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Original Research Article

Bowlesia incana Ruiz & Pav. (Apiaceae), a New Invasive Alien Plant in Korea

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Abstract - *Bowlesia incana* Ruiz & Pav., a new invasive alien plant in Korea, was found in Ulju-gun, Ulsan Metropolitan City. This species is characterized as being similar to the genera *Hydrocotyle* Tourn. ex L. and *Centella* L. However, it differs morphologically from these two genera in leaves, flowers, and fruits, as well as stellate pubescence growing on the whole plant. In Korea, *Bowlesia incana* Ruiz & Pav. is recorded for the first time in this study. A morphological description, distribution map, and illustrations based on the Korean materials collected are presented.

Key words – Apiaceae, *Bowlesia*, Flora, New record, Republic of Korea

Introduction

Bowlesia Ruiz & Pav. is a genus of flowering plant in the family Apiaceae, and about 15 species are known worldwide (Mathias and Constance, 1965). This genus can be distinguished from the related genera by its prostrate herbaceous habit, simple umbels, short carpophores, and stellate pubescence (Reiche, 1902).

Initially, *Bowlesia* was classified as belonging to the subfamily Hydrocotyloideae (Drude, 1898; Pimenov and Leonov, 1993), however, it has recently been placed in Azorelloideae by studies based on molecular data (Plunkett *et al.*, 2004). Representative genera of Azoerlloideae are *Azorella* Lam., *Asteriscium* Cham. & Schltdl. and *Diposis* DC., however, none of the taxa in subfamily have been recorded in Korea.

During extensive field surveys for floristic research in Korea in 2018, we collected an unidentifiable plant characterized by leaves similar to those of *Hydrocotyle* and flowers and fruits similar to those of *Centella* (Figs. 1, 2).

After we examined floras of various regions, herbarium specimens of Korea and adjacent countries, and the relevant literature, we concluded that the collected specimens represented an Apiaceae species hitherto unrecorded in Korea. We have formally described it below as *Bowlesia incana* Ruiz & Pav.

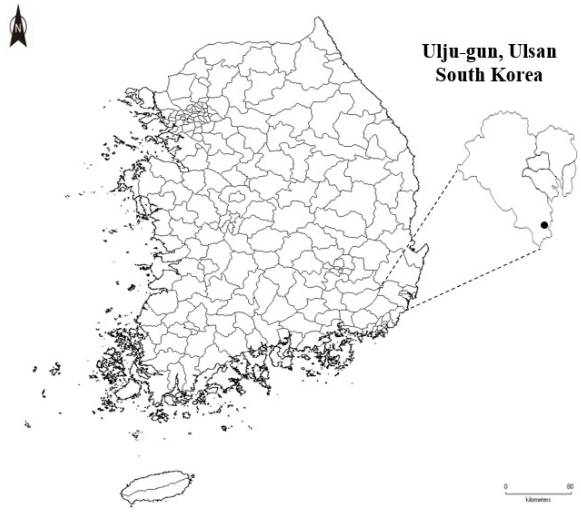

Fig. 1. Distribution of *Bowlesia incana* Ruiz & Pav. in South Korea. Illustration by Eun Su Kang.

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Taxonomic Treatment

***Bowlesia* Ruiz & Pav.**, Fl. Peruv. Prodr. 44 (1794).

Vernacular (Korean) name: Byeong-pul-a-jae-bi-sok (**병풀아재비속**; new Korean name).

***Bowlesia incana* Ruiz & Pav., Fl. Peruv. 3: 28 (1802) (Figs. 2, 3)**

Type: (neotype, designated by Mathias and Constance, 1965): —*P*: 'Habitat in Peruviae collibus ad Huanuci, Rondos et Pillao tractus.' (present address: Peru: Huanuco Dist. & Rondos Dist.), s.d., *Dombey s.n.* (F, digital photograph)

Annual creeping, small herb, covered with stellate hairs. **Stem** slender, glabrate to slightly stellate pubescent; hairs 8-rayed, unstalked. **Leaf** opposite, with fimbriate stipule and usually long petiole; blade palmate, 0.5–3 ㎝ long, rounded-reniform; lobes 5–9, widely lanceolate to round, generally obtuse with deep sinus, stellate pubescent; stalked hairs

Fig. 2. Photographs of *Bowlesia incana* Ruiz & Pav. A: Habit, B: Stem, C: Petiole, D: Leaf (lateral view), E–G: Flower, H: Fruit. Photographs by Yoon-Young Kim.

