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Research

Hemiboea shimentaiensis S. Y. Miao, Y. Q. Li & T. Chen (Gesneriaceae), a new species from northern Guangdong, China

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Hemiboea shimentaiensis (Gesneriaceae), a new species from northern Guangdong, China, is described and illustrated. It is most similar to *H. gamosepala*, *H. rubribracteata* and *H. malipoensis* in the nearly white corolla, which appears in a few species of *Hemiboea*, and nearly glabrous inner base of the corolla tube. It can be easily distinguished from the latter three species by the stoloniferous habit, distinct silvery veins, glabrous corolla except for a ring of hairs inside, anther coherent along ventral face when young, but cohering apically at maturity, three separate staminodes with lateral ones resembling deformed anthers, and with few sterile pollen grains inside, to antheroids at the tips of the staminodes. The life cycle and fluctuations in the population are unknown and need further study, the conservation status of *H. shimentaiensis* was not assessed.

Keywords: *H. gamosepala*, *H. malipoensis*, *H. rubribracteata*, morphology, taxonomy

Introduction

Between 2000 and 2019, 4407 new species of Chinese vascular plants were published, including 226 species of Gesneriaceae, ranking it second among families in China (376 new species of Orchidaceae (Du et al. 2020)). In 2020, 42 new species, mainly in *Primulina* Hance (10 species) and *Oreocharis* Benth. (10 species) and one new variety of Gesneriaceae were described in China (Du et al. 2021). Searching for undescribed Gesneriaceae has been among the most active areas of exploration for flowering plants in China. The number of known species of Gesneriaceae in China has increased from 520 in 2005 to 719 in 2019 (Wen et al. 2019). *Hemiboea* C. B. Clarke (Gesneriaceae), ranging from central to southern China, northern Vietnam to southern Japan, comprises at least 36 species and five varieties before 2019 (Wen et al. 2019, Wu et al. 2019). As of April 2022, according to the Checklists of Gesneriaceae Resource Centre (GRC 2022), 42 species and five varieties of *Hemiboea* were accepted. Among them, 39 species and five varieties are in China, with 20 species and two varieties in Guangxi (most species in China), and six species and one variety in Guangdong. Two species (*H. chanii* C. H. Nguyen & Aver. and *H. thanhhoensis* C. H. Nguyen, Aver. & F. Wen)

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were recorded for Vietnam and one, *H. olivifolia* Souvann. & Tagane, was in Laos (GRC 2022).

Species of *Hemiboea* are perennial stoloniferous herbs with dense, axillary or pseudoterminal, umbel-like cymes subtended by a globose to ovoid involucre. The calyx is 5-sect from base or 5-lobed from the middle or above. The corolla is white, pink, purple or yellow, zygomorphic and usually has a ring of hairs inside. The two stamens are adnate to the abaxial surface of the corolla tube below the middle. The basifixed anthers are coherent apically or adaxially. The two or three staminodes are adnate to the adaxial surface of the corolla tube. The disc is ring-like (The Chinese Academy of Sciences and the Missouri Botanical Garden 1989).

The lateral staminodes of the plants we collected were resembling deformed anthers, varying from cohering with each other and with few sterile pollen grains inside the two thecae, or were cross connected with each other to antheroids at apex of staminodes, even though complete separate, suggesting a new evidance for the process of the stamens from normal development to sterility. The distinct silvery lateral veins on adaxial surface of the leaf blades and the few hairs in a ring inside the corolla tube were similar to *Anna submontana* Pellegr. And may indicated a relationship between *Hemiboea* and *Anna*. *Anna* has four stamens and one staminode and the corolla tube is glabrous.

Since *Hemiboea* is taxonomically difficult, with many similar species and few distinguishing characteristics, the ring of hairs at the base of the corolla tube, the rows of uniseriate single-celled hairs at the base of the tube, mode of anther connections (entire adaxial surfaces or apically head) (Li 1983), vermiform or stellate sclereids of the epidermis and scattered vascular bundles, degree of separation of the calyx lobes, cohesion of lateral staminodes and staminodes characteristics are especially important.

