as the range of rare species, its declining patterns, or the spread of invasive plants. Ecological botanists compared specimens from different times and places using herbarium collections (López & Sassone, 2019). The herbarium data is digitized to make it more widely accessible. The database could also be sorted in various ways to fulfill many practical needs outside of the traditional alphabetical sorting of the taxa. For example, the available taxa can be sorted according to the area of distribution or its genetic relationship to other taxa, to further understand a certain taxon in both matters. Those data are important as a source of information related to taxonomic information on plant specimens. A researcher can use the herbarium collection stored as a reference to identify other specimens that are not yet recognized or find out the distribution of taxa by looking at the description of the location of the collection on the label. Therefore, the herbarium is considered an asset and a wealth of knowledge because it stores taxonomic and ecological data and represents plant diversity (Besnard et al., 2018; Yaman et al., 2022).

Some local herbarium units are managed by schools or universities to act as learning facility. One of them is Herbarium Depokensis (UIDEP) in the Department of Biology, Faculty of Mathematics and Natural Sciences Universitas Indonesia. UIDEP stores a collection of herbarium specimens from various locations in Indonesia, but mostly from UI's Green Spaces (RTHK). The specimens are collected from biodiversity exploration conducted by the students, or outcomes from practice classes. At least 400 of the specimens stored in UIDEP are *Pteridophytes*. One of the notable genera in *Pteridophyta* is *Pyrrosia*, which was first described by Mirbel (1803) (Hovenkamp & Wessendorp, 1986). *Pyrrosia* generally have thick and fleshy simple leaves. *Pyrrosia* leaves are usually dimorphic (different leaf shapes between sterile and fertile leaves) (Sofiyanti et al., 2015). *Pyrrosia* species is used as an ornamental and medicinal plant. Malays and Filipinos used to use *Pyrrosia* leaves as an external medicine. *P. piloselloides* leaf juice is reported to be used by Indonesian people as a cough medicine, constipation, and gonorrhoea (Fatimah, 2009; Natalia, 2012).

The collection of *Pyrrosia* specimens stored in UIDEP has not been well-curated. The problems regarding the specimens themselves were incomplete diagnostic characters of the fern, mainly caused by physical damage while storing or insufficient herbarium preservation method. In addition, there is a large part of the collection with old taxonomic information that has not been updated. This includes the species name in some of the specimen labels being *Drymoglossum* (*Pyrrosia*'s synonym). To maximize its function, herbarium collections must be correctly maintained which can be called Herbarium Management (Harris & Marsico, 2017).

This study focuses on two kinds of work in herbarium. One is about the taxonomy aspect of herbarium collections stored in UIDEP, which includes its accuracy in naming the plant specimen and how well the taxa were grouped according to the latest taxonomy classifications. The other aspect is the technical handling of those herbaria itself. That comprises how well the specimens were stored in the unit, and also the standard procedure of collecting and arranging a plant on herbarium paper. The objective of this study is to carry out Herbarium Management through a revitalization of all specimens which includes physical condition analysis, evaluation of species naming, and revitalization of each *Pyrrosia* specimen in UIDEP before digitizing the herbarium in an online database for easier access.

MATERIALS AND METHODS

The validation and specimen digitization activities were carried out in Herbarium Depokensis (UIDEP), Biota Collection Room Department of Biology, FMIPA, Universitas Indonesia, Depok. The herbarium sheets that will be examined are all specimens named *Pyrrosia* spp. and

Drymoglossum spp. on its label, a total of 59 specimens labeled as *P. piloselloides*, *P. lanceolata*, *P. longifolia*, *P. nummularifolia*, *D. piloselloides*, *Drymoglossum* sp., and *Pyrrosia* sp. When observing herbarium specimens for species validation, a Nikon Stereo Microscope SMZ745 and an Olympus long-arm microscope were used. A computer device is used to input data from the validation stages to the final database. When remounting the specimen, sewing thread, paper tape, scissors, glue, stationery, and isolation tape are needed. Revision labels are also used to mark the revised taxa as needed. Finally, specimen documentation for digitization using the Canon EOS 500D DSLR camera that was attached to a Canon Copy Stand.

