



## A new taxon of *Hymenophyllum* (Hymenophyllaceae): *H. wrightii* f. *serratum*

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### 처녀이끼속의 신분류군: 구름처녀이끼(처녀이끼과)

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**ABSTRACT:** A new taxon, *Hymenophyllum wrightii* f. *serratum* C.S. Lee & K. Lee (Hymenophyllaceae), forma nov. was collected and described from forests in Mt. Halla, Jeju-do, Korea. This taxon, *H. wrightii* f. *serratum* C.S. Lee & K. Lee (vernacular name: ‘Gu-reum-cheo-nyeo-i-kki’) was distinguished from *H. wrightii* f. *wrightii* by having smaller leaves, broader basal part of leaf blade, broad-ovate laminae, larger sori and serrate margins of lips of involucre. The new taxon’s name is based on serrate margin shape of the lips. A Korean name, ‘Gu-reum-cheo-nyeo-i-kki’, was newly given based on its habitat. Descriptions and its photograph in the habitat are provided along with a key to the species of *Hymenophyllum* from Korea.

**Keywords:** *Hymenophyllum wrightii* f. *serratum*, Hymenophyllaceae, new taxon, Korea

**적 요:** 처녀이끼과 신분류군 구름처녀이끼(*Hymenophyllum wrightii* f. *serratum* C.S. Lee & K. Lee)가 한국의 제주도 한라산에서 발견되어 기재되었다. 구름처녀이끼는 처녀이끼에 비하여 잎의 크기가 작고, 잎몸의 맨 아랫부분은 넓으며, 잎몸은 넓은 난형이고 포자낭군이 더 크며 포막의 입술 가장자리가 세열된 점이 뚜렷이 구별된다. 새로운 국명은 높은 산에 서식한다는 의미로 구름처녀이끼로 하였고, 주요형질에 대한 증거 및 해부도와 서식지 식물사진 및 한국산 처녀이끼속 식물에 대한 검색표를 제시하였다.

**주요어:** 구름처녀이끼, 처녀이끼과, 신분류군, 한국

The Hymenophyllaceae family, known as filmy ferns, is characterized as rather simple, mostly single cell thick, laminae like mosses, and the monophyly of the family has not been questioned (Ebihara et al., 2006). On the other hand, the intrafamilial classification of this family is highly controversial. Copeland (1938) divide this family into 34 genera, whereas

Morton (1968) split the family into only two genera, *Hymenophyllum* with bivalved involucre and *Trichomanes* with tubular involucre, which consists of nine subgenera, divided into 35 sections. Another system of consisting of 47 genera was proposed by Pichi Sermolli (1977). Iwatsuki (1984) created a new system consisting of eight genera based on morphological studies on Asiatic filmy ferns. Recent molecular systematic studies support two traditional genera showing two distinct monophyletic clades (Pryer et al., 2001; Ebihara et al., 2006, 2007). Finally, Ebihara et al. (2006) proposed a new

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classification of Hymenophyllaceae, consisting of nine genera (*Hymenophyllum*, *Didymoglossum*, *Crepidomanes*, *Polyphlebium*, *Vandenboschia*, *Abrodictyum*, *Trichomanes*, *Cephalomanes*, and *Callistopteris*) based on morphology, chromosome data, and molecular phylogeny. The family Hymenophyllaceae in Korea contains three genera, *Hymenophyllum*, *Crepidomanes*, and *Vandenboschia*, according to the system of Ebihara et al. (2006). Among these taxa of Hymenophyllaceae, *Crepidomanes schmidtianum* was added by Lee et al. (2014) as a newly recorded species.

The genus *Hymenophyllum* Sm. contains about 250 species that are mostly distributed throughout the tropics to temperate regions. This genus is characterized by frequently branching, usually filiform or wiry, up to 2 mm diam., nearly glabrous or sparsely covered with multicellular hairs (exceptionally densely covered with hairs in subg. *Fuciformia*), protostele subcollateral, dorsiventral, stipes various in length, at a distance from adjacent ones, blades usually pinnate to quadripinnate or occasionally simple, venation anadromous, laminae usually one cell thick but sometimes two or more cells thick, sori paratactic, lips usually bivalvate, receptacles usually included in involucre (Ebihara et al., 2006). According to Ebihara et al. (2006), this genus can be divided into 10 subgenera, *Hymenophyllum*, *Sphaerocionium*, *Mecodium*, *Globosa*, *Pleuromanens*, *Myrmecostylum*, *Hymenoglossum*, *Fuciformia*, and *Diplōphyllum* based on morphology, cytology, and molecular phylogeny. The base chromosome number of *Hymenophyllum* s.l. is  $n = 11$  to 36 (Vessey and Barlow, 1963; Dawson et al., 2000; Ebihara et al., 2006).