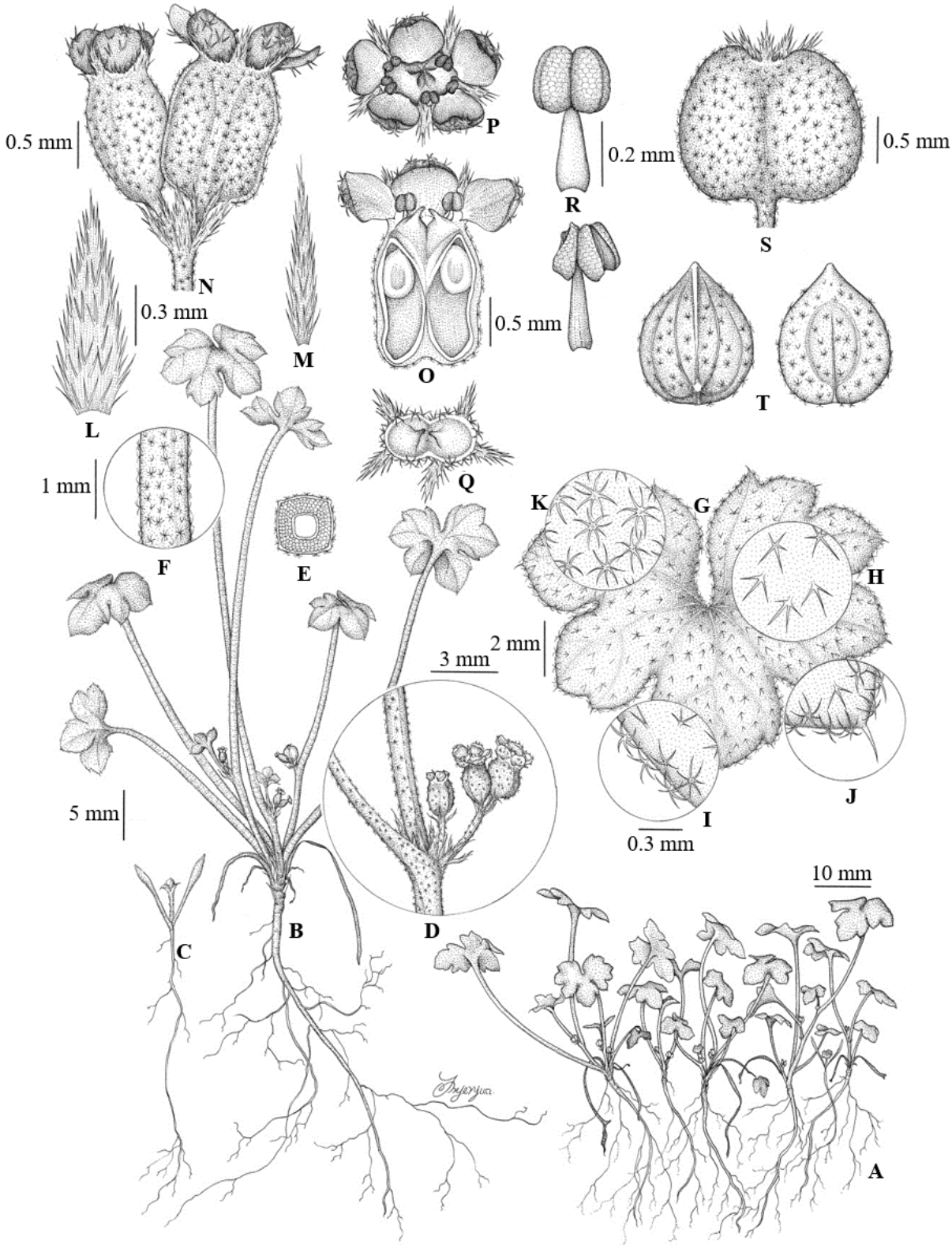

Fig. 3. Illustrations of *Bowlesia incana* Ruiz & Pav. A–B: Habit, C: Shoot, D: Inflorescence position, E: Stem cross-section, F: Petiole hair (stellate), G–K: Leaf (H: ventral surface, I: margin, J: apex, K: dorsal surface), L: Bract, M: Bractlet, N: Inflorescence, O: Flower longitudinal section, P: Flower (top view), Q: Calyx, R: Stamen, S: Fruit, T: Seed. Illustrations by Hyeryun Jo.

8-rayed on both surfaces. **Inflorescence** umbel, simple, axillary, few-flowered. **Bract** of a few scarious, white to purplish white, lacerate bractlet. **Flower** small; calyx teeth prominent; petal oblong to ovate, greenish white to purple; stamen inserted, anther purple. **Stylopodium** conical; style short; carpel densely stellate pubescent. **Fruit** small, broadly ellipsoid to globose ridge inconspicuous, ca. 2 ㎜ long, 1.5 ㎜ wide, covered with stellate hairs.

Phenology: Flowering Mar. to Apr.

Distribution: Korea (Ulju-gun), Japan (Honshu), South America, southern USA, Europe, western Pakistan, New Zealand.

Vernacular (Korean) name: Byeong-pul-a-jae-bi (**병풀아재비**; new Korean name).

Specimens examined: KOREA. Ulsan Metropolitan City, Ulju-gun, March 20, 2018, *Y.Y. Kim 180320-001* (KH)

Introduction route: *Bowlesia incana* was found on the slopes next to the protective walls installed along the road. Thus, we assume that their seeds unintentionally transported by vehicles along with construction materials in the construction sites. Eventually they