During floristic surveys in Shimentai National Nature Reserve of Guangdong, China, in 2019 and 2020, we found three species of *Hemiboea*, *H. follicularis* C.B.Clarke and *H. subcapitata* C.B.Clarke on limestone, and *H. subacaulis* Hand.-Mazz. on granite. However, some specimens of *Hemiboea* did not match descriptions of any known species. Those plants differed from similar species in having silvery veins, entire plant glabrous except for a ring of hairs inside the corolla tube, anthers coherent along ventral face when young, but cohering apically at maturity, and lateral staminodes with few sterile pollen grains. After comparing our collections with digital images of herbarium specimens, including the holotypes of *H. rubribracteata* Z. Y. Li & Yan Liu at IBK and *H. gamosepala* Z. Y. Li at IBSC, IBK and PE (National Plant Specimen Resource Center 2022). of possible relatives and a review of the literature (Li 1983, Wei and Wen 1995, Pan et al. 2012, Zhang and Liu 2014, Li et al. 2019), we concluded that the plants we collected were new to science. We here name them *H. shimentaiensis*.

Hemiboea shimentaiensis, sp. nov. (Fig. 1E, F, 2, 3)

Diagnosis: *Hemiboea shimentaiensis* is most similar to *H. gamosepala*, *H. rubribracteata* and *H. malipoensis* (Table 1, Fig. 1). It is most similar to them in the nearly white corolla, which is shared with few species of *Hemiboea*, leaf shape and nearly glabrous inner base of the corolla tube. It can be easily distinguished from them by the stoloniferous habit, distinct silvery veins, glabrous except for the ring of hairs inside the corolla, three staminodes with the lateral ones connected and with few sterile pollen grains inside.

Type: China, Guangdong Province: Yingde City, Guangdong Shimentai National Nature Reserve, 24°38′46″N, 113°26′43″E, alt. 660 m a.s.l., 30 Aug 2021, 202108001 (holotype SZG!).

Additional specimens examined (isotypes): China, Guangdong Province: Yingde City, Shakou town, Huangdong, Guangdong Shimentai National Nature Reserve, 24°38′46″N, 113°26′43″E, elev. 660 m a.s.l., 30 Aug 2021, 202108001 (SZG, SYS & IBK). ibid., 24°26′58″N, 113°26′42″E, elev. 674 m a.s.l., 30 Aug 2021, 202108002 (SZG). ibid., 24°26′42″N, 113°26′43″E, elev. 669 m a.s.l., 30 Aug 2021, 202108003 (SZG).

Etymology

The specific epithet is derived from the type locality, the Guangdong Shimentai National Nature Reserve, Yingde City, Guangdong Province, China.

Vernacular name

Shímén tái bàn shuò jù tái (Chinese pinyin pronunciation); 石门台半蒴苣苔(Chinese name).

Description

Herbs (Fig. 3A), perennial, stoloniferous (Fig. 3B); stolons creeping, 5–30 cm long, with light purple spots at base. Stems simple, erect, unbranched, 17–28 cm tall, rounded or slightly square, glabrous, slightly carnose, with obscure purple spots; nodes 5–10. Leaves opposite, 10–16; petiole 3–8 cm long, 2–3 mm in diameter, slightly flattened adaxially, glabrous; blade carnose, thin hard chartaceous when dry, adaxially green, abaxially light green near base but mostly purple (Fig. 3C); oblong to long rounded-oval, 16–23 × 7–10 cm, base cuneate, oblique, margin entire or somewhat undulate, apex acuminate, both surfaces glabrous; with scattered vermiform sclereids (of 5–11 cells, 1.3–2.2 mm long, 0.2–0.6 mm wide) surrounding vascular bundles on abaxial surface (Fig. 3O1 and O2); lateral veins 6–11 on each side of midrib, mostly silver. Inflorescences cymes, flowers paired in dichasia, axillary or subterminal, 3- or 4-branched, with 6–14 flowers; peduncle 1.0–2.5 cm long, ca 2 mm in diameter, glabrous; pedicels 2–3 mm long, ca 1 mm in diameter, glabrous. Involucre oblate-spherical, 1.5–2.5 cm long, 2.3–3.3 cm on wide side and 1.8–2.5 cm on narrow side, green, glabrous, longitudinal veins 5–7, apex acute, slightly boat shaped after opening; involucels at several levels, similar to involucre but smaller, membranous, pale green. Flowers: calyx white, 5-parted from base, lobes nearly equal, lanceolate, 6–7 × 2–3 mm, glabrous, somewhat viviparous and

