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## *Thismia perlisensis* (Thismiaceae), a new red-annulus *Thismia* species from Peninsular Malaysia

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### Abstract

A new species, *Thismia perlisensis*, found during a scientific expedition in the Perlis State Park, is described and illustrated. The new species was discovered in a wetland forest on a limestone foothill. Morphological description, photographic data including habitat, and a key to the species of the *Thismia* Sect. *Thismia* Subsect. *Brunonithismia* recorded from Malaysia are provided. The new species is easily distinguished from the similar species, *T. arachnites*, *T. javanica*, *T. tentaculata*, and *T. kenyirensis* by the prominent reddish dome-shaped annulus instead of ring-like with rim, deeply trilobed stigma with bifid and subulate lobes, and claviform apices of the inner tepals.

**Key words:** endemism, mycoheterotrophic plants, new species, Perlis state, plant diversity

### Introduction

*Thismia* Griffith (1845: 221) (Type: *T. brunonis* Griffith 1845: 221) belongs to family Thismiaceae and includes more than 90 accepted species occurring in, and outside the tropics (Govaerts *et al.*, 2022; POWO, 2022). Thismias are achlorophyllous and mycoheterotrophic, entirely non-photosynthetic plants that obtain energy and nutrients from mycorrhizal fungi (Leake, 1994). *Thismia* belongs to the family Thismiaceae, while earlier, it was frequently included in Burmanniaceae (Jonker, 1938). According to the recent taxonomic classification by Kumar *et al.* (2017), genus *Thismia* is divided into two subgenera, Subgen. *Ophiomeris* (Miers 1847: 328) Maas & Maas (1986: 144) and Subgen. *Thismia*. Hitherto, Peninsular Malaysia has 18 species of *Thismia* which all belongs to Subgen. *Thismia*. The subgenus is divided into five sections of which three occur in Peninsular Malaysia, (a) Sect. *Thismia* Schlechter (1921: 34) has two subsections established based on the tepal appearance, Subsect. *Brunonithismia* Jonker (1938: 242) and Subsect. *Odoardo* Schlechter (1921: 34), (b) Sect. *Sarcosiphon* (Blume 1850: 65) Jonker (1938: 251), and (c) Sect. *Geomitra* Kumar & S.W.Gale. A search for *Thismia* species in the forest is always challenging because of the dormancy, and the possibility of discovering or rediscovering them is very low. Majority of *Thismia* species seem to have been collected only once or a few times because the supraterrestrial and ephemeral parts of *Thismia* can be recognized only at the flowering and fruiting stage (Tsukaya & Okada, 2012). The aboveground parts usually sprout during or after a rainy season (Leake, 1994). In the past few years, several new species of this genus have been unveiled including *Thismia kelantanensis* Siti-Munirah (2018: 1), *T. terengganuensis* Siti-Munirah (2019: 130), *T. domei* Siti-Munirah (2019: 125), *T. belumensis* Siti-Munirah & Suhaimi-Miloko (2021: 124), *T. latiffiana* Siti-Munirah & Dome (2022: 107), *T. limkokthayi* Siti-Munirah & Eddie Chan (2022: 3), *T. kenyirensis* Siti-Munirah & Dome (2023: 64), and *T. malayana* Siti -Munirah, Hardy-Adrian, Mohamad-Shafiq & Irwan-Syah (2024: 230). In addition to this, during the

recent scientific expedition, our botanical team accompanied by members of NGOs (Perlis Nature Wildlife and Perlis Climbers) and General Operations Force (PGA), discovered another new species of *Thismia* in a wetland forest in Perlis State, Peninsular Malaysia. Here in this paper, we describe this previously unrecognised mycoheterotrophic species and provide a key to the Malesian species of the genus.

## Materials and methods

The specimen was kept in a Copenhagen solution [70% (v/v) methylated spirit, 29% (v/v) distilled water, 1% (v/v) glycerol] and deposited in the Herbarium of Department of Biology, Universiti Putra Malaysia (UPM). The structure of the entire plant was examined under a digital dissecting microscope (AM4113ZT Dino-Lite Digital Microscope, AnMo Electronics Corporation, Taiwan). The morphology was compared in detail with the botanical drawings and descriptions published in the protologues, monographs, and taxonomic research papers of *Thismia* species in the Malesian and Indo-China floristic regions including Smith (1910), Jonker (1948), Larsen & Averyanov (2007), Ho *et al.* (2009), Chantanaorrapint (2018), Tanaka *et al.* (2018), and Siti Munirah (2022).