Herbarium management is carried out in three main revitalization steps (Natural Herbarium of Cultivated Plants, 2019), which include taxonomic nomenclature validation, specimen repairment, and digitizing all specimens (including documentation and databasing). First, all specimens identified as *Pyrrosia* spp. and *Drymoglossum* spp. were re-grouped based on morphological characters' similarities between specimens. The method for morphometry was done through detailed morphological examination. The main characters of each group were compared with references, to confirm that the specimen is the species name that is written on the label. In this study, a couple of reference sources were used such as the *Pyrrosia* monograph by Hovenkamp and Wessendorp (1986), Hovenkamp et al. (1998), and PPG 2016 to validate specimens' nomenclature. Herbarium specimens were compared with each other's characteristics and determined whether or not they belonged to the same taxa group. The validated specimens are then ready for the repairment process. Repairment of all specimens has been made for 2 aspects, the physical condition of the herbarium sheets and information validation written in the label. Each herbarium sheet was carefully observed, and problems appeared and were identified. Both specimens' repairment and specimen' label checking were done based on herbarium references (Christenhusz & Chase, 2014). Digitization was carried out for all valid herbarium data resulting from previous work stages. The process was done in two steps, specimen documentation and data uploading to the website. Pictures were taken for each specimen with a DSLR camera that was mounted on a Copy Stand, the use of a photo lamp as a modification of lighting was made to ensure that the photos looked as close as the actual specimen. All valid data in the herbarium label were transferred into an Excel spreadsheet. Both the pictures and specimens' data were uploaded to Herbarium UIDEP online database (www.ruangkoleksibiotai.id).

RESULTS

Nomenclature Validation

All 59 herbarium sheets named *Pyrrosia* spp. and *Drymoglossum* spp. on their existing label before the validation process were then confirmed as *Pyrrosia*. The diagnostic character for this genus is the stellate hairs found on the surface of the lamina. Detailed morphological examination of those specimens resulted in three taxa of *Pyrrosia* (*P. piloselloides*, *P. lanceolata*, and *P. longifolia*). There was some nomenclature difference between the existent label and validation results (Table 1), which then were updated to the latter. Nomenclature changes were made possible by detailed morphological examination of several key characters of *P. piloselloides*, *P. lanceolata*, and *P. longifolia* (Table 2).

Table 1. Comparison of *Pyrrosia* species naming in Herbarium UIDEP before and after the validation process (numbers refer to the amount of specimen sheets)

Collection name	Year of collection	Before validation	After validation	Validation results
<i>P. piloselloides</i>	2014 (1), 2017 (5), 2019 (1)	7	51	2 specimens validated to <i>P. longifolia</i>
<i>P. lanceolata</i>	2017	2	5	
<i>P. longifolia</i>	2014	1	3	
<i>P. nummularifolia</i>	2019	2	-	Identified as <i>P. piloselloides</i>
<i>Pyrrosia</i> sp.	2017	4	-	2 identified as <i>P. piloselloides</i> and 2 identified as <i>P. lanceolata</i>
<i>D. piloselloides</i>	1988 (1), 1989 (1), 2002 (11), 2006 (7), 2007 (12), 2017 (3), 2019 (2), no info (4)	41	-	Moved to <i>P. piloselloides</i> (40 specimens) and <i>P. lanceolata</i> (1 specimen)
<i>Drymoglossum</i> sp.	2007	2	-	Identified as <i>P. piloselloides</i>
Total		59		