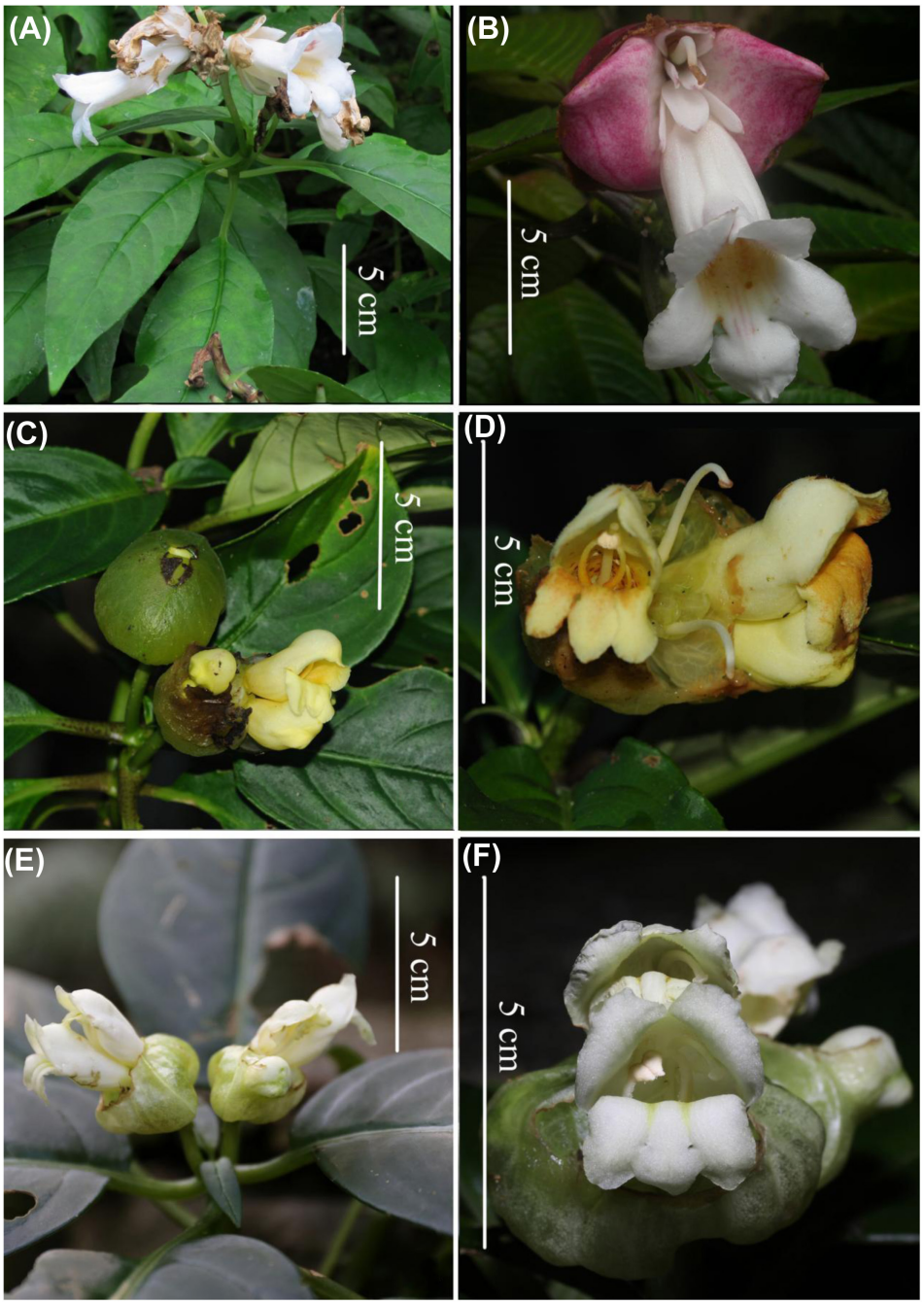

Figure 1. Comparison of *Hemiboea gamosepala*, *H. rubribracteata*, *H. malipoensis* and *H. shimentaiensis*. (A) *H. gamosepala* (photograph by Dong-xin Nong), showing green veins, cymes and 5-lobes calyx separate from middle. (B) *H. rubribracteata* (photograph by Yan Liu). Showing red involucre, 5-aparts calyx and hairs inside corolla; (C) *H. malipoensis* (photograph by Qin-wen Lin). showing the green veins, green involucre, 2-flowered cymes and pale yellow corolla; (D) *H. malipoensis* (photograph by Qin-wen Lin). showing anther lateral contact. (E) *H. shimentaiensis*. The frontal view of corolla, showing silvery veins, green involucre, 2-flowered cymes and white corolla. (F) *H. shimentaiensis.* The lateral view of corolla, showing the laterally contact anthers.