## Taxonomic treatment

*Thismia perlisensis* Besi & Rusea *sp. nov.* (Figs. 1 & 2).

**Type:**—MALAYSIA. Peninsular Malaysia: Perlis State, Perlis State Park, ca. 100 m elev., 4 October 2022, *E.E. Besi, M.I. Mat Esa, S.H. Tan, D. Sandin & R. Go EDW136* (holotype UPM spirit collection).

**Diagnosis:**—*Thismia perlisensis* can be easily distinguished from the *Thismia arachnites* Ridley (1905: 197) and *Thismia javanica* J.J.Sm. (1910: 32) by the blood-red, dome-shaped annulus (vs. ring-like with rim, orange annulus), prominent trilobed stigma with 1.8 mm long, bifid and subulate lobes (vs. ovate, truncate stigma), and claviform apices of appendages of the inner tepals (vs. subulate apices of appendages of the inner tepals).

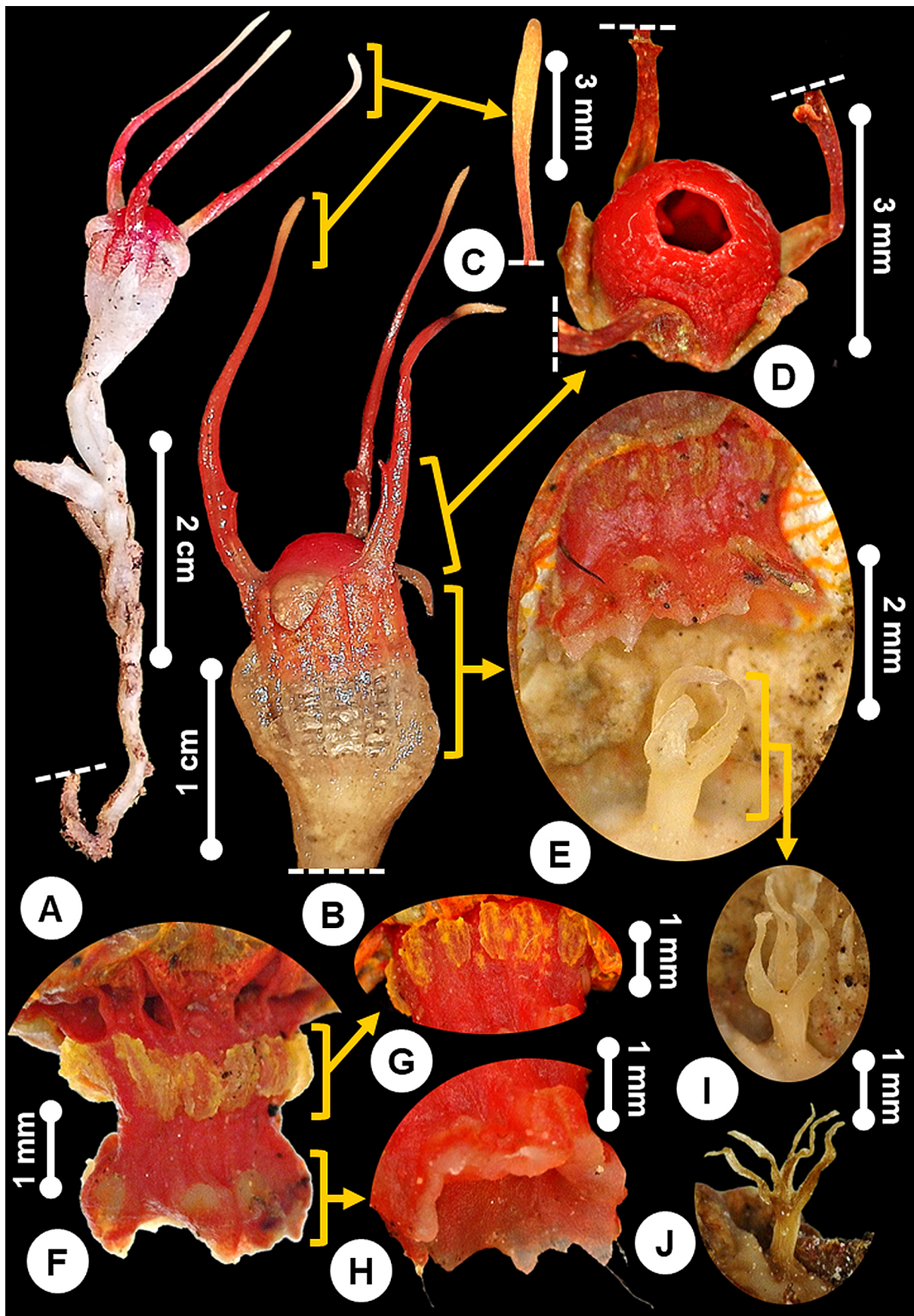
**Description:**—**Herb** achlorophyllous, small, terrestrial, ca. 5 cm tall. **Roots** clustered, horizontal, vermiform, fleshy, light brown tinged with white. **Stem** 1 cm long, erect-ascending, unbranched, 1–1.5 mm in diameter, white, glabrous. **Leaves** 4, white, appressed, clasping stem, narrowly triangular with acute apex, scale-like, 3–6 mm long, 0.9–2 mm wide; basal leaves smallest, upper leaves (almost equivalent to floral bracts) largest. **Floral bracts** oblong-triangular, entire, acute, ca. 1 cm long, 2 mm wide, pale brown. **Pedicel** 2–3 mm long, white. **Inflorescence** flowers solitary, actinomorphic, of six fused tepals, forming a floral tube with free apical tepals, ca. 3.5 cm long to the tip of the inner tepal appendage; white to dark red; **floral tube** (hypanthium) urceolate, ca. 1.2 cm in height, ca. 8.4 mm in width in the upper part, translucent; apex of floral tube fused to form a bright red, glossy, convex annulus, 0.8–1.0 mm wide, longitudinally grooved with 7 vertical ribs, reddish at upper part; **outer