



First record of *Hypodematium squamuloso-pilosum* Ching (Hypodematiaceae) from Korea

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한반도 미기록 식물: 흰금털고사리(금털고사리과)

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ABSTRACT: A new unrecorded species, *Hypodematium squamuloso-pilosum* Ching (Hypodematiaceae), previously known only in China, was newly found on the rocks of a limestone mountain in Yeongwol-gun, Gangwon-do, Korea. This taxon is distinguished from *H. glanduloso-pilosum* (Tagawa) Ohwi, reported as a species of *Hypodematium* in Korea based on linear lanceolate scales on the rhizome and a stipe base, white long hairs throughout the leaves, rarely reddish brown curly linear scales on the stipe, and oblong-lanceolate basal pinna. This taxon was most similar to *H. hirsutum* based on the plant height, rhizome, scale shape and size, sori position, and indusium shape. A new Korean name, ‘Huin-geum-teol-go-sa-ri’, was given based on the long white hair throughout. Descriptions and illustrations of this taxon and a photograph of its habitat are provided from Korea.

Keywords: Unrecorded species, *Hypodematium squamuloso-pilosum*, Hypodematiaceae

The genus *Hypodematium* Kunze was firstly recognized as four species, including one subspecies, by Iwatsuki (1964). It currently consists of 18 species distributed in rock crevices of limestone areas among mostly subtropical and warm-temperate regions of Asia and Africa, and 12–14 species are distributed in China (Shing et al., 1999; Zhang and Iwatsuki, 2013; Wang et al., 2014). This genus is well characterized by growth on limestone rocks, having short rhizome and swollen base of stipe densely covered with scales, stipes and laminae usually with acicular long hairs, mixed glandular hairs or glabrous, largest basal pinnae, and chromosome number $x = 41$ (Shing et al., 1999; Zhang and Iwatsuki, 2013; Wang et al., 2014). Opinions about the status of the genus *Hypodematium* were used differently by Dryopteridaceae (Loyal, 1960; Tryon and Tryon, 1982; Kramer et al., 1990;

Smith et al., 2006; Liu et al., 2007), Thelypteridaceae (Ching, 1963), and Athyriaceae (Pichi Sermolli, 1977). Hypodematiaceae firstly devised by Ching (1975) includes the genus *Hypodematium* as the majority genus (Wang et al., 2014), and this family is defined by one unique genus, *Hypodematium*, or three genera (*Hypodematium*, *Didymochlaena*, *Leucostegia*). It has been suggested that Hypodematiaceae is a monophyletic family based on molecular study (Christenhusz et al., 2011).

The genus *Hypodematium* in Korea was known to be distributed just one species, *H. glanduloso-pilosum* (Tagawa) Ohwi, with a simple species description (Park, 1975; Lee, 1980; Lee, 2006; Korea National Arboretum, 2008; Kim and Sun, 2015; Lee and Lee, 2015).

We identified an additional species, *Hypodematium squamuloso-pilosum* Ching, with about 100 individuals per

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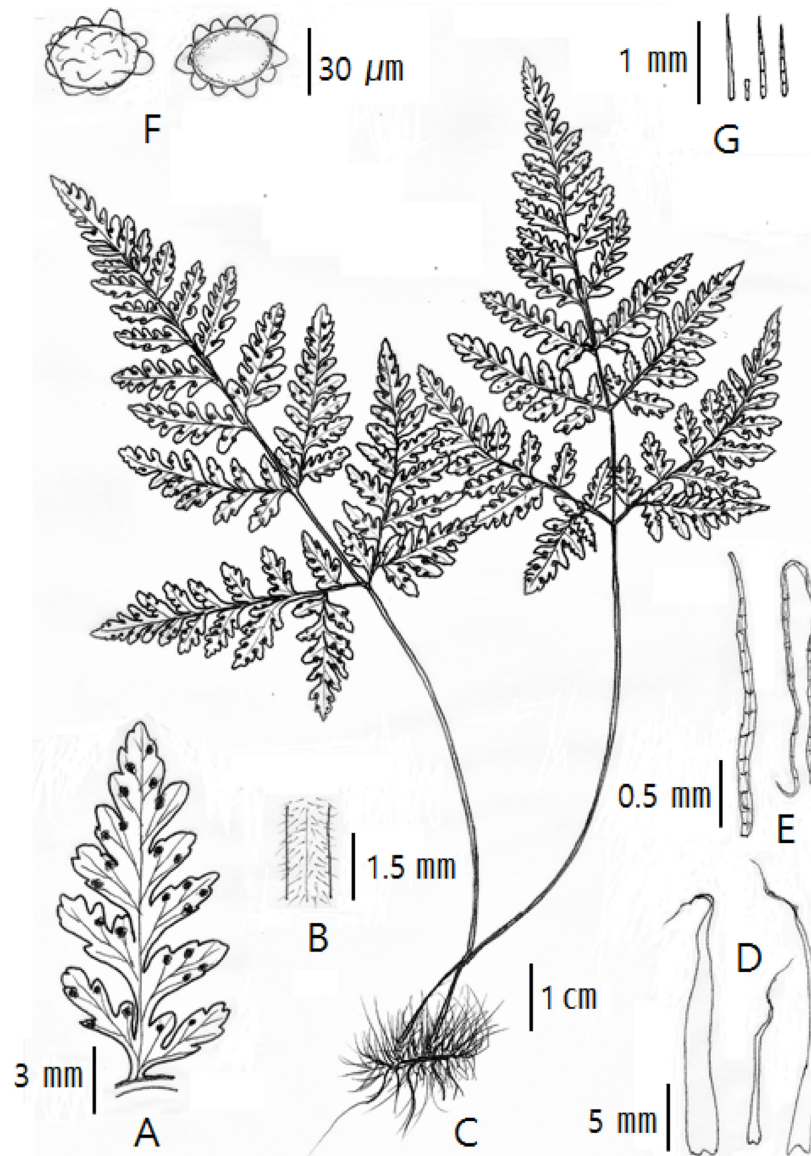