membranous when dry; corolla white and glabrous outside, pale yellowish green inside, almost glabrous, without purple spots, 2.5–3.5 cm long; tube 2–2.8 cm long, 1.2–1.4 cm in diameter at orifice, 4–5 mm in diameter at base, inside with ring of hairs ca 5 mm above base, ring of hairs 2–3 mm wide; limb distinctly 2-lipped; adaxial lip with a distinct boss, 1.2–1.5 × 1.0–1.2 cm, 2-lobed, lobes semi-rounded, 4–6 × 3–4 mm; abaxial lip 1.0–1.3 × 0.8–1.0 cm, 3-lobed almost to base, lateral lobes narrowly ovate, central lobe slightly tongue shaped at ca 5 mm from mouth; stamens 2, base of filaments flat, linear above middle, slightly bent, glabrous, adnate 8–10 mm above corolla base, 1.5–1.8 cm

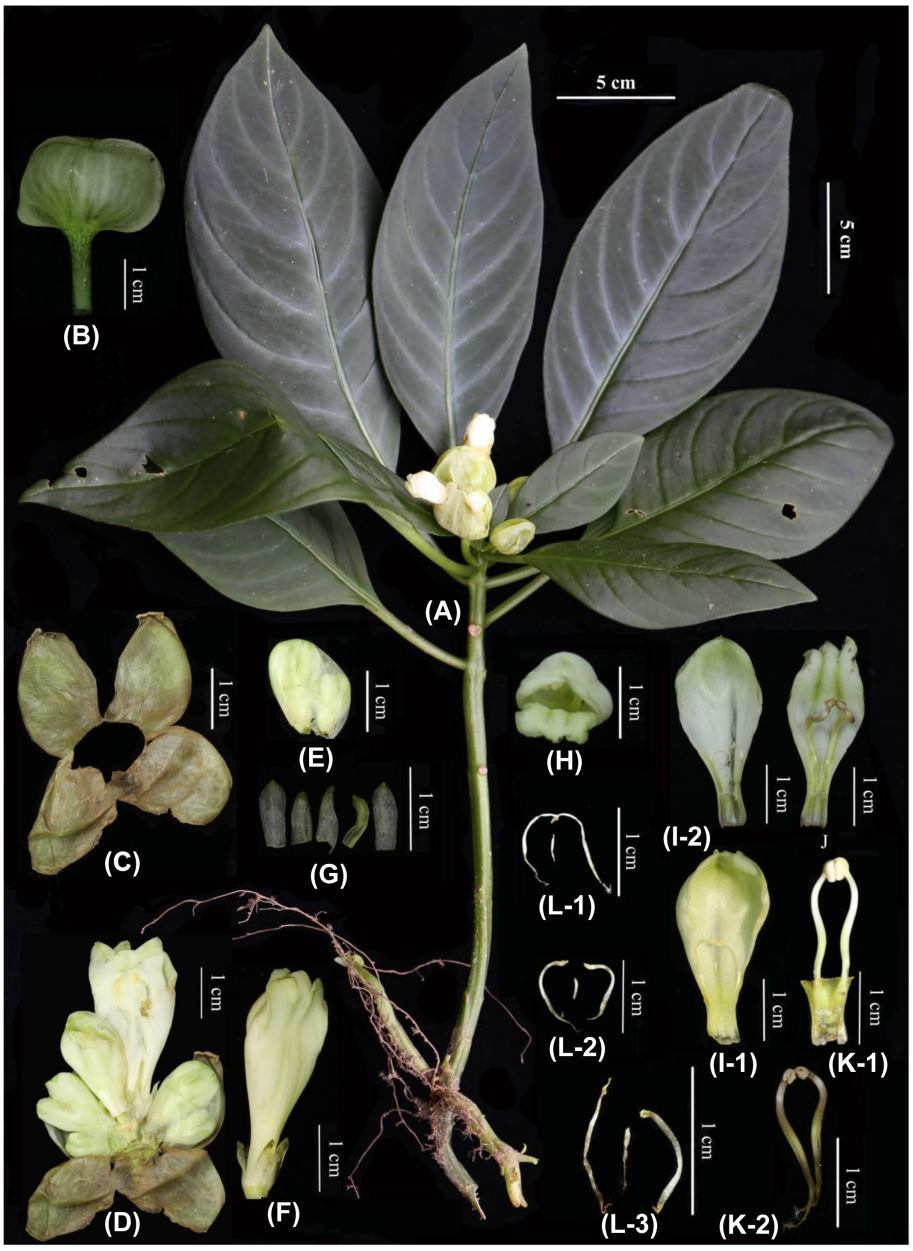

Figure 2. *Hemiboea shimentaiensis* sp. nov. (from type locality). (A) Habit, (B) involucre, (C) opened involucre, (D) cyme, (E) involucel, (F) flower, with calyx 5-parts from base, (G) calyx, (H) corolla, (I) adaxial lip with three staminode. (I-1) Lateral staminodes cohering by entire adaxial surfaces of relatively small anthers, (I-2) lateral staminodes with anthers crossing connected, (J) abaxial lip with anther and ring of hairs, (K) anther, (K-1) anthers cohering along ventral face when young, (K-2) anthers cohering apically at