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Discovery of *Lepisorus hachijoensis* (Polypodiaceae) misidentified as *Lepisorus onoei* on Gageodo Island, Korea

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ABSTRACT: While preparing for a floristic study of Gageodo Island, we discovered the following unrecorded species: *Lepisorus hachijoensis* (Polypodiaceae). It is known to be distributed only on Hachijo Island of Japan, which was the collection site of the type specimen. However, on the basis of the findings of the Fifth National Natural Environment Survey, it has recently been established that this plant also grows on the bark of trees and on shaded rocks along ridges on Gageodo Island, Sinan-gun, Jeollanam-do, in Korea. In this study, we present a description and photographs and indicate differences between Korean *L. hachijoensis* and related species as well as a key to the related taxa.

KEYWORDS: island, *Lepisorus*, *L. hachijoensis*, Polypodiaceae, unrecorded taxa

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INTRODUCTION

The genus *Lepisorus* (J. Sm.) Ching, the smallest and most widespread genus of Polypodiaceae, consists of ca. 40–80 species, with four species on the Korean Peninsula (Zhang et al., 2013; Sun, 2015). Geographically, they are mainly distributed in temperate and subtropical regions of the East Asia, and a small number of taxa are known to be distributed in Africa and Hawaii (Zhang et al., 2013).

The leaves of the genus *Lepisorus* is single that do not split along the right axis, the leaf margin is smooth, the scales of the rhizoids are ovate, round, or lanceolate with a clathrate, and the sporangium is circular and located in a row on both sides of the main vein. The genus *Lepisorus* is distinguished from similar genera (e.g., *Lemmaphyllum* C. Presl, *Neocheiropteris* H. Christ, *Microsorum* Link) by the presence of peltate scales early during group development (Zhang et al., 2013; Sun, 2015).

The first record of *Lepisorus* on the Korean Peninsula was in 1908 when Christ reported *Polypodium lineare* var. *coraiense* H. Christ (= *L. ussuriensis*) as a new variety based on specimen no. 83 collected from Jejudo Island by Urban Faurie (Christ, 1908). The Japanese botanist Takenoshin Nakai (1911) recorded the four species of *Polypodium lineare* Thunb. (= *L. thunbergianus* (Kaulf.) Ching), *Polypodium annuifrons* Makino (= *L. annuifrons* (Makino) Ching), *Polypodium onoei* Franch. & Sav. (= *L. onoei* (Franch. & Sav.) Ching), and *Polypodium annuifrons* var. *distans* (Makino) Nakai (= *L. ussuriensis* var. *distans* (Makino) Tagawa) in his book Flora Koreana.

Among Korea's major botanical encyclopedia and flora (Flora of Korea), the four species *L. annuifrons*, *L. onoei*, *L. thunbergianus*, and *L. ussuriensis* (Regel & Maack) Ching are recorded in the genus *Lepisorus* (Park, 1961, 1975; Lee, 1980; Lee, 1996; Lee, 2007; Sun, 2015). Also, in the Korean Fern Encyclopedia published by the Korean Fern Society (2005), five species have been reported with the addition of *L. uchiyamae* (Makino) H. Ito. However, in Lee and Lee (2015), Sun (2015), National Institute of Biological Resources (2019), and Korea National Arboretum (2020), *L. uchiyamae* is not recorded as being distributed in Korea, implying that there is a high possibility that it has been misidentified as a similar species (*L. onoei* or *L. thunbergianus*). Accordingly, it would be reasonable to remove *L. uchiyamae* from the Korean plant list.

In this study, we report *L. hachijoensis* as an unrecorded species of Korean flora identified on Gageodo Island during the Fifth National Ecosystem Survey.

TAXONOMIC TREATMENT

Lepisorus hachijoensis Sa. Kurata, Sci. Rep. Yokosuka City Mus. 11: 40, 1965 (Figs. 1, 2).

Type—: Japan, Hachijo Island, Mt. Mihara, *Y. Tanaka s.n.* (TOFO, observed only photos!).

Korean name: 섬일엽초(Seom-il-yeop-cho).

