Thismia brunneomitra, another new species of Thismia (Thismiaceae) from Ulu Temburong, Brunei Darussalam

MICHAL HRONEŠ1, LUCIE KOBROVÁ1, VOJTĚCH TARÁŠKA1, ONDŘEJ POPELKA1, RADIM HÉDL1,2, RAHYU SUKMARIA SUKRI3, FAIZAH METALI3 & MARTIN DANČÁK4

1 Department of Botany, Faculty of Science, Palacký University, Šlechtitelů 27, CZ-78371 Olomouc, Czech Republic; email: michal.hrones@gmail.com
2 Institute of Botany, Czech Academy of Sciences, Lidická 25/27, CZ-60200 Brno, Czech Republic
3 Universiti Brunei Darussalam, Environmental and Life Sciences Programme, Faculty of Science, Jalan Tungku Link, BE1410, Brunei Darussalam
4 Department of Ecology and Environmental Sciences, Faculty of Science, Palacký University, Šlechtitelů 27, CZ-78371 Olomouc, Czech Republic

Abstract

A new species of Thismia (Thismiaceae) from northwest Borneo is described and illustrated. Thismia brunneomitra was discovered in 2015 in lowland mixed dipterocarp forest in the Ulu Temburong National Park, Temburong district of Brunei Darussalam. The new species is characterized by brown to blackish flowers with twelve darker vertical stripes on the perianth tube, inner tepal lobes that are connate to form a mitre with three very short processes at the apex, three-toothed apical margin of the connective and large wing-like appendage of the connective. An updated determination key of Thismia species found in Borneo is included.

Key words: mycoheterotrophy, Malesia, mixed dipterocarp forest, Sarcosiphon

Introduction

Primary tropical rainforests of Borneo are one of the most species-rich ecosystems in one of the world’s biodiversity hotspots (Myers et al. 2000). The island harbours some 15,000 vascular plant species in an area of 743,330 km², of which ca. 37% are endemic (Raes et al. 2009). The lowland mixed dipterocarp forest represents the dominant natural forest habitat in Borneo (Primack & Corlett 2005). Unfortunately, these forests are threatened by large-scale timber extraction, as they contain several economically important tree species (Bryan et al. 2013). Thus, a combination of unique biodiversity and rapid deforestation has highlighted Borneo as a priority for nature conservation.

One of the most intriguing inhabitants of the primary tropical forests of Borneo are small mycoheterotrophic herbs from the genus Thismia Griffith (1844: 221; Thismiaceae, or alternatively Burmanniaceae; for discussion see Merckx et al. 2006). Species of this genus are chlorophyllous plants with very specific and complex morphology.

Currently, almost 60 species are recognized in the genus (Hroneš 2014, Hunt et al. 2014, Mar & Saunders 2015, Chantanaorrapint & Sridith 2015). Species of Thismia have scattered distribution through the (sub-)tropical areas of the Asia, Australia, New Zealand and South America (Jonker 1938, Maas et al. 1986, Hunt et al. 2014). Along with Thailand, Borneo represents one of the species diversity centres of the genus (Dančák et al. 2013, Chantanaorrapint et al. 2015).

According to Jonker (1938), Bornean species with free perianth lobes and creeping rhizomes are treated as section Thismia, while species with connate perianth lobes forming mitre-like flowers and dense coralliform rhizomes are treated as section Sarcosiphon (Blume 1850: 65) Jonker (1938: 251). In Borneo, two species from this section are known: T. episcopalis (Beccari 1877: 250) F. Mueller (1891: 235) and T. goodii Kiew (1999: 179).

During our recent expedition to Ulu Temburong in January and February 2015, we found a species of Thismia with fused tepals, which turned out to be another taxonomic novelty. This finding is only the second record of the family Thismiaceae for Brunei Darussalam (see Dančák et al. 2013).
Material & Methods

This study is based on material collected during February 2015 in the vicinity of the Kuala Belalong Field Studies Centre (KBFS), Brunei Darussalam. Morphological characters were studied using stereo microscope and high-resolution macro photography. Collected specimens were thoroughly compared with original drawings and descriptions given in protologues of Thismia sect. Sarcosiphon and also with high-resolution image of Thismia episcopalis type specimen (Beccari 1504 deposited in FI).