germinate and produce seeds which dispersed throughout area. Although *Bowlesia incana* was found in the forest areas, recently recorded other invasive alien plants, for instance, *Ludwigia peploides* (Kunth) P.H.Raven subsp. *montevidensis* (Spreng.) P.H. Raven and *Geranium purpureum* Vill., have been found in lakes and railroads (Kim *et al*., 2019a; 2019b). This indicated that invasive alien plants can grow in every possible environment, thus it is important to evaluate their invasiveness through regular monitoring and distribution survey. The final results should be provided as information for establishing the management of invasive alien plants.

Taxonomic note: While *Bowlesia incana*, native to Peru of South America, has been naturalized in countries in from tropic to temperate region including North America, Europe, Asia and New Zealand (Fig. 4). In Korea, this species is similar to *Hydrocotyle sibthorpioides* Lam. in terms of the appearance of young leaves and white-colored early blooms, and *Centella asiatica* (L.) Urb. with respect to the shape of the flower and fruit. However, *B. incana* can be distinguished by several features from these two species; in the former case, the white flower color changes into reddish as it grows, ridges on the fruit surface, which are not seen in *H. sibthorpioides*. Furthermore, *B. incana* has palmate leaves and hairy fruits, whereas *C. asiatica* has heart-shaped or reniform leaves and glabrous fruits. Above all, stellate pubescence growing all