surface** white with ca. 12 vertical reddish streaks on the upper half of the ribs, verrucose, ribbed; **inner surface** reticulate, transverse bars present; **outer tepals** 3, ovate, apex obtuse to rounded, tongue-like, hangs down over the upper margin of the perianth tube, 2.3 mm long, 2 mm wide at base, white; **inner tepals** 3, erect, narrowly triangular, apices obtuse, ca. 3 mm long, ca. 0.9 mm wide at base, tapering from the proximal lower margin into a long, reddish to reddish white filiform appendages, ca. 2 cm long, ca. 0.4 mm in diameter, apices claviform, 3 mm long, 0.5 mm in diameter; **annulus** (apical part of the floral tube) blood red, rounded, ca. 7 mm wide, convex, raised ca. 2 mm in height, dome-shaped, without rim, connected with the inner tepals; upper surface glossy; aperture, ca. 1.2 mm in diameter, hexagonal; lower margin minutely rugose; **stamens** 6, reddish, pendent from the annulus, 3 mm long, 2.8 mm in diameter, individual stamen with 2 thecae, thecae ca. 0.8 mm long and 0.5 mm wide; **filaments** 6, reddish, 0.5–0.8 mm long with apertures 0.2 mm wide in between filaments; **supraconnectives** 6, ca. 2.6 mm long, laterally connate, forming a tube, glabrous on the outer surface, apices tridentate with an indistinct and fragile hair on the free margins, with a triangular to quadrangular lateral appendages, upcurved; **interstaminal glands**, rounded, on the line of fusion between each connective; **pistil** ca. 2–2.3 mm long, white; **style** ca. 0.8 mm long, cylindrical, slender, erect, glabrous; **stigma** ca. 1–1.5 mm long, up to 1.8 mm long when the lobes straightened, glabrous, 3-lobed; lobes bifid, narrowly triangular or subulate, apices acute, lobes apices curved inward, white; **ovary** inferior, cup-shaped or obconical, ca. 2 mm long. **Fruit** not seen.





