**Ligularia monocephala** (Asteraceae, Senecioneae), a remarkable new species from Hubei, China

Wen-Qun Fei1,2, Tao Deng3, Long Wang1

1 Key Laboratory of Plant Resources Conservation and Sustainable Utilization, South China Botanical Garden, Chinese Academy of Sciences, Guangzhou 510650, Guangdong, China 2 University of Chinese Academy of Sciences, Beijing 100049, China 3 Key Laboratory for Plant Diversity and Biogeography of East Asia, Kunming Institute of Botany, Chinese Academy of Sciences, Kunming 650201, Yunnan, China

Corresponding author: Long Wang (lwang@scib.ac.cn)

Citation: Fei W-Q, Deng T, Wang L (2022) **Ligularia monocephala** (Asteraceae, Senecioneae), a remarkable new species from Hubei, China. PhytoKeys 189: 51–60. https://doi.org/10.3897/phytokeys.189.80016

**Abstract**

*Ligularia monocephala*, a remarkable new species from Hubei, China, is described and illustrated. It is readily distinguishable in the whole genus by character combination of the reniform to cordate-reniform leaf blades which are palmately-pinnately veined and abaxially purplish red, the solitary and erect capitula, and the pappus which are as long as or slightly longer than tube of the tubular corolla. A detailed description and distribution map of the species are also presented herein.

**Keywords**

Compositae, Hubei, Shennongjia, taxonomy

**Introduction**

*Ligularia* Cass., as the largest genus of tribe Senecioneae in Asteraceae in China, consists of approximately 130 species distributed mainly in eastern Asia (Liu 1989; Liu et al. 1994; Nordenstam 2007; Nordenstam et al. 2009; Liu and Illarionova 2011; Guo and Wang 2021). Since the publication of *Flora of China* (Liu and Illarionova 2011), the updated English version of *Florae Reipublicae Popularis Sinicae* (Liu 1989), extensive works have been done to the taxonomy of this genus at specific level (Fei et al. 2019; Lazkov and Sennikov 2019; Guo and Wang 2021, and references therein).
During a field expedition in August 2016 to Shennongjia, Hubei, China, the second author was able to discover a unique *Ligularia* population in an alpine region of this area. The plant, at first sight, shows an affinity with *Ligularia hookeri* (C.B. Clarke) Hand.-Mazz. in habit, however, the leaf color and the capitula orientation can easily set them apart. An in-depth survey of herbarium specimens was conducted, resulting in the finding of four gatherings (Anonymous 662, D.G. Zhang 080826018, Z.E. Zhao 1609 and X.L. Yu et al. 080078) all made from Shennongjia, Hubei, China, that are morphologically in conformity with this plant. To precisely decide the identity of these gatherings, we conducted another two field investigations to Shennongjia in September, 2020 and August, 2021, respectively, leading to a better understanding of the variation range of several main morphological characters of this plant. Upon careful observations and comparisons, it was found to be quite different from any other species in the genus in an array of morphological characters. We therefore concluded that this plant represents a hitherto undescribed species, which we describe below.

**Materials and methods**

For morphological comparisons, we critically examined physical or digitalized herbarium specimens with high-resolution of the genus *Ligularia* at A, BM, CDBI, CSFI, E, GH, HIB, HITBC, HNWP, IBSC, JIU, K, KATH, KUN, LE, NAS, NY, P, PE, S, SZ, W, WU, and WUK (acronyms follow Thiers (2021)). Specimens were collected from Hubei (first in September 2020, second in August 2021) during our several field expeditions. The morphological measurements in the description are based on the in-situ observations and dried specimens deposited at IBSC and KUN. Its records of distribution, habitat and phenology are based on both field investigations and specimen records.

**Taxonomy**

*Ligularia monocephala* Long Wang, sp. nov.
urn:lsid:ipni.org:names:77254167-1
Figures 1, 2

**Diagnosis.** Readily distinguishable in the whole genus by the character combination of the reniform to cordate-reniform leaf blades which are purplish red abaxially and palmately-pinnately veined, the solitary and erect capitula, and the pappus which are as long as, or slightly longer, than tube of the tubular corolla.