Table 2. Diagnostic characters of *Pyrrosia* spp. in Herbarium UIDEP

Diagnostic character	A (<i>P. piloselloides</i>)	B (<i>P. lanceolata</i>)	C (<i>P. longifolia</i>)
Rhizome	Thickness <1.5 mm (filiform)	1–2 mm thick, flexible	1.8–2.7 mm thick, rigid
Rhizome scales*	Ciliate, peltate without acumen	Ciliate, peltate with acumen	Entire, peltate with acumen
Distance between phylloids	0.8–1.7 cm	1–2 cm	1.8–2.2 cm
Sterile lamina	Shape	Orbiculate to ellipse	Elliptical, lanceolate to linear
	Apex	Rounded to obtuse	Acute to attenuate
	Base	Rounded to obtuse	Attenuate
	Stalk	Sessile to stalked <0.7 cm	1–2 cm long
Fertile lamina	Shape	Ellipse to lanceolate	Elliptical to linear
	Sori*	Lengthwise throughout the margin	Rounded, in 2 rows between midrib and margin
Amount	51 sheets	5 sheets	3 sheets

Note: The sign (*) indicates the micromorphological character observed with the aid of a microscope

Validation of all specimens as *Pyrrosia* was indicated by long-creeping rhizomes, simple leaves, and entire leaf margins. The diagnostic character of the genus *Pyrrosia* found was the presence of *stellate hairs* on the surface of the lamina. The stellate hairs have acicular rays and were found to be denser on the abaxial part of the leaf than on the adaxial. The presence of stellate hairs distinguishes *Pyrrosia* from other genera of ferns which also have thick leaves and entire leaf margins such as *Lemmaphyllum* (Donk, 1954).

To validate the species name within *Pyrrosia* diagnostics were used including macromorphological and micromorphological characters. The macromorphological characters observed were rhizome shape and size, distance between phylloids, and leaf shape (including apex, base, and stalk). In general, the two species can be distinguished by the apex and/or basal of the sterile lamina. In *P. lanceolata* the apex and/or basal part is more tapered and the widest part of the lamina is at the bottom or top of the middle of the leaf (lanceolate). In contrast, *P. piloselloides* has an overall elliptical leaf shape. *P. longifolia* has a leaf shape that is quite different from the other two species because of its strap-shaped leaf. The length of the leaves of *P. longifolia* can reach 20 cm or more (in specimens, the longest found is 54 cm).

Micromorphological diagnostic characters used to distinguish the three groups of *Pyrrosia* specimen collections in Herbarium UIDEP were rhizome scales and sori. Rhizome scales are found along the surface of the rhizome to the phyllopod of the *Pyrrosia*. The results of rhizome scales observation with a microscope showed that there were variations in the shape of the scales between species (Figure 1). All of the rhizome scales observed in the *Pyrrosia* specimens had the same attachment, which is peltate (attached to the center of the scales).

Based on Figure 1, the differences between species were indicated by the shape of the scales and the presence/absence of cilia at the margins of the scales. The shape of the rhizome scales in Figure (1a) was found in the *P. piloselloides* specimens. The margin of the rhizome scales was ciliate and did not have a long acumen (pointed angle). The size of the scales is also the smallest compared to the other two groups, namely ± 1 mm long and 0.8 mm wide. In *P. lanceolata*, peltate scales were found (Figure 1b). The margins of the scales were also ciliate but there is an acumen structure that looks elongated. The length of the scales of *P. lanceolata* can reach 1.5 to 3 mm while the width is 0.3–1.2 mm. The scale form (c) was found in the *P. longifolia*. Form c looks most distinctly different because the scale margins were flat without cilia (entire) and also have acumen. The size of the scales observed in *P. longifolia* specimen was $\pm 1-3.2 \times 0.6-1.5$ mm.