Description

Thismia brunneomitra Hroneš, Kobrlová & Dančák, sp. nov., Fig. 1

Similar to Thismia episcopalis, but differing in having 1–2 flowers per individual, presence of three short processes at the apex of the mitre, free apical margin of the stamen connective with two broad obtusely triangular lateral lobes and narrowly triangular middle lobe, large entire wing-like lateral appendage of the connective and brown to blackish colour of the perianth tube (Table 1).

Type:—BRUNEI DARUSSALAM. Temburong distr.: Kuala Belalong, right bank of the stream Sungai Mata Ikan, ca. 150 m NW from the Kuala Belalong Field Studies Centre. Coordinates WGS 84: N 04°32´51.2˝; E 115°09´24.5˝; elevation ca. 105 m a.s.l., 3 February 2015. Hroneš & Kobrlová 402015 (holotype BRUN! [herbarium specimen, accession number B031129], isotype OL! [herbarium specimen, accession number 31594]).

Description:—Perennial achlorophyllous mycoheterotrophic herb, 6.2–8 cm tall. Roots coralliform, slightly branched towards the apex, whitish. Stem 4.5–6.5 cm tall, ascending to erect, simple, one or two flowered, sparsely shortly hairy, mostly pale brown (Figs 1A, 2A, B), blackish when young (Fig. 2C); pedicel dark brown to blackish and elongating after anthesis (Fig. 2D). Leaves 6–7, spirally arranged, well-spaced, scale-like, triangular, acute, entire, 3.5–5 mm long, 2–3 mm wide at base, pale brown, glabrous. Floral bracts three, similar in shape to leaves but slightly larger, 5.5–7 mm long, 3.5–5 mm wide at base, keeled, enveloping base of flower, pale brown. Flowers bisexual, actinomorphic, 1.6–1.7 cm long, 0.9–1 cm wide at top of perianth tube; perianth tube urceolate, of 6 fused tepals; outer surface with six longitudinal ribs, dark brown to blackish when young, later pale brown to brown with 12 vertical dark brown stripes; outer tepal lobes absent; inner tepal lobes well-developed, connate at top and forming mitre with three holes, 5–7 mm tall; holes reniform-elliptic to almost rounded, 4–6 mm wide, 2–4 mm high; mitre dark brown to blackish when young, at maturity dark brown with paler brown to reddish-brown apex and margins of holes, topped by three short obtuse processes (Figs 1B, 2E). Annulus absent. Stamens 6, hanging from top of perianth tube, bluish to purplish (Figs 2G–I); connectives flattened, ribbon shaped, connate to form tube; individual connective with two tufts of glandular hairs on adaxial side and three lobes on free apical margin; lateral lobes wide, obtusely triangular; middle lobe narrowly triangular (Figs 1D, 2I); each lobe terminated by tuft of glandular hairs; lateral appendage of connective flattened, large, wing-like, protruding outwards to the perianth tube, with marginal glandular hairs; thecae whitish (Figs 1C, 2G). Style trifid, papillose, terminated by very shallowly notched stigmas (Fig. 2F); ovary obconical, with six vertical ribs on surface and blackish horizontal line at apex. Capsule cup-shaped, brown to dark brown, sparingly hairy, topped by basal ring of perianth tube and withered style (Fig. 2D). Seeds not seen.

Variability:—The basic colour of the perianth tube and the mitre varies from almost black to brown-reddish. The number of flowers in one individual varies from one to rarely two.

Habitat and ecology:—Shaded understory of lowland mixed dipterocarp forest. The only known site is in a ravine of a small stream. The terrain is steep, rocky and somewhat disturbed, with patches of bare mineral soil. Plants were found primarily in these bare patches with several individuals growing on a rock crevice just next to the stream in association with Diplazium cordifolium Blume (1828: 190), Epipremnum falcifolium Engler (1898: 11), Mapania monostachya Uitien (1935: 194), Schismatoglottis asperata Engler (1879: 297) and Selaginella involvens agg. Several other mycoheterotrophic species were recorded around, within a distance of 5 m: Epiprénaxanthés elongata Blume (1823: 82), E. papuana J.J.Smith (1912: 486), Sciaphila densiflora Schlechter (1912: 87), S. secundiflora Whaites ex Bentham (1855: 10) and Gymnosiphon aphylus agg.

Distribution:—Thismia brunneomitra was found near the Kuala Belalong Field Studies Centre in the Temburong district of Brunei Darussalam. The only known population occurs on the right bank of the small stream Sungai Mata Ikan, approximately 100 m from its confluence with the Belalong River and near the “Ashton trail” forest circuit.