**Type.** China. Hubei Province, Shennongjia Forest Department, Shennongding Nature Reserve, Shennonggu valley, 31°26'19.36"N, 110°16'26.46"E, 2681 m a.s.l., on cliffs, 12 July 2021, W.Q. Fei & H.S. Wu 324 (holotype: IBSC; isotypes: IBSC, KUN).
Description. Perennial herb. Stems solitary, erect, 15–20 cm tall, ca. 3 mm in diam. at base, proximal to median part slightly brown puberulent and white arachnoid to glabrescent, distal part densely brownish pilose. Basal leaves ascending, long petiolate; petiole 5–10 cm long, not winged throughout; leaf blade reniform to cordate-reniform, 3.5–4.5(–6) cm long, 3.5–5(–7) cm wide, herbaceous, adaxially dark green, slightly shortly puberulent to glabrescent, abaxially purplish red, brownish puberulent at first, especially along veins, then becoming glabrescent, base cordate, margin regularly dentate, apex rounded or slightly obtuse; sinus narrow, basal lobes nearly rounded, slightly divergent; vein palmate-pinnate; primary veins 3–5. Stem leaves 4–6(–7). Proximal stem leaves usually 1, petiolate; petioles ca. 3 cm long, basally sheathed; sheath usually more or less broadened; leaf blade reniform to cordate-reniform, slightly smaller than basal leaves. Median stem leaves usually 1, nearly sessile; leaf blade usually less than 3 cm long and 3 cm wide; base slightly or enlarged sheathed. Distal stem leaves usually 2–5, much smaller and reduced, bract-like, lanceolate, 6–10 mm long, 1.5–3 mm wide; margin slightly ciliate or entire. Capitula solitary, erect, 5 cm in diam. including ray florets; bracts 1 or 2, lanceolate to subulate, 3–4 mm long, ca. 1 mm wide. Involucres cylindrical, 11–14 mm high, 9–14 mm in diam., outside shortly brownish puberulent; receptacle densely shortly puberulent outside; phyllaries 9–10, spreading, in 2 rows; outer phyllaries narrowly oblanceolate, 2–2.5 mm wide, apex acute; inner phyllaries oblanceolate, ca. 3 mm wide, margin membranous, apex acute to obtuse. Ray florets 6–9, yellow; lamina oblanceolate to elliptic, 3.0–3.5 cm long, 6–7 mm wide, apex acute, 3-denticulate; tube 5 mm long. Tubular florets numerous, yellow, ca. 2 cm long; tube 5 mm long; limb campanulate, 5–7 mm long; style 1.2 cm long. Achenes (immature) oblanceolate, cylindrical, pale yellow, 3–4 mm long, glabrous. Pappus brown in the upper two-thirds, white (distal part) and purplish red (proximal part) in the lower one-third, 5–7 mm long, as long as, or slightly longer, than tube of tubular corolla.

Etymology. The specific epithet ‘*monocephala*’ alludes to occurrence of solitary capitulum per stem.

Phenology. Flowering from July to August; fruiting in September.

Distribution and habitat. This species is currently known only from Shennongjia of Hubei (Fig. 3). It grows in moist forests or on moist cliffs covered by mosses at elevations of between 2681–3026 m above sea level.

Additional specimens examined (paratypes). China. Hubei: Shennongjia Forest District, Shennongding Scenic Spot, Badongya, on rocky cliffs, 10 July 1987, Anonymous 662 (HIB); Shennongjia Forest District, Shennongding Scenic Spot, Shennonggu valley, on moist cliffs covered by mosses, 31°26′42.95″N, 110°15′49.88″E, 3026 m a.s.l., 22 September 2020, L. Wang, X.Q. Guo & Q.E. Yang 4216 (IBSC); ibid., on cliffs, 2852 m, 9 August 2008, X.L. Yu et al. 080078 (CSFI); Shennongjia Forest District, precise locality unknown, 17 August 2012, D.G. Zhang 080826018 (JIU); Shennongjia Forest District, precise locality unknown, in rock crevices, 2800 m a.s.l., 2 September 1980, Z.E. Zhao 1609 (HIB).
Figure 1. Photographs of Ligularia monocephala sp. nov. A habitat B, C habit. All photographs by Wen-Qun Fei.
Figure 2. Photographs of *Ligularia monocephala* sp. nov. A portion of stem B leaf blade (adaxial surface) C leaf blade (abaxial surface) D capitulum (top view) E capitulum (side view) F outer phyllaries (abaxial surface) G inner phyllaries (abaxial surface) H ray florets I tubular florets. All photographs by Wen-Qun Fei.
Discussion