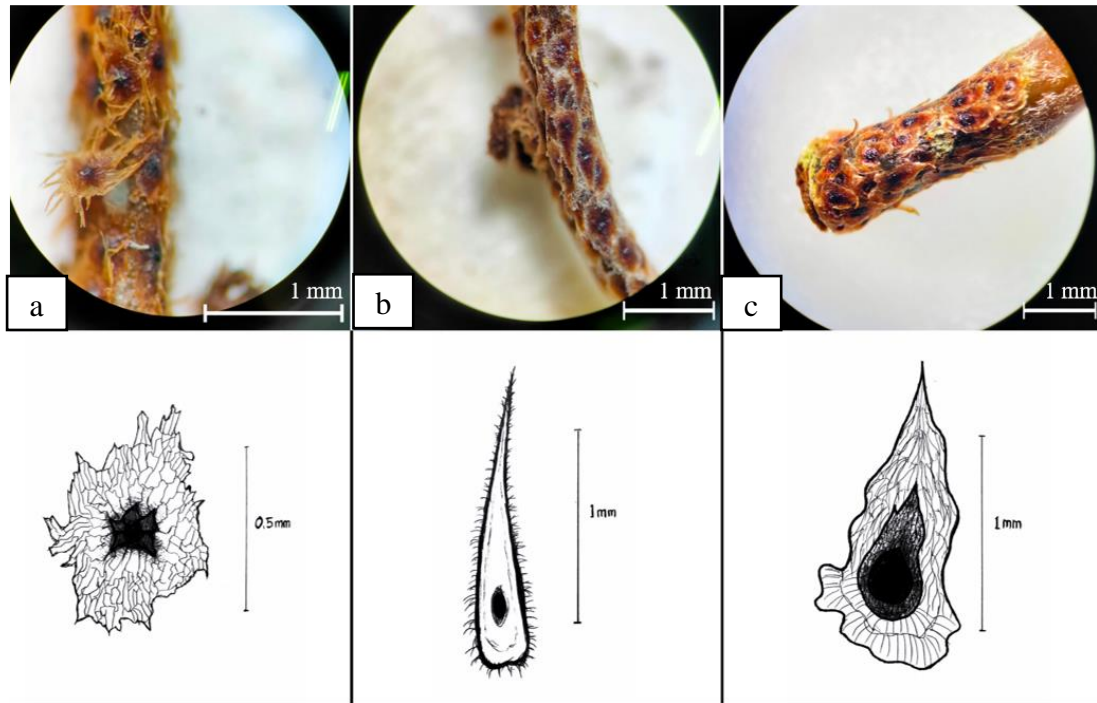


Figure 1. Rhizome scales on 3 species of *Pyrrosia*. *Pyrrosia piloselloides* (a), *Pyrrosia lanceolata* (b), and *Pyrrosia longifolia* (c)

In addition to rhizome scales, another micromorphological character observed to distinguish *Pyrrosia* species in Herbarium DEP was its sori arrangement. The position of the sori on the fertile lamina was observed as shown in Figure 2. The sori in Figure (a) was found in the *P. piloselloides*, it could be seen that the sori were arranged longitudinally at the margin. The sori arrangement in Figure (b) was found in *P. lanceolata*. Sori rounded, arranged in 2 rows on the abaxial surface of the leaf lamina between the midrib and margin. Sori looks a bit sunken and covered in thick stellate hairs. Sori in Figure (c) was found in the *P. longifolia*. Sori rounded and scattered on the abaxial surface of the lamina but only found around the apex to before the middle of the leaf. No sori were found around the leaf basal area even on very long (>50 cm) lamina.

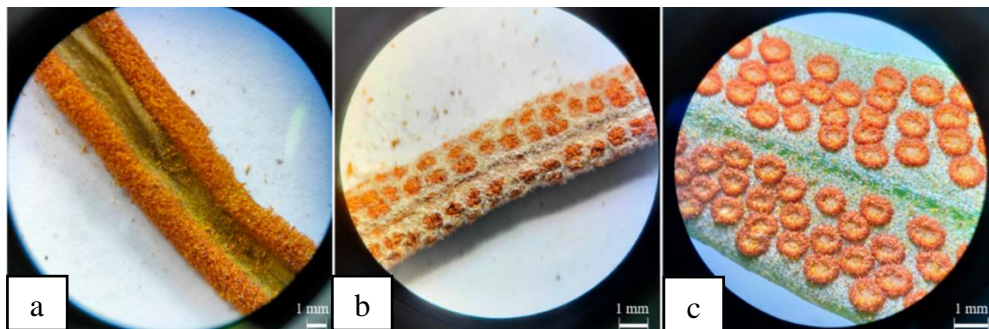


Figure 2. Soral arrangement on the fertile lamina of 3 species of *Pyrrosia*. *Pyrrosia piloselloides* (a), *Pyrrosia lanceolata* (b), and *Pyrrosia longifolia* (c)