**Conservation status:**—Population of *T. brunneomitra* occurs within the designated research zone of Ulu Temburong National Park, to which public access is restricted. The type locality and its surroundings are thus protected from logging or other destructive anthropogenic activities. However, given that after a thorough search, no more than 15 individuals were noticed, and that the population is situated near relatively frequented forest trail, we suggest evaluating the species as critically endangered (CR) according to the IUCN Red List Categories and Criteria (IUCN 2012).
Etymology:—Name of the species is composed from Latin words brunneus (brown) and Greek mitra, referring to the typical colour and shape of the flowers.

Taxonomic affinities

Thismia brunneomitra belongs to the section Sarcosiphon. Members of this section share several characteristics, such as coralliform rhizomes, three floral bracts enveloping the base of the flower and inner tepal lobes fused at the top and forming a mitre. Up to now, this section included five species, Thismia clandestina (Blume 1850: 65) Miqel (1855: 616) from western Java, T. crocea (Beccari 1877: 249) J. J. Smith (1909: 193) from West Papua, T. episcopalis and T. goodii Kiew (1999: 179) from Sarawak and T. yorkensis Cribb (1995: 51) from northern Australia. Moreover, two other species, T. clavigera (Beccari 1877: 251) F. Mueller (1891: 235) and T. betung-kerihunensis Tsukaya & Okada (2012: 56), both known from western Borneo, are sometimes included to this section (Tsukaya & Okada 2012). Thismia brunneomitra is readily distinguished from the two last species by the absence of the long clavate segments on the apex of the mitre. Flowers of T. yorkensis are white with well developed outer perianth lobes and inner perianth lobes wide, forming hemispherical mitre (Cribb 1995). Thismia crocea flowers have much longer perianth tube with a distinct constriction in the middle, stamen tube inserted near the constriction inside and the mitre with small triangular holes formed by wide inner perianth lobes (Beccari 1877). The remaining species from Java and Borneo are therefore morphologically most similar. Thismia goodii differs by the blue colour of the flowers and glabrous stamens, and T. clandestina differs by its conspicuous annulus, shorter mitre and two (or sometimes three) asymmetrical lobes on the free apical margin of the connective (Smith 1911, Jonker 1938, Kiew 1999). This leaves T. episcopalis the most similar to T. brunneomitra (see Table 1).

### TABLE 1. Main morphological differences among members of Thismia sect. Sarcosiphon (T. betung-kerihunensis and T. clavigera excluded) from Borneo and Java.

<table>
<thead>
<tr>
<th></th>
<th>T. brunneomitra</th>
<th>T. clandestina</th>
<th>T. episcopalis</th>
<th>T. goodii</th>
</tr>
</thead>
<tbody>
<tr>
<td>number of flowers</td>
<td>1(−2)</td>
<td>1–3</td>
<td>1–7</td>
<td>1(−2)</td>
</tr>
<tr>
<td>perianth coloration</td>
<td>brown to blackish with</td>
<td>pale brown to dark</td>
<td>orange-yellow</td>
<td>white with faint dark</td>
</tr>
<tr>
<td></td>
<td>12 longitudinal dark</td>
<td>greenish gray with 12</td>
<td>longitudinal dark brown</td>
<td>green tinge and narrow</td>
</tr>
<tr>
<td>brown stripes</td>
<td>stripes</td>
<td></td>
<td></td>
<td>dark blackish green</td>
</tr>
<tr>
<td>outer perianth lobes</td>
<td>absent</td>
<td>absent</td>
<td>absent</td>
<td>absent</td>
</tr>
<tr>
<td>height of mitre (mm)</td>
<td>5–7</td>
<td>ca 2(−4)</td>
<td>ca 5</td>
<td>(5−)7(−9)</td>
</tr>
<tr>
<td>mitre apex</td>
<td>not fully connate with</td>
<td>obtusely acuminate without any projections</td>
<td>obtuse without any projections</td>
<td>acuminate without any projections</td>
</tr>
<tr>
<td>teeth on free apical part of connective</td>
<td>3; middle lobe narrowly triangular, lateral lobes larger, obtusely triangular present</td>
<td>2–3; asymmetrical, with additional several bristle-like laciniae present</td>
<td>3; all teeth obtusely triangular, all similar in shape and size present</td>
<td>3; middle lobe wide, triangular, lateral lobes smaller present</td>
</tr>
<tr>
<td>hairs on apical part of connective</td>
<td>large, entire, exceeding whole apical part of the connective</td>
<td>dentate, not exceeding apical part of the connective</td>
<td>entire, slightly undulated, not exceeding apical part of the connective</td>
<td>? (not stated in the protologue)</td>
</tr>
<tr>
<td>lateral appendage of the connective</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The colour of the perianth tube of T. episcopalis is described as “luteo-crocei” by O. Beccari, i.e. yellow-orange, whereas in our species perianth tube is brown to blackish. Number of flowers is generally higher in T. episcopalis, in which varies from 1 to 7, than in T. brunneomitra, in which only one or rarely two flowers per individual plant were recorded. The mitre of T. episcopalis has round holes and entire, blunt apex in comparison with T. brunneomitra, in which mitre holes are rather reniform-elliptic and there are three short erect obtuse projections on the apex, which represent tips of the perianth lobes. Differences between these two species also exist in the size and shape of the stamens. Free apical margin of connective in both species bear three teeth. However, the teeth architecture differs—all three teeth are ± similar in shape and size in T. episcopalis, but in T. brunneomitra the two lateral teeth are noticeably larger and obtusely triangular while the central tooth is narrowly triangular. Lateral appendage of the connective is much larger, exceeding whole apical part of the connective when viewed from the outside of the flower in T. brunneomitra, while the appendage of T. episcopalis is noticeably shorter than the apex of the connective (Table 1).
Revised key of genus *Thismia* in Borneo modified after Tsukaya & Okada 2012