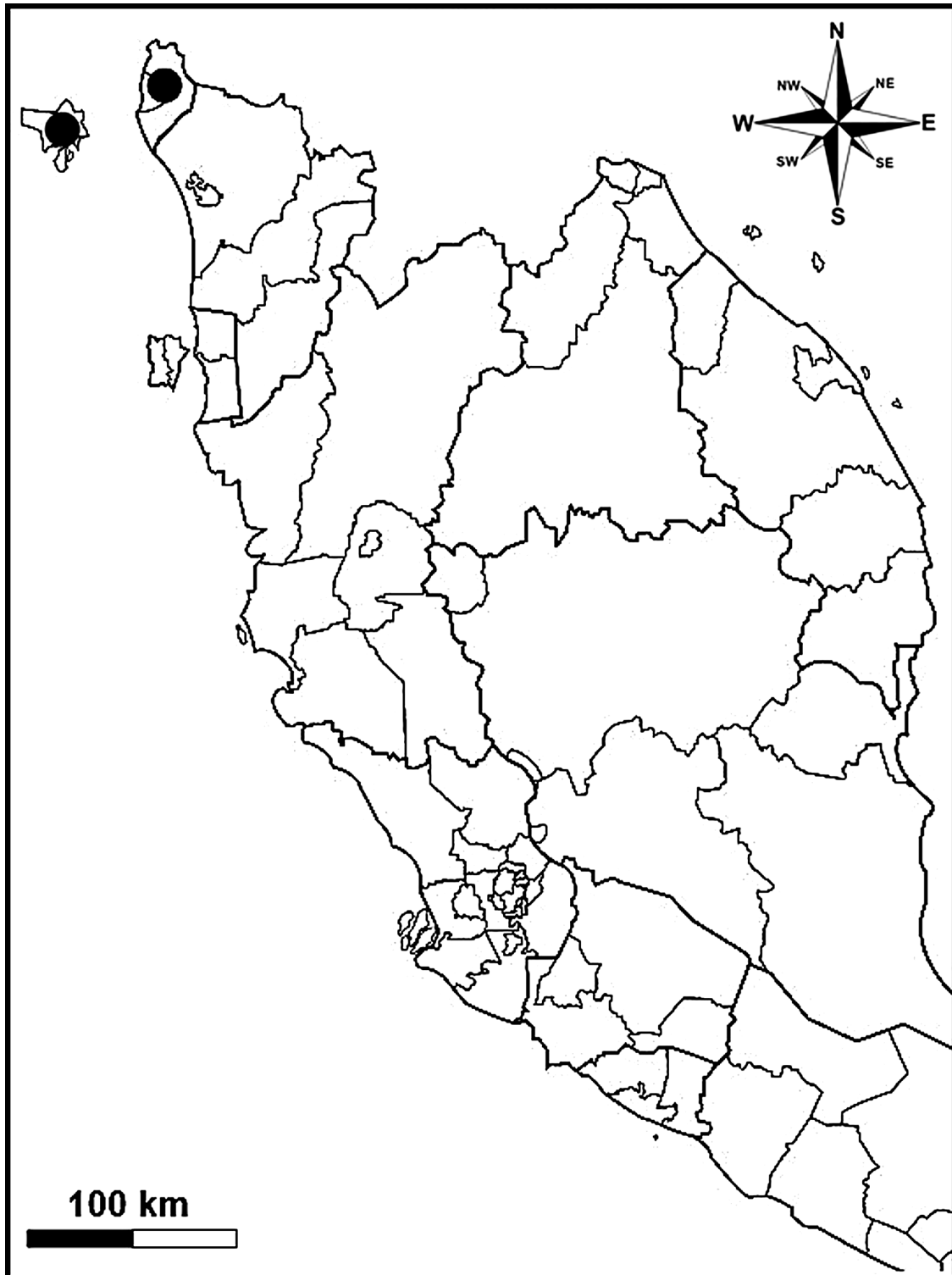
FIGURE 1. *Thismia perlisensis* in the wild. Images by Edward Entalai Besi and Muhamad Ikhwanuddin Mat Esa.





**FIGURE 2.** Flower's dissection of *Thismia perlisensis*. **A.** Plant. **B.** Flower. **C.** Claviform apex of an inner tepals. **D.** Dome-shaped annulus. **E.** Stamens and pistil. **F.** Stamens. **G.** Anther thecae. **H.** View of the supraconnectives. **I, J.** Pistil with stigmas straightened showing subulate lobes. **B–J** spirit-preserved specimens. Images by Edward Entalai Besi.