Wright's filmy fern, *Hymenophyllum wrightii* Bosch is distributed in west Canada (Alaska) and east Asia (Japan, Korea and Siberia), and its habitat is rocks or tree trunks in wet forests (Iwatsuki, 1992; Iwatsuki et al., 1995). This species was classified as part of the genus *Mecodium* by Copeland (1938), or subgenus *Mecodium* according to the system of Ebihara (2006). With more than 100 species, *Mecodium* is the largest infrageneric taxon of *Hymenophyllum* sensu lato. It has long been considered as a natural and homogeneous group, but recent phylogenetic studies have questioned this assertion. Using *rbcL*, *rbcL-accD*, and *rps4-trnS* sequences, we demonstrate that *Mecodium* is highly polyphyletic. Several species of *Mecodium* form the derived clade "*H. polyanthos*" with *H. wrightii*; one species is nested within a second derived clade while remaining species are assigned to five basal clades including taxa regarded as distantly related (Hennequin et al., 2006).

The genus *Hymenophyllum* in Korea has been reported to contain five species, *H. barbatum* (Bosch) Baker, and *H. polyanthos* Sw., *H. coreanum* Nakai, *H. wrightii* Bosch, and *H.*

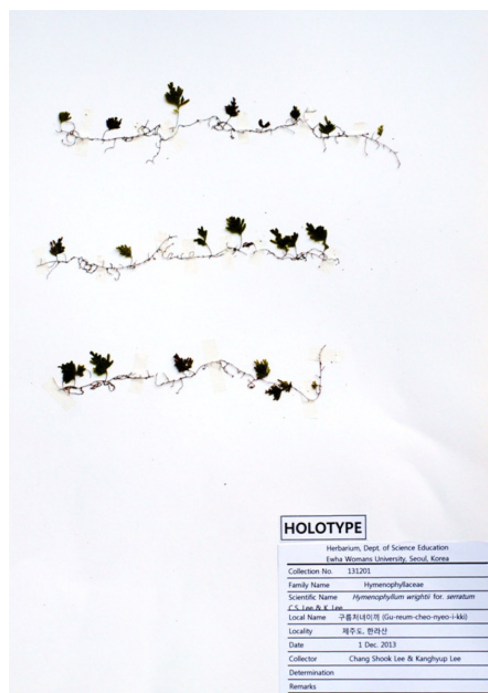
*oligosorum* Makino (Park, 1975; Lee, 1980; Korean Fern Society, 2005; Lee, 2006; Korea National Arboretum, 2008). *H. barbatum* and *H. oligosorum* correspond to the subgenus *Hymenophyllum*, whereas remaining taxa (*H. polyanthos*, *H. coreanum* and *H. wrightii*) belong to the subgenus *Mecodium* as sensu Ebihara et al. (2006). Except for these types of simple taxonomic descriptions like this, no study on the taxa of *Hymenophyllum* or even Hymenophyllaceae from Korea has been carried out.

In addition to the above taxa, we found an additional new taxon, *Hymenophyllum wrightii* f. *serratum* forma nov., with about 100 individuals per 2 m<sup>2</sup>. It is described as a newly found taxon from Korea, and it was collected from a forest in Mt. Halla, Jeju-do. The local name was designated as 'Gu-reum-cheo-nyeo-i-kki' based on its habitat. We compared and analyzed morphological characters between *Hymenophyllum wrightii* f. *serratum* and similar taxa of *Hymenophyllum* in order to elucidate their taxonomic relationship. Morphological characters and illustrations of *Hymenophyllum wrightii* f. *serratum*, along with photographs of the habitat, are newly reported with a taxonomic key to the species of *Hymenophyllum* from Korea.