Physical Examination and Specimen Handling

Herbarium sheets examination on all specimens identified types of damage and inaccurate information in the labels as shown in Table 3. Most of the problems occurred on the plant specimen itself, whether it is from physical damage or not enough representation of preserved plant parts on the herbarium sheet. Damages found include the crumbled lamina, decays caused by insects, etc. The second most problems were incorrect nomenclature in 51 sheets. Incorrect names were due to missed identification and outdated classification. The other problem is incomplete herbarium in *Pyrrosia* specimens, mainly lack of fertile lamina of the fern.

Table 3. Problems regarding the physical condition of the herbarium and repairment efforts

Specimen problems/damages	Affected sheets	Repairment efforts
Sample detached from duplex	5	Re-arranged and re-mounted with <i>isolation tape</i>
No fertile lamina	44	Stored in the herbarium, added re-collection of the same species
Damages to the fertile lamina	5	plants with complete identification characters
Incorrect nomenclature	51	Added a revision label above the herbarium label with the correct name
Incomplete label notes	5	Added notes from field observations
Insects found on the specimen	2	Disinfected at 40 °C oven for 1–2 days, cleaned the storage rack

Apart from carrying out physical improvements, additions to the collection were made by collecting fresh specimens from the field. Fresh sampling from the field was carried out to add to the collection and complete the lack of character data. New *Pyrrosia* samples were also collected to make a voucher herbarium and complete the data of existing specimens without the fertile lamina (Table 4).

Table 4. Samples collected in the field

Species	Collector	Coll.no	Date	Location
<i>Pyrrosia piloselloides</i>	Ghifari Rahmandika	G 21 1(A)	03-Nov-21	Wales Barat
<i>Pyrrosia piloselloides</i>	Ghifari Rahmandika	G 21 1(B)	03-Nov-21	Wales Barat
<i>Pyrrosia piloselloides</i>	Ghifari Rahmandika	G 21 2	08-Nov-21	Selatan Danau Puspa
<i>Pyrrosia piloselloides</i>	Ghifari Rahmandika	G 21 3	08-Nov-21	UI Wood Wales Timur
<i>Pyrrosia piloselloides</i>	Ghifari Rahmandika	G 21 4	22-Nov-21	Hutan UI Utara FIB
<i>Pyrrosia piloselloides</i>	Ghifari Rahmandika	G 21 5	17-Nov-21	Pinggir Danau Agathis UI
<i>Pyrrosia lanceolata</i>	Ghifari Rahmandika	G 21 6	22-Nov-21	Pintu Kukusan Teknik UI
<i>Pyrrosia lanceolata</i>	Ghifari Rahmandika	G 21 7	30-Nov-21	Pusat Studi Jepang, FIB
<i>Pyrrosia longifolia</i>	Ghifari Rahmandika	G 21 8	07-Dec-21	Boulevard FKM-FIK
<i>Pyrrosia longifolia</i>	Ghifari Rahmandika	G 21 9	07-Dec-21	Boulevard FKM-FIK

Incorrect nomenclature is the biggest problem in *Pyrrosia* specimen collections. Identification errors or nomenclature updates on the labels were corrected by adding revision labels. The label contains the correct nomenclature/taxa description and is mounted to the top of the existing herbarium label (Figure 4).

Figure 4. Added revision label above specimen label

Digitization of the Specimen

The valid herbaria resulting from the revitalization process (both specimen and label) are documented to an online database. All specimen sheets were digitally documented and resulted in

representative herbarium photos and a massive database containing complete information on all *Pyrrosia* collections (Figure 3).