The generic placement of this newly described taxon, which is superficially similar to some species of Cremanthodium in the general habit (the gatherings Anonymous 662, D.G. Zhang 080826018, and Z.E. Zhao 1609 were, in fact, previously identified on the determination slips as species of Cremanthodium), is worthy of detailed remarks. The independent generic status of Cremanthodium, the putatively closest ally of Ligularia, has been widely accepted in recent checklists or Floras at the national level (e.g. Mathur 1995; Liu 1989; Grierson and Springate 2001; Kress et al. 2003; Liu and Illarionova 2011). Morphologically, the former is generally considered different from the latter by its broadly campanulate or hemispheric (vs. cylindrical or obconic) involucre, although this character is not always applicable in a few species (for example, C. liangshanicum L. Wang, C. Ren & Q.E. Yang). Geographically, the former is a high-alpine genus endemic to Sino-Himalayan region with its distribution range locating at 25°–40°N, 75°–104°E (Liu et al. 2002; Wang 2018), while the latter is an Eurasian genus more widely distributed than the former (Liu et al. 1994; Liu et al. 2002). However, the recognition and segregation of Cremanthodium has also been
Ligularia monocephala sp. nov. from China

It was once considered as an alpine variant (Wulff 1944) or ecotype (Drury 1967) of Ligularia. In addition, recent molecular phylogenetic studies focused on the LCP complex (Ligularia-Cremanthodium-Parasenecio; Asteraceae, Senecioneae) (Liu et al. 2006; Ren 2012; Ren et al. 2017, 2020) revealed that the two genera are not monophyletic as traditionally defined. They together form three distinct and distantly related clades on chloroplast gene trees, with two clades having the species of the two genera interspersed between each other. The results contradict heavily with Liu's infrageneric classification system (Liu 1982, 1985) of the two genera established based mainly on morphological characters, but seem to be well correlated with the geographical distributions. Based on the above discussion, the newly reported species, characterizing by having cylindrical involucre, and locating at 31°N, 110°E, is here tentatively placed within Ligularia on morphological and geographical grounds.

In the genus Ligularia, L. monocephala is tentatively assigned to L. sect. Corymbosae (Franch.) Hand.-Mazz. ser. Retusae S.W. Liu due to its palmate-pinnate leaf venation, lanceolate to subulate bract, and cylindrical involucre. Within this series, it resembles L. phoenicochaeta (Franch.) Hand.-Mazz. to some extent, but differs mainly by the abaxially purplish red (vs. pale green) leaf blades (Fig. 2C), the erect (vs. cernuous) capitula (Fig. 2E), the cylindrical (vs. hemispheric) involucres (Fig. 2E), and the 5–7 mm (1–2 mm) long pappus (Fig. 2I). Ligularia monocephala is also superficially similar to L. jamesii (Hemsl.) Kom. of sect. Ligularia ser. Monocephalae (Nakai) Kitam. and L. hookeri (C.B. Clarke) Hand.-Mazz. (those plants with solitary capitula) of sect. Ligularia ser. Ligularia, particularly in the general habit and the solitary capitula. Morphologically, L. monocephala differs from L. jamesii immediately by the reniform to cordate-reniform (vs. triangular-hastate) leaf blades which are abaxially purplish red (vs. pale green, rarely purplish red) and apically rounded or slightly obtuse (vs. acute or acuminate) (Fig. 2C), the cylindrical (vs. broadly campanulate) involucres (Fig. 2E), the oblong to elliptic (vs. linear-lanceolate) ray laminae which are 6–7 mm (vs. 3–4 mm) wide (Fig. 2H), and the pappus which are as long as or slightly longer than tube of tubular corolla (vs. as long as tubular corolla) (Fig. 2I); and L. monocephala differs from L. hookeri mainly by the abaxially purplish red (vs. pale green, rarely purplish red) leaf blades (Fig. 2C), the erect (vs. cernuous to horizontal) capitula (Fig. 2E), the oblong to elliptic (vs. linear) ray laminae which are 6–7 mm (vs. 1.5–2 mm) wide (Fig. 2H), and the pappus which are as long as, or slightly longer than, the tube of tubular corolla (vs. as long as tubular corolla) (Fig. 2I). A detailed comparison of the four species is given in Table 1.