Plants evergreen. Rhizomes creeping, cylindrical, ca. 1.0–1.2 mm in diam., densely scaly; scales dark brown, lanceolate, 3–4 mm long, apex caudate or acute, margins irregularly toothed, clathrate, opaque in center, transparent at margin. Fronds 5.0–10.0 × 0.5–1.1 cm, widest near apex, coriaceous; petiole green, 1.0–2.0 cm, scaly at base; blade linear, linear-spatulate or spatulate, 4.0–8.0 × 0.5–1.1 cm, apex rounded, obtuse or acute, base cuneate or attenuate, margins reflexed, glabrous, scaly on abaxial midvein. Veins: midvein distinct; lateral veins indistinct. Sori usually on apical part of blade, in 1 row on each side of midvein, 3–8 pairs, round, 2.0–2.5 mm in diam., scaly; scales dark brown, peltate, round to polygonal, margins irregularly undulate or dentate, clathrate, opaque or transparent.

Habitat: On bark of *Quercus acuta* Thunb., *Eurya japonica* Thunb., *Castanopsis sieboldii* (Makino) Hatus., *Styrax japonicus* Siebold & Zucc., *Acer pictum* var. *mono* (Maxim.) Franch., and *Buxus microphylla* var. *koreana* Nakai ex Rehder in evergreen forests or on shady rocks.

Distribution: Japan (Honshu, Southern central Japan), Korea (Jeollanam-do).

Specimens examined: KOREA. Jeollanam-do: Sinan-gun, Gageodo Island, 12 Apr 2023, *J.H. Kim et al. 23001* (3 sheets, JNU), 6 Jun 2023, *S.S. Choi et al. 23010* (5 sheets, JNU), 2 Oct 2023, *S.S. Choi et al. 23020* (3 sheets, JNU).

Lepisorus hachijoensis was described as a new species by Kurata (1965) based on type specimens collected from Mt. Mihara on Hachijo Island in Japan by Y. Tanaka in 1961. *Lepisorus hachijoensis* is similar to *L. onoei* but its rhizome is thicker than that of *L. onoei* (1.5–2.0 mm vs. 1.0–1.5 mm) and the blades are wider (10.0–15.0 mm vs. 2.0–5.0 mm) (Kurata, 1965). In earlier studies of the flora of Gageodo Island, *L. hachijoensis* was often misidentified as *L. onoei* or *L. thunbergianus* (Kim et al., 2012; Yun et al., 2012; Yang et al., 2013). *Lepisorus onoei* can be distinguished from *L. hachijoensis* by the following characteristics: the blade width is narrow (less than 10 mm), and the petiole (stipe) is continuous with the leaf and is short or difficult to distinguish (Table 1).

Table 1. Comparison of several major characteristics of *Lepisorus* in Korea

Characteristics	*L. annuifrons*[a]	*L. ussuriensis*	*L. thunbergianus*	*L. onoei*	*L. hachijoensis*
Rhizome thickness (mm)	1.5–2.0	1.5–2.0	2.0–3.0	0.8–1.0	1.0–1.2
Rhizome scale					
Shape	Ovate	Triangular ovate	Lanceolate	Lanceolate	Lanceolate
Length (mm)	1.0–2.0	1.0–1.5	3.0–5.0	3.0–5.0	3.0–5.0
Blade scale	Ovate	Triangular ovate	Lanceolate	Lanceolate	Lanceolate
Paraphysis	Round to polygonal, peltate	Round to polygonal, peltate	Round to polygonal, peltate	Round to polygonal, peltate	Round to polygonal, peltate
Apex of blade	Acute or acuminate	Acute or acuminate	Acute or acuminate	Acute, obtuse or rounded	Rounded, obtuse or acute
Blade length (cm)	10.0–20.0	5.0–20.0	8.0–20.0	2.5–8.8	4.0–10.0
Blade width (mm)	10.0–30.0	5.0–15.0	4.0–10.0	3.0–10.0	5.0–11.0
Petiole (stipe) length (mm)	4.0–5.0	10.0–17.0	10.0–33.0	5.0–10.0	10.0–20.0

[a]Based on Sun (2015) and our own measurements.