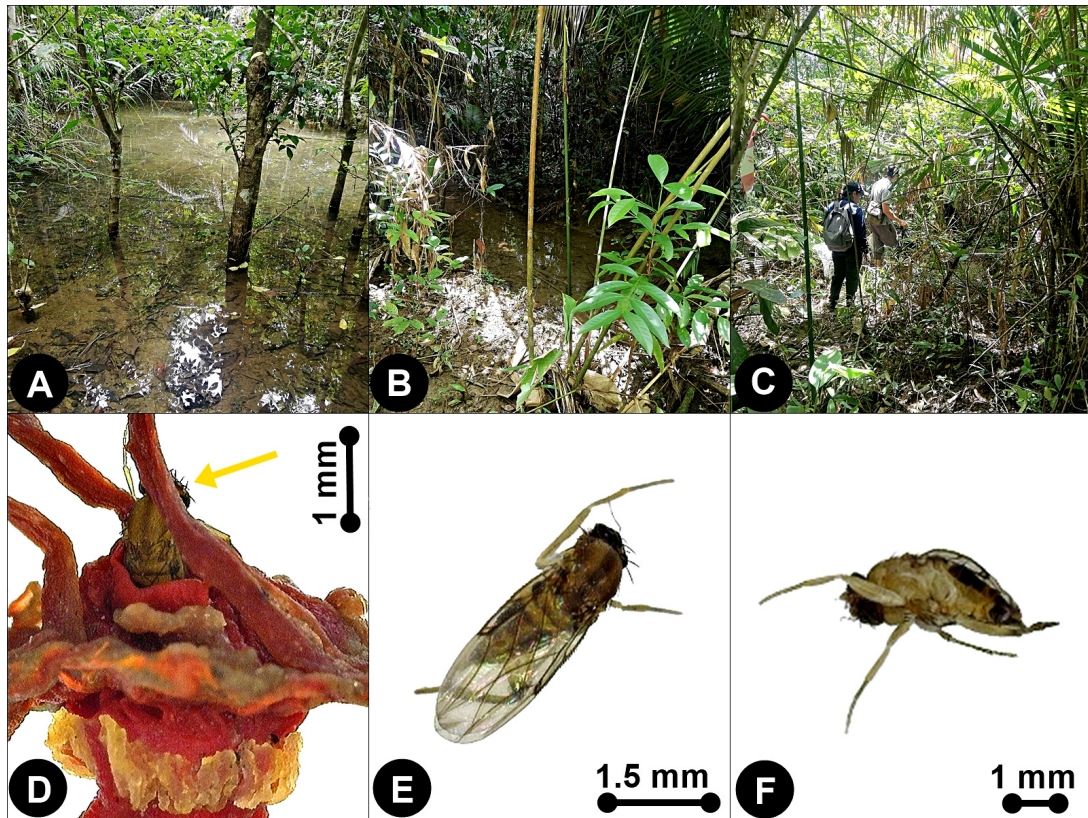
**Distribution:**—Stenoendemic to the northern part of Peninsular Malaysia, Perlis State, and it possibly occurs in Langkawi Island (Fig. 3). While there have been sightings of the plant on Langkawi Island, these locations have only been based on photos posted on social media. Currently, there are no specimens or additional information to confirm these locations.



**FIGURE 3.** Map of Peninsular Malaysia showing locations of *Thismia perlisensis* (●).

**Habitat and ecology:**—Growing on a damp sandy soil of a wetland forest, under shade of fan palms, *Licuala peltata*, *Donax caniniformis*, and *Eugeissona tristis* at an elevation of about 100 m a.s.l.. Flowering was recorded in October. A fly (Diptera) was observed to be trapped in the floral tube (Fig. 4). The fly must have been trapped inside the flower during the sample collection. This supports the observation made by Guo *et al.* (2019) who confirmed that Diptera often visit *Thismia* flower.





**FIGURE 4.** Habitat and ecological interactions of *Thismia perlisensis*, including a floral visitor. **A, B, C.** The habitat views. **D, E, F.** A Diptera species trapped within the floral chamber of *T. perlisensis*. Images by Edward Entalai Besi.

**Etymology:**—The specific epithet is named after Perlis State, the type locality of this species.

**Conservation status:**—*Thismia perlisensis* was discovered at its type locality in Perlis State Park, where minimal human activity helps protect its habitat. However, being a holomycoheterotrophic species, its cryptic growth habit and brief flowering period make estimating mature individuals difficult. Nothing much is known about the habitat and ecological preference, population structure of the species. Thus, following the IUCN Red List Categories and Criteria version 14 (August 2019) (IUCN Standards and Petitions Committee, 2019), *T. perlisensis* is assessed currently as Data Deficient (DD). More studies and monitoring of this species are highly recommended.