maturity, (L) staminodes, (L-1) lateral staminodes with small anthers cross connected, (L-2) lateral staminodes apart from each other, but antheroids at apex of staminodes, (L-3) Lateral staminodes apart from each other, anther completely degraded.

long; anthers capitate, 1.0–2.5 mm long, glabrous, anthers coherent along ventral face when young, but cohering apically at maturity; Staminodes 3, glabrous, adnate 11–14 mm above corolla base, central staminode gracile, completely sterile, like antheroids without pollen grains, 1–2 mm long; lateral staminodes thick, 7–8 mm long, resembling deformed anthers, varying from cohering with each other and with few sterile pollen grains inside to antheroids at apex of staminodes; disc ring-like, surface of disc uneven, pale yellow, 1.0–1.5 mm tall, glabrous. Pistil 2.2–2.5 cm long, glabrous; ovary nearly cylindrical, 5–7 mm long, 1.5–1.8 mm in diameter; style linear, 1.6–2.0 cm long, curved; stigma flat, ca 1 mm in diameter, slightly wider than style. Capsule ellipsoid-lanceolate, 1.2–1.5 cm long, 3.0–4.0 mm in diameter, slightly curved, glabrous, with scattered white warts (perhaps sclereids) (Fig. 3N). Ovary 2-locular, only one locule fertile; placenta 1, axile (Fig. 3G); dehiscence loculicidal at maturity (Fig. 3H–I). Seeds, flat, ovoid.