1. Perianth lobes free; roots creeping, vermiciform ................................................................. 2
2. Perianth lobes connate above the mouth of the perianth tube; roots clustered, coralliform ................................................................. 7
3. All perianth lobes simple, of the same length and size .......................................................... 3
4. Inner perianth lobes simple, outer perianth lobes consisting of three parts ............................... *Thismia neptunis*
5. Perianth tube with distinct transverse bars at least at the base; stigmas bifid ................................................ *Thismia ophiurus*
6. Perianth tube without transverse bars; stigmas not bifid .................................................... *Thismia bifida*
7. Transverse bars found throughout the perianth tube; anther appendages 2 or 4 ................. 5
8. Flowers yellow-orange to pink-red; free apical margin of the connective triangular, acute ................................................................. *Thismia hexagona*
9. Flowers blue; outer perianth lobes distinct; free apical margin of the connective glabrous, without any hairs or ciliae ...................... *Thismia clavigera*
10. Flowers yellow-orange; apex of the mitre obtuse without any projections; free apical margin of the connective with lateral lobes larger, obtusely triangular and the middle lobe narrowly triangular ................. *Thismia brunneomitra*

**Acknowledgements**

We would like to thank Michal Sochor, who first noticed the plant and took photograph of the fruiting individual in 2013. Kateřina Janošíková has pictures on Figure 1. Chiara Nepi (Herbarium FI) graciously provided photographs of *T. episcopalis* holotype. Zdeněk Mačát provided excellent photographs of perianth tube. We would like to thank also KBFSC staff for their excellent service and support during our stay at the research station, and UBD for permission to conduct research at KBFSC. We also thank the Brunei Forestry Department and the Biodiversity Research and Innovation Centre, Ministry of Industry and Primary Resources for permission to work at the Ulu Temburong National Park and permit to export specimens respectively. Researchers from Palacký University were supported by internal grant from Palacký University (IGA_PrF_2015_001) and project no. CZ.1.07/2.2.00/28.0149. RH was further supported by the long-term research development Project No. RVO 67985939.

**References**

http://dx.doi.org/10.1371/journal.pone.0069679
http://dx.doi.org/10.11646/phytotaxa.217.3.7
Chantanaorrapint, S., Tetsana, N. & Sridith, K. (2015) Notes on *Thismia clandestina* (Thismiaceae), a little known mycoheterotrophic...
http://dx.doi.org/10.1515/pbj-2015-0013


http://dx.doi.org/10.11646/phytotaxa.125.1.5


http://dx.doi.org/10.11646/phytotaxa.172.1.8

http://dx.doi.org/10.7751/telopea20147809


http://dx.doi.org/10.3897/phytokeys.46.8963

http://dx.doi.org/10.1111/j.1600-0587.2009.05800.x


http://dx.doi.org/10.1002/fedr.19120103010

http://dx.doi.org/10.1600/036364412X616639

178 • *Phytotaxa* 234 (2) © 2015 Magnolia Press