	C	D	E	F	G	H	I	J	
	Famili	Genus	Spesies	Kolektor	No. Koleksi	Tanggal	Lokasi	Habitat	Catatan
1	Polypodiaceae	<i>Pyrrosia</i>	<i>Pyrrosia lanceolata</i>	Nita Purida	7B04	17-Feb-17	Universitas Indonesia	Herba	Bentuk fertil dari Pyrros
2	Polypodiaceae	<i>Pyrrosia</i>	<i>Pyrrosia lanceolata</i>	Nita Purida	7B04	17-Feb-17	Universitas Indonesia	Herba	Bentuk fertil dari Pyrros
3	Polypodiaceae	<i>Pyrrosia</i>	<i>Pyrrosia longifolia</i>	M. Muhaimin	M 117	05-Oct-13	Hutan Kota UI Zona Wales Barat	Epifit, tempat terbuka	
4	Polypodiaceae	<i>Pyrrosia</i>	<i>Pyrrosia piloselloides</i>	M. Muhaimin	M 125	11-Jan-14	UI	Epifit, tempat terbuka	
5	Polypodiaceae	<i>Pyrrosia</i>	<i>Pyrrosia piloselloides</i>	Tim KKL Bio '85	49	12-May-89	Panyariban, Rawa Danau	Akuatik, tepi rawa	Paku-pakuan, epifit. Su
6	Polypodiaceae	<i>Pyrrosia</i>	<i>Pyrrosia piloselloides</i>	Yuniarni	21	21-Sep-88	Campus UI Depok	Terrestrial	1a-17b-18b-19b-22b-23
7	Polypodiaceae	<i>Pyrrosia</i>	<i>Pyrrosia piloselloides</i>	M. Alief	2	21-Feb-02	Stadion UI	Epifit, batang pohon Ac	panjang 5-22cm; Akar r
8	Polypodiaceae	<i>Pyrrosia</i>	<i>Pyrrosia piloselloides</i>	Michael Tobing	22	14-Feb-02	Hutan kota UI	Arboreal, Epifit	Akar rimpang yang pan
9	Polypodiaceae	<i>Pyrrosia</i>	<i>Pyrrosia piloselloides</i>	Hanifan Asnil	22	14-Feb-02	Hutan kota UI	Arboreal, Epifit	Akar Rimpang yang pan
10	Polypodiaceae	<i>Pyrrosia</i>	<i>Pyrrosia piloselloides</i>	Ruly Marthina K.	7	21-Feb-02	Stadion UI	Epifit, batang pohon Ac	Akar rimpang panjang,
11	Polypodiaceae	<i>Pyrrosia</i>	<i>Pyrrosia piloselloides</i>	Ika Mustika	5	21-Feb-02	Stadion UI	Epifit, batang pohon Ac	panjang 5-22cm, akar ri
12	Polypodiaceae	<i>Pyrrosia</i>	<i>Pyrrosia piloselloides</i>	Vilya A.	1	21-Feb-02	Stadion UI	Epifit, batang pohon Ac	panjang 5-22cm, meran
13	Polypodiaceae	<i>Pyrrosia</i>	<i>Pyrrosia piloselloides</i>	Linda R.	36	14-Feb-02	Depok	Epifit, dibatang pohon	panjang 5-20cm, akar ri
14	Polypodiaceae	<i>Pyrrosia</i>	<i>Pyrrosia piloselloides</i>	Devi R.	46	14-Feb-02	Depok	Epifit dibatang pohon	panjang 5-22cm, akar ri
15	Polypodiaceae	<i>Pyrrosia</i>	<i>Pyrrosia piloselloides</i>	Fifi Octavia	52	14-Feb-02	Depok	Epifit dibatang pohon	akar rimpang panjang d
16	Polypodiaceae	<i>Pyrrosia</i>	<i>Pyrrosia piloselloides</i>	Shelvy D.C.	64	14-Feb-02	Depok	Epifit, dibatang pohon	panjang 5-22cm, akar ri
17	Polypodiaceae	<i>Pyrrosia</i>	<i>Pyrrosia piloselloides</i>	Fita K.	10	14-Feb-02	FMIPA UI depok	epifit, di batang pohon	panjang 5-22cm, akar ri
18	Polypodiaceae	<i>Pyrrosia</i>	<i>Pyrrosia piloselloides</i>	Erna Fristian	8	07-Sep-07	Hutan Fakultas Ekonomi UI	Terrestrial, Epifit	spora berbentuk daun