**Taxonomic notes:**—Following the taxonomic treatment of Jonker (1948), Sect. *Thismia* Schltr. (Sect. *Euthismia* Schltr.) is classified into two subsections, Subsect. *Odoardoa* Schltr. with tepals equal in length and size, and Subsect. *Brunonithismia* Jonker with inner tepals larger than outer ones (Jonker, 1948). The new species belongs to *Thismia* Sect. *Thismia* Subsect. *Brunonithismia* (Type: *T. brunonis* Griff.). In addition, following the identification key of the subgenera, sections, and subsections of *Thismia* in Kumar *et al.* (2017), *T. perlisensis* is falling within the Subgen. *Thismia* Sect. *Brunonithismia* by having anther thecae free, mitre absent, and free tepals distinctly dissimilar in shape and size. In the Subsect. *Brunonithismia*, the gross morphology of *T. perlisensis* is similar to that of several other species with actinomorphic flower with ovate outer tepals, such as *T. arachnites*, *T. breviappendiculata* Nobuyuki Tanaka (2018: 68), *T. javanica*, and *T. tentaculata* Kai Larsen & Averyanov (2007: 16). Previously, only *T. arachnites* and *T. javanica* were reported occurring in Peninsular Malaysia. *Thismia perlisensis* is similar to *T. javanica*, in having the urceolate floral tube, inner wall of floral tube with longitudinal ribs connected by many transverse bars, outer tepals ear-shaped and ovate, inner tepals triangular terminated with filiform tentacles, dentate connective apical margins. However, *Thismia perlisensis* is easily distinguished by its outer appearance, the prominent reddish dome-shaped annulus with a small aperture, instead of yellowish or orangish annulus with rim (raised margins, ring-like) and a wider (more than 2 mm wide) aperture. The dome-shaped and blood-red annulus in the new species is unique. The raised, dome-shaped, glossy, and blood-red coloured annulus distinguishes *T. perlisensis* from all its congeners. In addition, aside from the size differences of the vegetative and floral parts, none of these species share bifid and subulate stigmatic lobes as in *T. perlisensis* (Table 1). Similar to *T. breviappendiculata*, an endemic species to Myanmar, *T. perlisensis* has inner tepals filiform with claviform apex but differs in the total length of the tepals ( $2 \times 0.7$  cm), and shape of annulus

and stigmas. To date, apart from *T. perlisensis* and *T. breviappendiculata*, no other species of Subsect. *Brunonithismia* bearing tepal appendages with claviform apices has been discovered and reported.

Key to the species of *Thismia* Subgen. *Thismia* Sect. *Brunonithismia* modified from Tsukaya & Okada (2012):

1. Flowers zygomorphic ..... *T. labiata*  
Flowers actinomorphic ..... 2
2. Inner tepals simple. Tube with prominent horizontal bars inside ..... 3  
Inner tepals consisting of 3 parts. Perianth tube without bars ..... *T. neptunis*
3. Stigma (including style) ca. 1-2 mm long, trilobed; lobes ca. 1 mm long, oblong-quadrangular, truncate, finely papillose ..... 4  
Stigma (including style) ca. 3 mm long, trilobed; lobes ca. 1.8 mm long, bifid, subulate, apices curved inward, glabrous ..... 5
4. Outer tepals short, ear-shaped ..... *T. javanica*  
Outer tepals long, petaloid ..... *T. kenyirensis*
5. Annulus with rim, round-hexagonal ..... *T. arachnites*  
Annulus dome-shaped, without rim ..... *T. perlisensis*

**TABLE 1.** Morphological comparison of *Thismia perlisensis*, *T. arachnites*, *T. javanica*, *T. tentaculata*, and *Thismia kenyirensis*. **Species references:**—*Thismia arachnites* Ridl. (Chantanaorrapint, 2018); *Thismia breviappendiculata* Nob. Tanaka (Tanaka *et al.*, 2018); *Thismia javanica* J.J.Sm. (Smith, 1910; Jonker, 1948; Siti-Munirah, 2022); *Thismia kenyirensis* Siti-Munirah & Dome (Siti-Munirah & Nikong, 2023); *Thismia tentaculata* K.Larsen & Aver. (Larsen & Averyanov, 2007; Ho *et al.*, 2009).