Fig. 1. Illustrations of *Hypodematium squamuloso-pilosum* Ching, taken in a limestone forest at Yeongwol-gun, Gangwon-do, Korea, 24 Sep 2016. **A.** Sori and indusium in pinnules. **B.** Hairs in stipe. **C.** Habit. **D.** Scales in rhizome and stipe base. **E.** Sparse scales in stipe and rachis. **F.** Spore. **G.** White and long hairs.

10 m². It is reported as a newly recorded taxon from Korea and was collected from rocks of a limestone mountain in Yeongwol-gun, Gangwon-do. The local name was designated as ‘Huin-geum-teol-go-sa-ri’ based on its habitat. We compared and analyzed morphological characters between *H. squamuloso-pilosum* and similar interspecific taxa of *Hypodematium* to elucidate their taxonomic relationship. Morphological characters and illustrations of *H. squamuloso-pilosum*, along with photographs of the habitat, are newly reported to the species of *Hypodematium* from Korea.

Taxonomic Treatment

Hypodematium squamuloso-pilosum Ching

Korean name: Huin-geum-teol-go-sa-ri (흰금털고사리) (Figs. 1, 2).

Herbs, mostly rupestral, 12–30 tall. Rhizomes shortly creeping, 1–2 mm in diameter, densely scaly; scales linear to narrowly lanceolate, 10–17 × 1.0 × 1.7 mm, reddish brown, lustrous, membranous. Stipes 5–23 cm long, stramineous, densely scaly on swollen base, densely grayish white hairy,



Fig. 2. Photographs of *Hypodematium squamuloso-pilosum* Ching, taken in a limestone forest at Yeongwol-gun, Gangwon-do, Korea, 24 Sep 2016. **A.** Habit. **B.** Indusia and sori in pinnule, and densely white long hairs in rachis and pinnule. **C.** Stipe base and rhizome covered with densely scales. **D.** Linear lanceolate scales in stipe base and rhizome.

Table 1. Comparative morphological characters between *Hypodematium squamuloso-pilosum* Ching, and related species distributed in China and Japan of *Hypodematium* (Iwatsuki, 1992; Wang et al., 2010; Zhang and Iwatsuki, 2013).