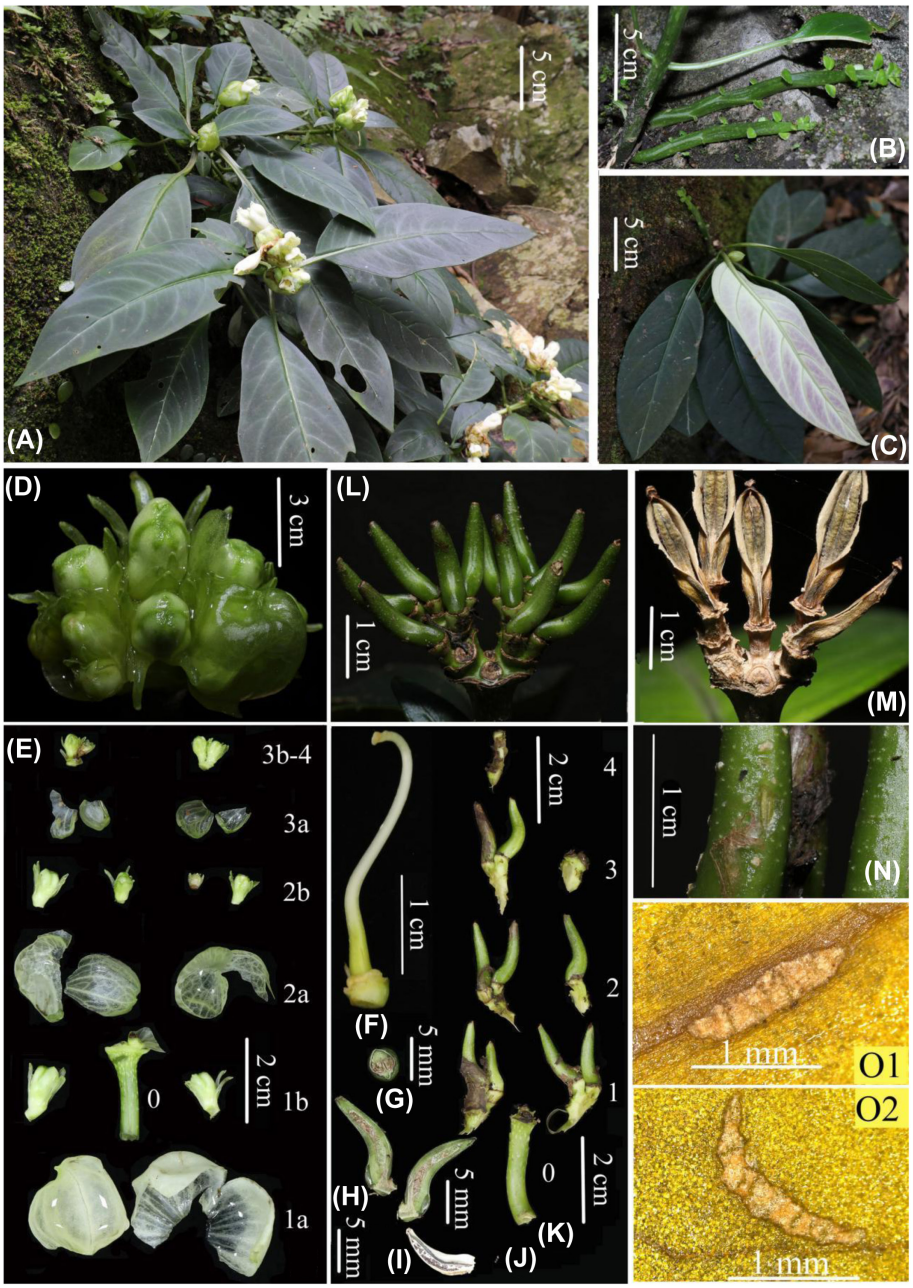

Figure 3. *Hemiboea shimentaiensis* sp. nov. (A) Habit, (B) rhizome with purple spots, (C) abaxially leaf surface, (D) cyme without phyllary, (E) flowers in dichasium. 0 peduncle, 1a phyllary, 1b two flowers of first branch, 2a involucel of second branch, 2b four flowers of second branch, 3a involucel of third branch, 3b-4 flowers and involucel of fourth branch. (F) Pistil with disk at base, (G) transverse section of ovary, 2-loculed, only adaxial locule fertile, (H) longitudinal section of immature fruit, most ovules exist within developing pericardium, (I) longitudinal section of mature fruit, with many seeds, (J) seed, (K) infructescence. 0 peduncle, 1 fruit of first branch, 2 fruit of second branch, 3 fruit of third branch, 4 fruit of fourth branch, other fruit undeveloped. (L) immature infructescence, (M) opened ripe fruits, (N) immature fruit, showing white warts on surface. (O1 and O2) Scattered vermiform sclereids surrounding vascular bundles on abaxial surface of blade (photographs by Hou-lin Wang).

Phenology

Flowering August–October; fruiting September–November.

Distribution, habitat and ecology

Hemiboea shimentaiensis is known only from Yingde, northern Guangdong Province, China. It grows in red soils in evergreen broad-leaved forests at ca 660 m a.s.l. The main herbaceous companion species were: *Cibotium barometz* (L.) J. Sm., *Pteris vittata* L., *P. multifida* Poir., *P. fauriei* Hieron., *Diplopterygium chinense* (Ros.) De Vol, *Dicranopteris pedata* (Houtt.) Nakaike, *Blechnum orientale* L., *Woodwardia japonica* (L. f.) Sm., *Odontosoria chinensis* J. Sm., *Cyclosorus parasiticus* (L.)

Table 1. Morphological comparison of *Hemiboea shimentaiensis* and similar species *H. gamosepala*, *H. rubribracteata* and *H. malipoensis*.