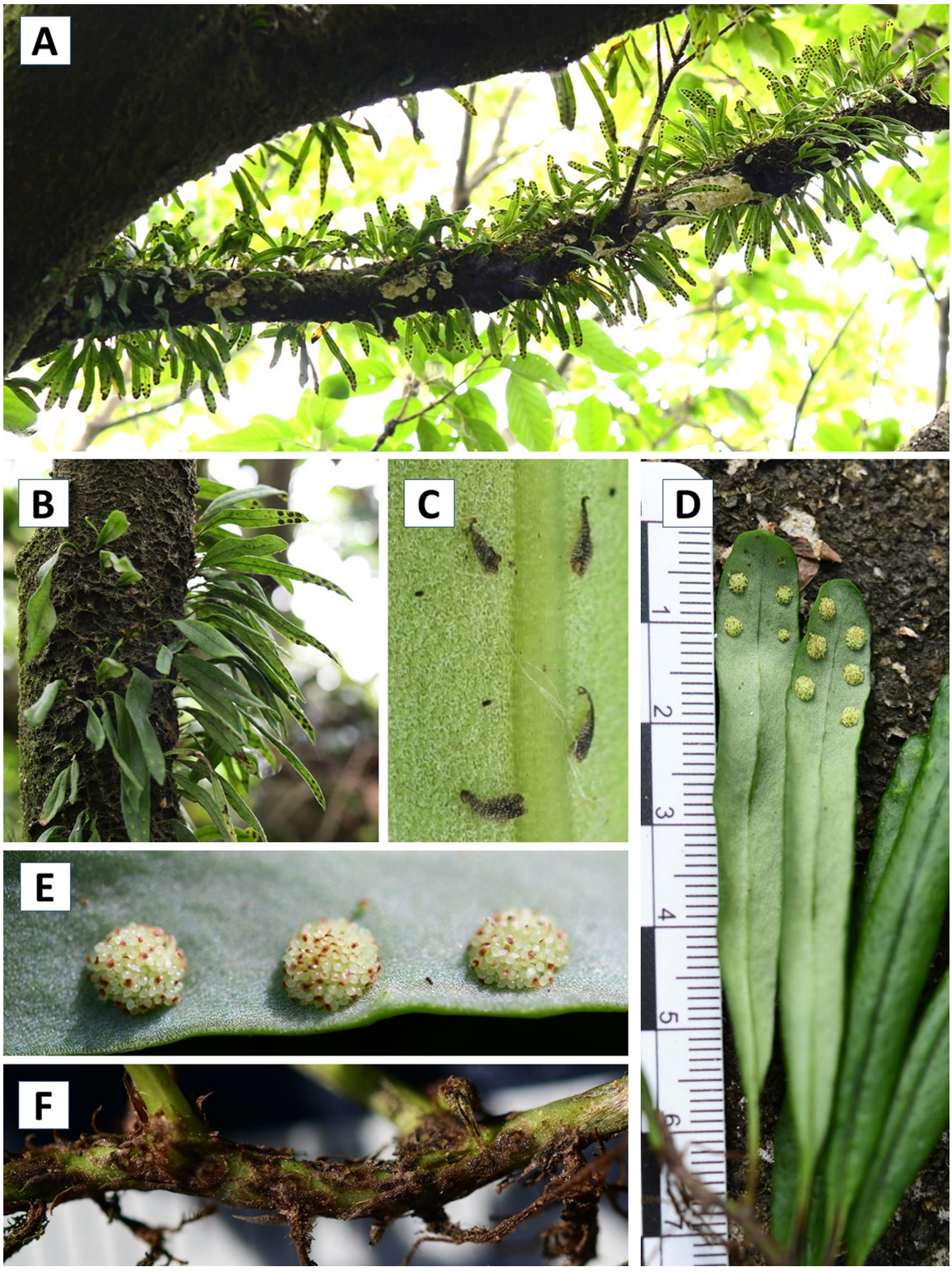

Fig. 1. *Lepisorus hachijoensis* on Gageodo Island of Korea. **A, B.** Habitat. **C.** Scales on blade. **D.** Plant. **E.** Sori on blade. **F.** Scales on rhizoids (photo by S. S. Choi and M. O. Moon).