## Taxonomic Treatment

*Hymenophyllum wrightii* f. *serratum* C.S. Lee & K. Lee, forma nov. (Figs. 1-3)

**Korean name:** Gu-reum-cheo-nyeo-i-kki 구름처녀이끼



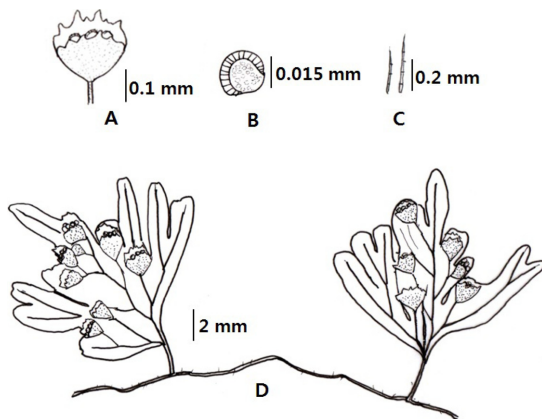
**Fig. 1.** Holotype of *Hymenophyllum wrightii* f. *serratum* C.S. Lee & K. Lee.

**Holotype:** 960 m, Mt. Halla, Jeju-do, Korea, 1 Dec. 2013 C.S. Lee & K. Lee 131201 (EWH)

**Isotypes:** EWH, KB, KH.

**Paratypes:** Mt. Halla, Jeju-do, Korea, 1 June 2014 C.S. Lee & K. Lee 14060101 (EWH); Mt. Halla, Jeju-do, Korea, 10 Nov. 2014 C.S. Lee & K. Lee 14060102-3 (KB)

Winter green herb, on rock or epiphytic, height 1.3-1.8 cm. Rhizomes long creeping, thin, 0.12-0.15 mm diameter, rarely blackish brownish hairy, hairs unicellular, 0.2-0.5 mm length. Stipes remote 1.5-2.0 cm apart, 0.3-0.7 cm length, 0.12-0.15 mm width, with flat winged at apex (sometimes decurrent to middle or near to base), rarely brownish haired in base. Laminae bipinnatifid, 1-3 lateral pinnae pairs, broadly ovate,



**Fig. 2.** Illustrations of *Hymenophyllum wrightii* f. *serratum* C.S. Lee & K. Lee. A. Sori and involucre; B. Sporangium; C. Hairs in rhizome and stipe; D. Habit.

green, membranous, 1.0-1.3 cm length, 1.0-1.5 cm width, glabrous or with a few multicellular hairs; lateral pinnae oblong or ovate, narrowing continuously from base, 0.7-1.0 cm length, 3-4 mm width; no-stalked, ultimate segments linear, margin entire, apex round, 4-6 mm length, 0.7-1.0 mm width, sometimes imbricate to the neighboring ones; costae with winged throughout; veins dichotomous, obvious. Sori terminal on short axially segments; involucre bivalvate, cleft to medium, lip margin serrate, ca. 0.2-0.25 mm length, 0.2-0.27 mm diameter, apex broadly rounded, Spores trilete.

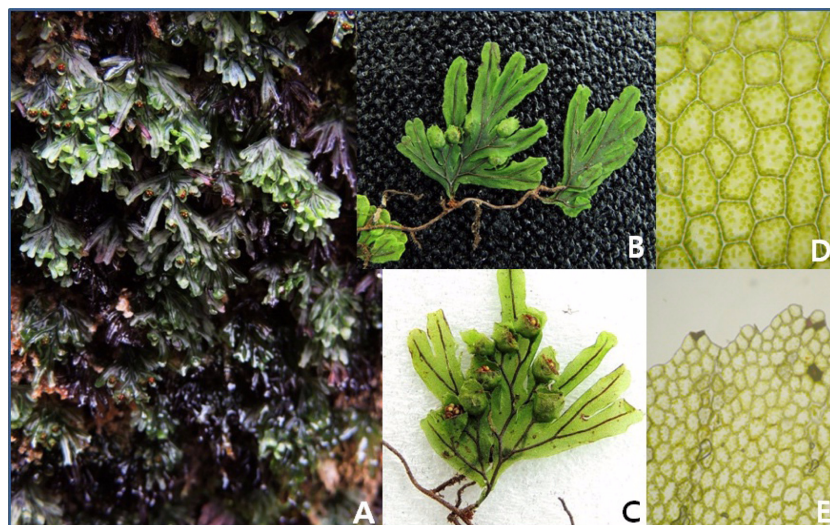
**Habitat:** In forests of High Mountain.