Acknowledgements

We would like to thank Dr. Chen Ren and Dr. Alexander Sennikov for their constructive suggestions. We are grateful to the curators of A, BM, CDBI, CSFI, E, GH, HIB, HITBC, HNWP, IBSC, JIU, K, KATH, KUN, LE, NAS, NY, P, PE, S,
**Table 1.** Differences among *Ligularia hookeri*, *L. jamesii*, *L. monocephala* and *L. phoenicochaeta*.

|                | *L. hookeri*                                                                 | *L. jamesii*                                                                 | *L. monocephala*                                                            | *L. phoenicochaeta*                                                        |
|----------------|------------------------------------------------------------------------------|------------------------------------------------------------------------------|----------------------------------------------------------------------------|----------------------------------------------------------------------------|
| **Stems**      | distally white arachnoid and shortly brown pilose                           | distally white arachnoid-puberulent                                          | densely brownish pilose                                                     | distally shortly brown pilose                                              |
| **Basal leaves**| leaf bladecordate-sagittate or reniform, abaxially pale green, rarely purplish red; margin triangularly or coarsely dentate, between teeth shortly pilose, apex rounded; palmately veined | leaf blade triangular-hastate, abaxially pale green; margin sharply dentate, apex acute or acuminate; palmately pinnately veined | leaf blade reniform to cordate-reniform, abaxially purplish red; margin regularly dentate, apex rounded or slightly obtuse; palmately-pinnately veined | leaf blade orbicular-reniform, abaxially pale green; margin regularly triangular-dentate, apex rounded; palmately veined |
| **Capitula**   | usually solitary, sometimes 2–7(–16) arranged in a raceme; cernuous to horizontal | solitary; erect                                                             | solitary; erect                                                             | usually solitary, sometimes 2–4 arranged in a lax corymb; cernuous         |
| **Involucres** | campanulate, 6–8(–10) mm in diam., outside shortly brown pilose or glabrous | broadly campanulate, to 1.5 cm, outside white arachnoid-puberulent           | cylindrical, 9–14 mm in diam., outside shortly brownish puberulent          | hemispheric, to 24 mm in diam., outside glabrous                           |
| **Ray florets**| lamina linear, 1.5–2 mm wide                                                 | lamina linear-lanceolate, 3–4 mm wide                                       | lamina obleng to elliptic, 6–7 mm wide                                     | lamina elliptic or obleng-lanceolate, ca. 2 mm wide                       |
| **Pappus**     | brown or pale brown, 6–7 mm long, as long as tubular corolla                | pale yellow, 7–8 mm long, as long as tubular corolla                        | brown in the upper two-thirds, white (distal part) and purplish red (proximal part) in the lower one-third, 5–7 mm long, as long as or slightly longer than tube of tubular corolla | purplish brown, 1–2 mm long, much shorter than tube of tubular corolla     |
| **Distribution in China** | Shaanxi, Sichuan, Xizang, Yunnan                                       | Jilin, Liaoning, Nei Mongol                                                 | Chongqing, Hubei                                                           | Yunnan                                                                     |

SZ, W, WU, and WUK for allowing us to use their scanned images of specimens and for research facilities. Thanks are also given to Mr. Xin-Qiang Guo, and Mr. Hai-Song Wu for field assistance. This work was supported by the National Natural Science Foundation of China (grant no. 31900183), the Biological Resources Programme of the Chinese Academy of Sciences (grant no. KFJ-BRP-017-08), Key Laboratory of Conservation Biology of Golden monkey in Shennongjia of Hubei Province (grant no. SNJGKLI202002), the Youth Innovation Promotion Association of Chinese Academy of Sciences (grant no. 2019382), and the Ten Thousand Talents Program of Yunnan Province (grant no. 202005AB160005).

**References**

Drury DG (1967) A taxonomic study of Compositae with special reference to *Senecio*. PhD Thesis, Southampton University, England, 148 pp.

Fei WQ, Chen JL, Yang SL, Li DX, Gao XZ, Wang L (2019) *Ligularia dalaolingensis* sp. nov. (Asteraceae–Senecioneae) from central China. Nordic Journal of Botany 37(7): 1–7. [https://doi.org/10.1111/njb.02413](https://doi.org/10.1111/njb.02413)

Grierson AJC, Springate LS (2001) Compositae. In: Grierson AJC, Long DG (Eds) Flora of Bhutan (vol. 2 (3)). Royal Botanic Garden Edinburgh, Edinburgh & Royal Government of Bhutan, Thimphu, 1397–1632.
Ligularia monocephala sp. nov. from China

Guo XQ, Wang L (2021) Ligularia pseudolamarum (Asteraceae, Senecioneae), a new species from southeastern Xizang, China. Nordic Journal of Botany. https://doi.org/10.1111/njb.03212

Kress WJ, DeFilipps RA, Farr E, Kyi DYY (2003) A checklist of the trees, shrubs, herbs and climbers of Myanmar. Contributions from the United States National Herbarium 45: 1–590.