As indicated by the scientific name of *L. hachijoensis*, the holotype native habitat of this species is Hachijo Island, Japan. It is a volcanic island located 287 km south of Tokyo. The island has a humid subtropical climate with an average temperature of 21°C (70°F), with approximately 3,000 mm of precipitation per year. It is noteworthy that Hachijo Island is the type locality of *Diplazium hachijoense* Nakai distributed also on Jejudo Island, and some taxa known only in Japan

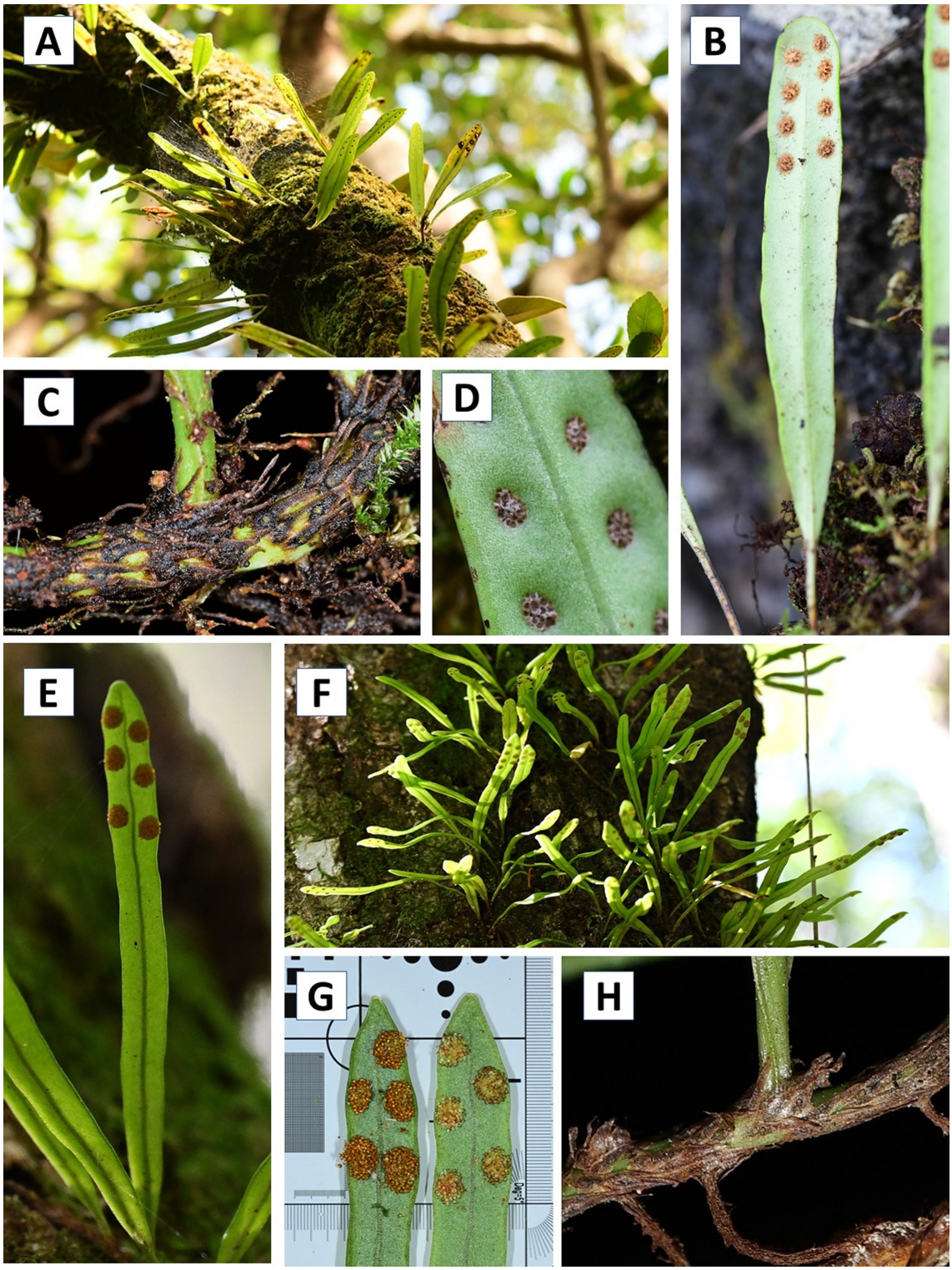

Fig. 2. *Lepisorus hachijoensis* on Hachijo Island of Japan. **A, B.** Habitat. **C.** Scales on rhizoids. **D.** Sori on blade. *Lepisorus onoei* on Jejudo Island of Korea. **E, F**. Habitat. **G.** Sori on blade. **H**. Scales on rhizoids (photo by S. S. Choi and M. O. Moon).

were later discovered in Korea and China. Although Gageodo Island in Shinan-gun and Hachijo Island are 1,370 km apart, there are plant species shared by both islands, such as *Podocarpus macrophyllus* (Thunb.) Sweet, *Daphniphyllum teijsmannii* Kurz ex Teijsm. & Binn., *Pittosporum tobira* (Thunb.) W. T. Aiton, *Rhaphiolepis indica* var. *umbellata* (Thunb.) Ohashi, *Neolitsea sericea* (Blume) Koidz., and *Diplopterygium glaucum* (Thunb. ex Houtt.) Nakai, suggesting

a floristic connection between two remotely isolated islands.

This can be seen by examining the distribution of *Diplazium hachijoense* Nakai, a fern, as well as several other common species, which can appear on Gageodo Island given its similar climate distribution.

Lepisorus hachijoensis grows in large and small groups on trees and rocks near Mt. Doksilsan on Gageodo Island. This plant grows on both sides of mountain ridges. It grows on the branches of evergreen trees such as *Castanopsis sieboldii* (Makino) Hatus., *Machilus thunbergii* Siebold & Zucc., *Quercus acuta* Thunb., *Eurya