Characters		<i>T. perlisensis</i>	<i>T. arachnites</i>	<i>T. javanica</i>	<i>T. tentaculata</i>	<i>T. kenyirensis</i>
<b>Plant</b>	Height	ca. 5 cm	ca. 12 cm	ca. 12 cm	ca. 7 cm	ca. 13 cm
	Stem	Length	ca. 1 cm	7–12 cm	ca. 12 cm	ca. 7 cm
<b>Leaf</b>	Shape	Narrowly triangular	Lanceolate	Ovate or lanceolate-ovate	Narrowly triangular	Triangular to narrowly triangular
	Size	3–6 × 0.9–2 mm	3–4 mm long	3 mm long	2–8 × 0.5–2 mm	2–6 × 1 mm
<b>Inflorescence</b>	Flower number	1	1–5	1–5	1–3	
<b>Floral bracts</b>	Shape	Oblong-triangular	Ovate-lanceolate	Ovate-lanceolate	Narrowly triangular	Triangular to narrowly triangular
	Size	ca. 1 × 0.2 cm	5–7 mm long	Unknown	2–8 × 0.5–2 mm (same as leaves)	8 × 1.5–2.5 mm (same as leaves)
<b>Flowers</b>	Colour	White to red	White to orange	White to orange	White to orange	Pale brown or pale orange
<b>Hypanthium</b>	Shape	Urceolate	Campanulate	Campanulate	Campanulate	Urceolate
	Size	12 × 8.4 mm	14 × 8 mm	6–8 mm long	8–12 × 5–7 mm	12–15 × 5–6 mm
	Colour	White with reddish vertical streaks	White to yellow with reddish vertical streaks	White with orangish vertical streaks	Pure white	Orange to brownish-orange with darker orange vertical streaks
	Inner surface texture	Reticulate	Reticulate	Reticulate	Finely irregular manicate-rugulose	Smooth or rough without reticulate ornamentation
	Transverse bars	Present	Present	Present	Absent	Absent

.....continued on the next page

TABLE 1 (Continued)

Characters		<i>T. perlisensis</i>	<i>T. arachnites</i>	<i>T. javanica</i>	<i>T. tentaculata</i>	<i>T. kenyirensis</i>
<b>Tepals</b>	Outer tepal shape	Ovate	Ovate	Ovate	Triangular	Petaloid, ovate to obovate
	Outer tepal size	2.3 × 2 mm	5–6.5 × 4.5–5.5 mm	1.3–2.3 mm long	ca. 2 × 2 mm	8 × 4–5.5 mm
	Outer tepal colour	White	Orange	Orange	Orange	Orange
	Inner tepal length	Up to 2 cm	Up to 3.4 cm	1.6–3 cm long	Up to 1.6 cm	8 mm
	Inner tepal apices	Claviform	Narrowly acute	Narrowly acute	Narrowly acute	Narrowly acute
	Inner tepal colour	Red to orange	Red to orange	Red to white translucent	Red to orange	Dark to bright orange
<b>Annulus</b>	Shape	Dome-like	Round or hexagonal with rim	Round or hexagonal with rim	Round or hexagonal with rim	Round with rim
	Rim	Absent	Present	Present	Present	Present
	Colour	Bright red	Yellowish orange	Yellowish orange	Yellow	Dark orange
	Aperture	Small, <1.5 mm wide	Large, >2 mm wide	Large, >2 mm wide	Large, >2 mm	Small, 2–3 mm wide
<b>Stamens &amp; connectives</b>	Colour	Red	Yellowish white	Yellowish white	Yellowish white	Greenish orange to greenish brown
	Length	ca. 2.6 mm	ca. 4 mm	ca. 4 mm	ca. 5 mm	ca. 5 mm
	Apices	Dentate with 3 distinct teeth	Dentate with indistinct	Dentate with 3 distinct teeth	Finely crenulate	Finely crenulate
<b>Ovary</b>	Shape	Obconical	Obconical	Obovoid	Obconical to obovoid	Obconical to obovoid
<b>Stigma</b>	Shape	Trilobed	Trilobed	Ovate, apex truncate	Trilobed	Trilobed
	Texture	Glabrous	Glabrous	Finely papillose	Finely papillose	Finely papillose
	Lobes shape	Subulate and bifid	Lanceolate	Rectangular	Ovate, shortly notched	Rectangular

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