Figure 3. Screenshot of the digitizing herbarium specimen information to an Excel spreadsheet

The specimens themselves were photographed with a DSLR camera that was mounted on a Copy Stand. To make the photos look as close as possible to the original specimen, a lamp is used to provide proper lighting, and a white photo box to spread the light evenly throughout the specimen. In the documentation process, herbarium sheets were placed in the photo box on the stage board of the Copy Stand to be photographed one by one into a .jpeg file format. Data on the label is also typed in the Herbarium UIDEP database spreadsheet.

DISCUSSION

Nomenclature Validation

Validation of all specimens as *Pyrrosia* was indicated by long-creeping rhizomes, simple leaves, and entire leaf margins. The diagnostic character of the genus *Pyrrosia* found was the presence of *stellate hairs* on the surface of the lamina. The stellate hairs have acicular rays and were found to be denser on the abaxial part of the leaf than on the adaxial. The presence of stellate hairs distinguishes *Pyrrosia* from other genera of ferns which also have thick leaves and entire leaf margins such as *Lemmaphyllum* (Donk, 1954).

To validate the species name within *Pyrrosia* diagnostic characters used including macromorphological and micromorphological characters. The macromorphological characters observed were rhizome shape and size, distance between phylloids, and leaf shape (including apex, base, and stalk). In general, the two species can be distinguished by apex and/or basal of the sterile lamina. In *P. lanceolata* the apex and/or basal part is more tapered and the widest part of the lamina is at the bottom or top of the middle of the leaf (lanceolate). In contrast, *P. piloselloides* has an overall elliptical leaf shape. *P. longifolia* has a leaf shape that is quite different from the other two species because of its strap-shaped leaf. The length of the leaves of *P. longifolia* can reach 20 cm or more (in specimens, the longest found is 54 cm).

All of the rhizome scales observed in the *Pyrrosia* specimens had the same attachment, which is peltate (attached to the center of the scales). Peltate forms and attachments in *Pyrrosia* were also described in Flora Malesiana ser. II Vol. 3 (Hovenkamp et al., 1998). The size of the scales observed in *P. longifolia* specimen was $\pm 1-3.2 \times 0.6-1.5$ mm. This is consistent with the descriptions in the monographs of *Pyrrosia* (Hovenkamp & Wessendorp, 1986; Hovenkamp et al., 1998) so that it can be used as a diagnostic character to distinguish species.

Physical Examination and Specimen Handling

Problems identified in *Pyrrosia* herbarium collection are samples detached from duplex, lack of fertile lamina, damages to the fertile lamina, incorrect nomenclature, incomplete label notes, and insects found on the specimen. Every problem is resolved with appropriate treatment.

Damages on the lamina were resolved by removing the damaged part but still paying attention to its representative plant parts, so it stays complete and not reducing any information on herbarium specimens. Poor mounting causes sample specimen to detach is solved by rearrangement of the specimen on the duplex paper. Existing herbarium specimens that have damage on the plant parts can be repaired with the same equipment as the general mounting process in making the herbarium. Specimens were arranged above the duplex paper and remounted if the old glue/tape had loosened and/or the specimen position was disorganized.

Incomplete label notes found in specimens were mostly due to a lack of detailed informations about the samples. In that case, additional notes regarding the morphological features of the plant were added. The data was taken from observations throughout the nomenclature validation process so that the future user will be informed about the specimen's characteristics, especially if its nomenclature were updated.