Species	*H. shimentaiensis*	*H. gamosepala*	*H. rubribracteata*	*H. malipoensis*
Stolons	present	absent	absent	absent
Leaves, adaxial surface	glabrous	glabrous	glabrous or few short soft hairs on the veins	glabrous
Leaf margin	entire	wavy shallow blunt teeth or near entire	mostly serrated or shallow blunt teeth	entire
Lateral veins: color	mostly silvery	green	green	green
Vermiform sclereids	on blade abaxial surface	present	present	no data
Peduncle length (cm)	1.0–2.5	1–2	3–9	3.0–3.5
Involucre color	green	green	red	green
Involucre diameter (cm)	1.8–3.3	1.8–2.3	2.2–3.5	3.5–4.0
Calyx 5-lobed from	base	middle	base	base
Corolla hairs	glabrous	scattered with glandular hairs outside	scattered with glandular hairs inside	glabrous; with purple spots inside
Anthers cohesion	ventral face when young, but cohering apically at maturity	ventral	apically	ventral
Staminode number	3	2	3	3
Lateral staminodes length (mm)	7–8	4–5	8–10	10–12
Lateral staminodes characteristics	deformed anther, varied from cohering and with sterile pollen grains to apart from each other	not cohering	not cohering	not cohering
Pistil length (cm)	2.2–2.5	1.5	2.0–2.8	3.5–3.8
Disk height (mm)	1.0–1.5	1.2	1.2–1.5	2.5–3.0
Capsule long (cm)	1.2–1.5	1.8–2.4	1.4–1.8	2.5–3.0
Habitat	non-limestone	non-limestone	limestone	limestone

Farwell., *Dryopteris decipiens* (Hook.) Kuntze, *Lemmaphyllum microphyllum* C. Presl, *Lepidomicrosorium buergerianum* (Miq.) Ching & K. H. Shing ex S. X. Xu, *Henckelia anachoreta* (Hance) D.J.Middleton & Mich.Möller, *Oreocharis benthamii* var. *reticulata* Dunn, *Cyclea barbata* Miers, *Piper austrosinense* Tseng, *Boehmeria nivea* (L.) Gaudich., *Hydrocotyle nepalensis* Hook., *Ophiorrhiza japonica* Bl., *Vernonia cinerea* (L.) Less., *Canscora andrographioides* Griff. ex C. B. Clarke, *Lycianthes biflora* (Lour.) Bitter, *Lobelia melliana* E. Wimm., *Paraphlomis javanica* (Bl.) Prain, *Pothos chinensis* (Raf.) Merr., *Alpinia oblongifolia* Hay., *Carex cruciata* Wahlenb., *Lophatherum gracile* Brongn. and *Setaria palmifolia* (Koen.) Stapf.

Conservation status

Hemiboea shimentaiensis is endemic to Shimentai Nature Reserve, Yingde County, northern Guangdong. The only population known has fewer than 50 mature individuals; The extent of occurrence (EOO) and area of occupancy (AOO) were both less than 10 km^2. Although there is no significant threats to the plants and their habitat by humans, because their habitat is in a national nature reserves, their most serious threats maybe their own breeding mechanism and natural ecological factors. Because we found the species in 2019, we have not had time to study the life cycle and population dynamics. According to the IUCN Red List Criteria (IUCN 2022), the conservation status of *H. shimentaiensis* is unknown.

Similar species

Hemiboea shimentaiensis is most similar to *H. gamosepala* of shaded montane valleys at 500–800 m, in SW Guizhou, China (Li 1983), *H. rubribracteata* on limestone in valleys at ca 550 m in Guangxi, China (Li et al. 2004) and *H. malipoensis* on limestone in forests at ca 1250 m in southeastern Yunnan, China (Zhang and Liu 2014). They share the nearly white corolla, which is in few species of *Hemiboea*, and nearly glabrous base of the inner corolla tube. Their differences are summarized in Table 1.

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Author contributions

Shen-yu Miao and **Guo-xin Guo** contributed equally to this publication. **Shen-yu Miao**: Conceptualization (equal); Funding acquisition (lead); Investigation (equal); Methodology (equal); Writing – original draft (equal).

Guo-xin Guo: Conceptualization (equal); Data curation (equal); Investigation (equal); Resources (equal); Writing – original draft (equal). **Ke-yuan Dai**: Data curation (equal); Project administration (equal); Resources (equal); Validation (equal). **Jin-hai Xiao**: Data curation (equal); Resources (equal); Validation (equal). **Yuan-qiu Li**: Conceptualization (equal); Investigation (equal); Resources (equal). **Tao Chen**: Conceptualization (equal); Funding acquisition (lead); Methodology (equal); Supervision (equal); Writing – review and editing (equal).

Data availability statement

Data are available from the Dryad Digital Repository: <https://doi.org/10.5061/dryad.j0zpc86hg> (Miao et al. 2022).

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