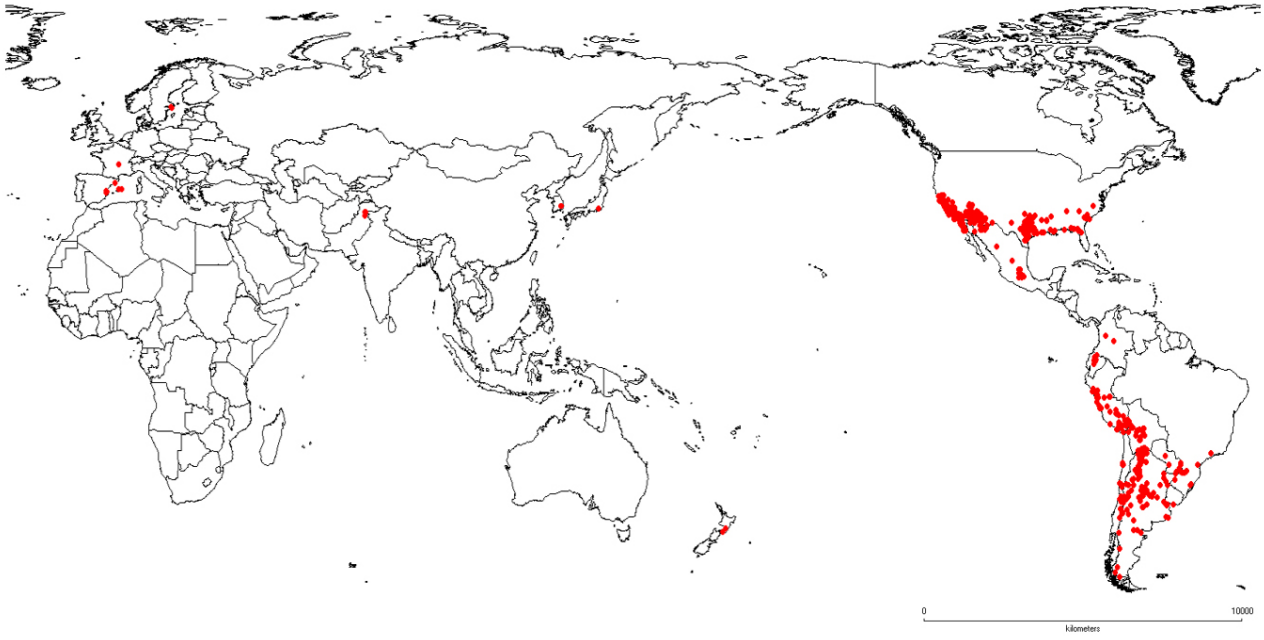

Fig. 4. Distribution of *Bowlesia incana* Ruiz & Pav. in the world. Illustration by Eun Su Kang.

over the surface of *B. incana* is the most important characteristic that is not found in the two similar species (Figs. 2, 3). According to our investigation, this genus is recorded for Korean flora as the species *B. incana*. This is the first record of this species in the Korea area. The number of genera of Apiaceae in the Flora of Korea (Korea National Arboretum, 2017) has increased to 41 with the addition of *Bowlesia*. Meanwhile, *Drusa* DC. and *Homalocarpus* Hook. & Arn. are known to be related with *Bowlesia* (Plunkett *et al*., 2018). However, these genera were not found in Korea, thus we described *Bowlesia incana* comparing apparently similar genera, *Hydrocotyle* and *Centella* in Apiaceae. The identification key of *Bowlesia* and related genera of the family Apiaceae has been recorded and is given as follows.

Key to *Bowlesia* and morphologically similar genera of Apiaceae in Korea

1. Fruit without ridges ····· ····· *Hydrocotyle* Tourn. ex L. 피막이속
1. Fruit with reticulate ridges.
2. Herbs perennial, glabrous. Adventitious root development at node. Leaf cordate or reniform. Calyx and petals glabrous. Fruits reticulate, ridged ····· ····· *Centella* L. 병풀속
2. Herbs annual, with stellate trichomes. Adventitious roots absent. Leaf palmate. Calyx and petals covered with stellate hairs on dorsal surface. Fruits not ridged ····· *Bowlesia* Ruiz & Pav. 병풀아재비속

* Although *Hydrocotyle* is recently placed in Araliaceae by some authors based on molecular phylogenetic studies (Downie *et al*., 2000; Plunkett *et al*., 2004; Erbar *et al*., 2004; Angiosperm Phylogeny Group, 2009), we described it as belonging to Apiaceae in accordance with Flora of Korea (Korea National Arboretum, 2017; Park *et al*., 2017)

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