A good herbarium relies on the complete and accurate information stated on its label. The label should have information on the specimen's scientific name, vernacular name, date, and location of collection, collector's name, and habitat/ecological data. It should also include supplementary data such as notes on colors, plant habits, and other features that may be important for identification but cannot be shown well as a preserved specimen. Identification errors or nomenclature updates on the labels were corrected by adding revision labels. The label contains the correct nomenclature/taxa description and is mounted to the top of the existing herbarium label (Figure 4). Based on the latest Pteridophyta classification PPG 2016, it is stated that the *Drymoglossum* and *Saxioglossum* groups are included in the genus *Pyrrosia* (PPG 2016: 590).

To maintain the specimens' physical condition after revitalization, a standard procedure of all herbarium works was established. This includes standard storing temperature and humidity, regular examination for pests or other potential problems, and new specimen guidelines for future collections. The references used during taxonomic validation were also used to determine what plant parts need to be present on a *Pyrrosia* herbarium specimen. Collecting ferns for a herbarium is not just about taking the plant and preserving it, but planning so the information within can be observed and studied even after a long time. When collecting and preserving the plant for herbarium making, it is important to include some of the key characters to identify the plant. So that the plant's morphological characteristics could be representatively displayed on a herbarium sheet.

Based on those physical examination results, we advise some specific techniques in handling *Pyrrosia* specimens. First, make sure to take complete note of the fern habit before collecting. *Pyrrosia* species characteristics vary in many things, some are no longer visible after preservation, it is best to write them down first. Lastly, make sure to collect all parts of *Pyrrosia* that are crucial for identification such as rhizome and fertile lamina.

Digitization of the Specimen

The valid herbaria resulting from the revitalization process (both specimen and label) is documented in an online database (Vissers et al., 2017). The data regarding specimen identity, location, and taxonomy information were then uploaded to the Herbarium UIDEP website. It can be accessed at www.ruangkoleksibiotai.id. (Additional pictures were provided to give more information about the said specimen to the viewers. After the herbarium data is entered on the input page, the specimen information cannot be directly visible publicly on the website.

However, the uploaded data is entered in the admin menu for approval (Figure 5). The approval process by the admin is needed to protect the database from arbitrary specimen uploads. After the herbarium data entry is approved, the input results will appear publicly and can be accessed by entering the appropriate keywords on the search page (Figure 6). Herbarium data can be searched by family name, genus, species, and local name.

No	Specimen ID	Nama MHS	NPM	Coll. No.	Collector	Collection Date	Location	Family	Genus
1	0	Ghifari Rahmandika	1606826905	M 125	M. Muhaimin	11 January 14	UI-Depok	Polypodiaceae	Pyrrosia

Figure 5. The input results are shown on the website admin menu (Source: ruangkoleksibiotai.id)

Welcome to the Ruang Koleksi Biota Departemen Biologi FMIPA UI Botany Catalogue

Simple searches can be initiated from this page. Please refer to the help pages for advice as to how to formulate database queries. Please contact us if you have ideas as to how we can improve this site.

Search

Search by:

Family
Genus
Species
Local Name
Quick Search Name

Figure 6. Database search page on the Herbarium UIDEP website page (Source: ruangkoleksibiotai.id)

CONCLUSION

The management has been carried out on the herbarium specimens which has resulted in 3 validated species of *Pyrrosia* in the Herbarium Depokensis (UIDEP) collection, namely *Pyrrosia piloselloides*, *Pyrrosia lanceolata*, and *Pyrrosia longifolia*. The three species can be distinguished by the morphology of the rhizome, lamina, and soral position. Nomenclature validation and specimen revitalization resulted in a collection of valid *Pyrrosia* specimens. Digitization of valid *Pyrrosia* specimen collection produced an online database that can be accessed and used by the public.

From the results of this study, it can be suggested to periodically check the results of identification or naming of specimen collections, check the physical condition of specimens, conduct collections, and build a better database system.

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