**Distribution:** Mt. Halla, Jeju-do, Korea

**Notes:** This taxon was distinguished from *H. wrightii* f. *wrightii* by having pseudo-vein, broadly winged in rachis, almost wingless in stipe, cup shaped involucre, and prominently bent back involucre margin (Table 1, Figs. 1-3).

The new taxon in Korea, *Hymenophyllum wrightii* f. *serratum* C.S. Lee & K. Lee, could be classified as a taxon of the genus *Mecodium* (Copeland, 1947) or the genus *Hymenophyllum* (Morton, 1968; Iwatsuki, 1990). Moreover, this taxon belongs to the subgenus *Mecodium* of the genus *Hymenophyllum* corresponding to Ebihara et al. (2006) based on those species by having filiform rhizomes, nearly glabrous, bivalved involucre, and receptacles included in involucre as the morphological characters.

*Hymenophyllum wrightii* f. *serratum* is distinguished with *H. wrightii* f. *wrightii* based on its smaller height and broader basal leaf blades, broad-ovate lamina, larger sori and serrated



**Fig. 3.** Photographs of *Hymenophyllum wrightii* f. *serratum* C.S. Lee & K. Lee. A. Habit; B. Adaxial leaf blades with involucre and sori; C. Abaxial leaf blades; D, E. Leaf epidermal surface.

**Table 1.** Comparative morphological characters between *Hymenophyllum wrightii* f. *serratum* and *H. wrightii* f. *wrightii* distributed in Korea.

Characters	<i>H. wrightii</i>	
	f. <i>wrightii</i>	f. <i>serratum</i>
Laminae shape	2-3 pinnatifid, ovate-lanceolate	2-pinnatifid, broadly ovate
Leaf blades length/width (cm)	1.5-3.5 / 1.0-1.5	1.0-1.3 / 1.0-1.5
Pinnae shape	ovate or obovate	oblong or ovate
Sori diameter (mm)	0.12-0.15	0.20-0.27
Involucre lips margins	entire	serrate

margins of involucre lips (Table 1). This taxon has very similar sequences to *H. wrightii* f. *wrightii* based on chloroplast DNA, *rbcL* and *rps4-trnS* (Lee et al., unpubl. data). From these results, we concluded that this new taxon is the forma of *H. wrightii* at the infraspecific level.

The new local name ‘Gu-reum-cheo-nyeo-i-kki’ was given to the new taxon based on its habitat of distribution in the high mountains. It was found in Korea with *Hymenophyllum polyanthos* Sw., *Lycopodium chinense* H. Christ, *Crepidomanes minutum* (Blume) K. Iwats., *Quercus phillyraeoides* A. Gray., *Weigela subsessilis* L. H. Bailey, *Hydrangea serrata* for. *acuminata* (Siebold & Zucc.) Wilson, *Abies koreana* Wilson, *Rhododendron yedoense* var. *poukhanense* Lev. & Nakai, and *Deutzia parviflora* Bunge in a forest in Mt. Halla, Jeju-do.

### Key to the known allied taxa of *Hymenophyllum wrightii* f. *serratum* in Korea

1. Segments margins irregularly serrate  
.....*H. barbatum* 수염이끼
1. Segments margins entire
  2. Stipes and rachis of abaxial leaf blades light brown hairs permanently ..... *H. oligosorum* 금강치녀이끼
  2. Stipes and rachis of abaxial leaf blades seldom hairs
  3. Laminae 3 pinnatifid, segments attached at 45°-90° from rachis
  4. Sori stuck to laminae base, segments attached at 45°-75° from rachis ..... *H. polyanthos* 줍치녀이끼
  4. Sori stuck to only upper laminae segments attached at 80°-90° from rachis ..... *H. coreanum* 애기수염이끼
3. Laminae 2-3 pinnatifid, segments attached at 30°-45° from rachis
  5. Laminae linear lanceolate, involucre lips margins entire ..... *H. wrightii* f. *wrightii* 처녀이끼
  5. Laminae broadly ovate, involucre lips margins serrate  
..... *H. wrightii* f. *serratum* 구름치녀이끼

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