emarginata* (Thunb.) Makino and *Litsea japonica* (Thunb.) Juss. The summit and ridges of Mt. Doksilsan are humid due to frequent fog, and *Arachniodes aristata* (G. Forst.) Tindale, *Athyrium sheareri* (Baker) Ching, *Lemmaphyllum microphyllum* C. Presl, *Dryopteris uniformis* (Makino) Makino, and *Polystichum polyblepharum* (Roem. ex Kunze) C. Presl grow there. On Hachijo Island, the native habitat of *L. hachijoensis*, *Lemmaphyllum microphyllum* C. Presl, *Pyrrosia lingua* (Thunb.) Farw., *Diplopterygium glaucum* (Thunb. ex Houtt.) Nakai, and *Dendrobium moniliforme* (L.) Sw. grow together around an altitude of about 500 m or more.

The new Korean name given is 'Seom-il-yep-cho' based on the growth habitat on Gageodo Island.

The following key to the related Korean *Lepisorus* taxa has been prepared for all species on the Korean Peninsula.

Key to the species of *Lepisorus* in Korea

1. Scales of rhizomes lanceolate, 3–5 mm long; fronds coriaceous.
   2. Rhizomes 2–3 mm in diam.; fronds apex acuminate, parallel ····· *L. thunbergianus* 일엽초
   2. Rhizomes ca. 1.5 mm in diam.; fronds apex rounded or obtuse, widest near apex
      3. Stipe (petiole) obscure or short, 5.0–10.0 mm long; blades 3.0–10.0 mm wide; ··· *L. onoei* 애기일엽초
      3. Stipe (petiole) clear or rather long, 10.0–20.0 mm long; blades 5.0–11.0 mm wide; ····· ····· *L. hachijoensis* 섬일엽초
1. Scales of rhizomes ovate, 1–2 mm long; fronds papery to thinly coriaceous.
   4. Fronds persistent, linear-lanceolate or widely linear, 1 cm wide, closely spaced ··· *L. ussuriensis* 산일엽초
   4. Fronds deciduous, ovate-deltoid, 1–3 cm wide, distantly spaced ····· *L. annuifrons* 다시마일엽초

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CONFLICTS OF INTEREST

The authors declare that there are no conflicts of interest.

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