Characters	<i>H. squamuloso-pilosum</i>	<i>H. hirsutum</i>	<i>H. fordii</i>	<i>H. glanduloso-pilosum</i>
Plant height (cm)	12–30(–45)	(23–)35–60(–80)	35–50	12–56
Scales shape in rhizome and stipe base	Linear to narrowly lanceolate	Linear-lanceolate	Narrowly lanceolate	Lanceolate
Scales size (mm)	10–17/1.0–1.7	10–15/1–1.3	10–15/1.5	10–15/1–3
Stipe length (cm)	5–23	(7–)15–25(–40)	15–20	4–27
Hairs and scales presence in stipe	Long hairs throughout, sometimes mixed with glandular hairs and reddish brown curly, linear scales	Glabrous upward	Upward with sparse golden, rod-shaped, short glandular hairs	Densely white short hairs & golden, rod-shaped glands
Ratio of stipe and lamina	1–6/5	3/4–5/7	1	4/7–27/29
Hairs and scales presence in lamina	Long hairs all over, sparsely reddish brown curly, linear scales	Both surfaces with sparsely short grayish white hairs, sometimes abaxially with linear lanceolate scales on costae and costules	Both surfaces sparsely golden glandular hairs, densely on rachis, costae, costules with glands	Both surfaces sparsely hairy, densely hairs and rod-shaped glands along rachis, costae, costules; sometimes mixed with reddish brown linear lanceolate scales
Basal pinna shape	Oblong-lanceolate	Slightly oblique	Triangular-ovate	Ovate-oblong
Basal pinnule shape	Oblong to ovate-oblong	Oblique	Oblong	Oblong
Hairs in indusia	Densely hairs	Densely hairs	Sparsely glandular hairs especially along margins	Densely hairs, usually with a few glands
Distribution	Limestone crevices, Korea, China	Limestone crevices, China, Bhutan, India, Myanmar, Nepal	Limestone crevices, China, Japan	Korea, C. China, Japan, Thailand

rarely mixed with curly, linear scales at upward. Lamina 3–4 pinnatifid, ovate-oblong, base cordate, apex acuminate, herbaceous, 8–15 × ca. 7–12 cm, densely white long hairy on rachis and costae, sometimes mixed with glandular hairs and curly, linear, reddish brown scales. Pinnae 8–12 pairs, lower pairs 2–4 cm apart, basal pair almost opposite and largest, oblong lanceolate, apex shortly acuminate, 2–3 pinnatifid, base cordate, 5–8 × 2.5–3.5 cm, basal pinnae shortly stalked. Pinnules 7–9 pairs, alternate, anadromous, shortly stalked, upper ones smaller, apex round or obtuse, margins serrate. Veins free, simple, ending at margin. Sori orbicular, 1–4 per segment, located on the middle of veinlets. Indusia reniform, persistent, almost entire or somewhat serrate at margin, densely covered with hairs.

Habitat: In rocks of limestone regions within forests.

Distribution: Yeongwol-gun, Gangwon-do, Korea.

Specimens examined: KOREA. Gangwon-do: Yeongwol-gun, Hanbando-myeon, elev. 240 m, 24 Sep 2016, C.S. Lee & K. Lee 16092401 (EWH [4 sheets], KH [3 sheets], KB [3 sheets]; 28 Oct 2013, K. Lee & M.K. Lee 13102801 (KH [1 sheet]).

Taxonomic notes: The newly reported taxon in Korea, *Hypodematium squamuloso-pilosum* is known as an endemic in China (Zhang and Iwatsuki, 2013) but was found first in Gangwon-do in Korea.

The new local name ‘Huin-geum-teol-go-sa-ri’ was given based on its having throughout long white hairy. It was firstly found with *Cornus walteri*, *Fraxinus rhynchophylla*, *Celtis koraiensis*, *Lespedeza maximowiczii*, *Ulmus davidiana* var. *japonica*, *Juniperus rigida*, *Aster scaber*, and *Commelina communis* in a forest in Hanbando-myeon, Yeongwol-gun, Gangwon-do.

This taxon is distinguished from *H. glanduloso-pilosum* (Tagawa) Ohwi reported as one species of *Hypodematium* in Korea based on scales in rhizome and stipe base linear to narrowly lanceolate, white long hairs throughout leaves, rarely reddish brown curly linear scales on stipe, and basal pinna oblong-lanceolate.

The chromosome numbers of *H. squamuloso-pilosum* and *H. hirsutum* have the same type as $n = 41$ (41 II) based on cytotoxic study by Wang et al. (2014). This taxon firstly described from Korea was most similar with *H. hirsutum* distributed in China, Bhutan, India, Myanmar, and Nepal based on rhizome, scale shape and size, sori position, and hairs in indusia (Iwatsuki, 1992, 1995; Wang et al., 2010; Zhang and Iwatsuki, 2013) (Table 1). *Hypodematium fordii* distributed in China and Japan was also similar with *H. squamuloso-pilosum*, but the former has different characters from the latter based on almost glabrous upward in stipe, densely glandular hairs in

lamina, triangular ovate basal pinna, and sparsely glandular hairs in indusia (Table 1).

Furthermore, it was distinguished from other taxa of the genus *Hypodematium* the distinct characters such as densely long hairs throughout the leaf and sparsely with glandular hairs and reddish brown curly linear scales, and basal pinna oblong lanceolate (Table 1).

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