Lazkov GA, Sennikov AN (2019) Ligularia philanthrax (Asteraceae), a new species from a coal mining region of Kyrgyzstan. Annales Botanici Fennici 56(4–6): 355–359. https://doi.org/10.5735/085.056.0421

Liu SW (1982) A taxonomic study on the genus Cremanthodium Benth. Acta Biologica Plateau Sinica 1: 49–59. [In Chinese]

Liu SW (1985) The taxonomic system of the genus Ligularia (L.) Cass. Bulletin of Botanical Research 5(4): 63–80. [In Chinese]

Liu SW (1989) Ligularia Cass. In: Ling Y, Liu SW (Eds) Flora Reipublicae Popularis Sinicae Vol. 77(2). Science Press, Beijing, 4–115. [In Chinese]

Liu SW, Illarionova ID (2011) Ligularia Cassini. In: Wu ZY, Raven PH, Hong DY (Eds) Flora of China (vol. 20–21). Science Press, Beijing & Missouri Botanical Garden Press, St. Louis, 376–415.

Liu SW, Deng DS, Liu JQ (1994) The origin, evolution and distribution of Ligularia Cass. (Compositae). Zhiwu Fenlei Xuebao 32: 514–524.

Liu SW, Ho TN, Chen SL, Liu JQ (2002) On the origin and distribution of the genus Cremanthodium Benth. Acta Biologica Plateau Sinica 15: 53–61. [In Chinese]

Liu JQ, Wang YJ, Wang AL, Hideaki O, Abbott RJ (2006) Radiation and diversification within the Ligularia-Cremanthodium-Parasenecio complex (Asteraceae) triggered by uplift of the Qinghai-Tibetan Plateau. Molecular Phylogenetics and Evolution 38(1): 31–49. https://doi.org/10.1016/j.ympev.2005.09.010

Mathur R (1995) Senecioneae Cass. (Asteraceae) In: Hajra PK, Rao RR, Singh DK, Uniyal BP (Eds) Flora of India (vol. 13). Botanical Survey of India, Calcutta, 186–323.

Nordenstam B (2007) Tribe Senecioneae Cass. In: Kadereit JW, Jeffrey C (Eds) The Families and Genera of Vascular Plants (vol. 8), Flowering Plants: Eudicots, Asterales. Springer, Berlin, 208–242.

Nordenstam B, Pelser PB, Kadereit JW, Watson LE (2009) Senecioneae. In: Funk VA, Susanna A, Stuessy T, Bayer R (Eds) Systematics, Evolution & Bogeography of Compositae, IAPT, Vienna, 503–535.

Ren C (2012) Cytotaxonomy, Molecular Systematics, and Biogeography of the Ligularia-Cremanthodium-Parasenecio Complex (Asteraceae-Seneioncea). PhD Dissertation, South China Botanical Garden, Chinese Academy of Sciences.

Ren C, Hong Y, Wang L, Yang QE (2017) Generic circumscription of Parasenecio (Asteraceae: Senecioneae) based on nuclear ribosomal and plastid DNA sequences, with descriptions of two new genera. Botanical Journal of the Linnean Society 184(4): 418–443. https://doi.org/10.1093/botlinnean/box034

Ren C, Wang L, Illarionova ID, Yang QE (2020) Circumscription and phylogenetic position of Ligularia sect. Stenostegia (Asteraceae: Senecioneae) based on morphological, cytological, and molecular phylogenetic evidence. Taxon 69(4): 739–755. https://doi.org/10.1002/tax.12280
Thiers B (2021) Index Herbariorum: A global directory of public herbaria and associated Staff. http://sweetgum.nybg.org/science/ih/ [accessed 1 August 2021]

Wang L (2018) A taxonomic study of *Cremanthodium* Benth. (Asteraceae-Senecioneae). PhD Thesis, University of Chinese Academy of Sciences, China.

Wulff EV (1944) Historical plant geography: history of the world flora. Academy of Sciences of the USSR, St Petersburg, 545 pp. [In Russian]