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Thismia tectipora (Thismiaceae) a new, unusual mitre-form species from tropical Australia

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Abstract

Cowie, I.D. & Liddle, D.T. *Thismia tectipora* (Thismiaceae) a new, unusual mitre-form species from tropical Australia. *Nuytsia* 27: 85–94 (2016). A new tropical species, *Thismia tectipora* Cowie from Melville Island in the far north of the Northern Territory, Australia, is described and illustrated. The species is unique in the genus in having a thickened, fleshy, verrucose, cap-like mitre, the rim of which is reflexed to hide the pores in the upper perianth tube. It appears allied to taxa previously placed in *Thismia* Griff. sect. *Sarcosiphon* (Blume) Jonker, *Geomitra* Becc. and *Scaphiophora* Schltr. Available evidence suggests *T. tectipora* has a restricted distribution on Melville Island. Threats to the species, and its conservation status, are discussed.

Introduction

Thismia Griff. is a genus of around 60 species of mycoheterotrophic, leafless herbs with centres of species and morphological diversity in East to South East Asia and South America (Jonker 1938; Mabberley 2008; The Plant List 2013; Mycoheterotrophic Plants 2016). Plants typically flower in leaf litter in often shady, moist forest environments. In most instances, species are apparently rare and known from few collections. While most *Thismia* species are tropical, several species in the Americas, East Asia and Australia-New Zealand have subtropical to temperate distributions.

Thismia and a number of related genera have been variously placed in Burmanniaceae (as the tribe Thismieae Miers) or segregated into Thismiaceae (e.g. Dahlgren 1980; Cronquist 1981). Genetic molecular data now confirm that *Thismia* is best placed in its own family (Merckx *et al.* 2006; Merckx *et al.* 2009; Merckx *et al.* 2010). Morphological and genetic data also suggest that the neotropical *Thismia* subg. *Ophiomeris* (Miers) Maas & H.Maas should be placed in a separate genus from a broadly defined subg. *Thismia* containing the remaining species (Merckx *et al.* 2006; Merckx & Smets 2014).

Four described species of *Thismia* are currently known from Australia (one tropical and three temperate). *Thismia yorkensis* Cribb occurs in rainforest on Cape York Peninsula in north Queensland, *T. clavarioides* K.R.Thiele and *T. megalongensis* C.Hunt, G.Steenbeeke & V.Merckx are found near Sydney in New South Wales and *T. rodwayi* F.Muell. has been recorded at widely scattered localities

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from Queensland to Tasmania (Thiele & Jordan 2002; Hunt *et al.* 2014; Merckx & Smets 2014). *Thismia hillii* (Cheeseman) N.Pfeiff., from the North Island of New Zealand, has recently been reinstated as distinct from *T. rodwayi* (Merckx & Smets 2014).

A fifth, undescribed, tropical species of *Thismia* was discovered on Melville Island, Northern Territory in 2010, during field work to survey threatened, endemic species of *Typhonium* (Araceae). The Tiwi Islands (Melville and Bathurst Islands) experience a wet-dry tropical climate and are known to support at least 28 highly disjunct or Northern Territory endemic rainforest species across a range of families (Woinarski *et al.* 2003). These taxa exhibit disjunctions or affinities with those from Cape York Peninsula in north Queensland or east Malesia, especially New Guinea. Distribution patterns may partly be related to the fact that this area has the highest rainfall in the Northern Territory (around 1,800 mm per annum). Also, past periods of more intense monsoons, drainage of New Guinea rivers to the then inland, freshwater Lake Carpentaria and its westward flowing outlet, and land connections to New Guinea during periods of lower sea level (Holt 2005) may have facilitated the westward and southward dispersal of rainforest taxa to the Tiwi Islands.

With many new *Thismia* species described from Malesia and adjacent areas of East Asia and Australia since Jonker's revision and *Flora Malesiana* treatment (Jonker 1938, 1948), the total number known for the East Asian-Australasian region is now *c.* 46 species. The Sunda Shelf and adjacent areas of South-East Asia appear to be the major centre of Asian speciation, with the island of Borneo having up to 11 species (Hroneš *et al.* 2015), and Peninsular Malaysia and Thailand eight species each (Jonker 1948; van Steenis 1982; Larsen 1987; Chantanaorrapint & Sridith 2007; Chantanaorrapint 2008; Chantanaorrapint & Chantanaorrapint 2009; Chantanaorrapint 2012; Chantanaorrapint & Sridith 2015; Chantanaorrapint *et al.* 2015). In addition, Vietnam has six species, Australia and China-Taiwan each have five species (Wu *et al.* 2010; Chiang & Hsieh 2011; Li & Bi 2013; Hunt *et al.* 2014; Nuraliev *et al.* 2014; Mar & Saunders 2015; Nuraliev *et al.* 2015; this study), with three in Sumatra (Jonker 1948; van Steenis 1982). Java, Japan and New Guinea each have two recorded species (Jonker 1948; Hatusima 1976) while one species is recorded in each of the Philippines, Myanmar and New Zealand (Griffith 1845; Jonker 1948; Thiele & Jordan 2002). However, new species are regularly being discovered even in some relatively well-populated areas and the number of species in this often cryptic genus is likely to increase in future.

Most authors currently accept a broad circumscription of *Thismia* to include the genera *Geomitra* Becc., *Sarcosiphon* Blume and *Scaphiophora* Schltr. The monotypic genus *Geomitra* (*G. clavigera* Becc.) was reduced to synonymy under *Thismia* by Mueller (1890). This status has been explicitly or implicitly accepted by many authors (e.g. Stone 1980; van Steenis 1982; Maas *et al.* 1986; Maas-van de Kamer 1998; Thiele & Jordan 2002; Mabberley 2008; Chantanaorrapint & Chantanaorrapint 2009; Imhof 2011; Hroneš 2014), though Govaerts *et al.* (2013) has a contrasting view. As currently generally accepted, *Thismia* also includes the segregate Asian genera *Sarcosiphon* and *Scaphiophora* (Maas *et al.* 1986; Maas-van de Kamer 1998; Mabberley 2008; Merckx *et al.* 2013; Hroneš 2014).

Methods

This study was based on examination of a spirit-preserved specimen at DNA. Herbarium abbreviations follow Thiers (continuously updated).

Taxonomy

Thismia tectipora Cowie, *sp. nov.*

Type: Melville Island [near Paru], Northern Territory [precise locality withheld for conservation reasons], 18 February 2010, *D.T. Liddle, N.A. Trikojus & N. Hunter* 3603 (*holo*: DNA D0196145, spirit only).

Thismia sp. Melville Island (D.T. Liddle *et al.* 3603). Department of Land Resource Management, in *FloraNT Northern Territory Flora Online*, http://eflora.nt.gov.au [accessed 26 April 2016].

Achlorophyllous *herb*, *c.* 70 mm high (including mitre-process); root system coralloid. *Stems* to 75 mm long, rather fleshy, colourless; apex with a cluster of apparently 2 leaves (damaged) and 3 bracts subtending the flower. *Leaves* alternate, scale-like, apparently white, 4–6 mm long, ± truncate to 3-lobed at apex. *Bracts* ovate, *c.* 8 mm long, white; apex cucullate, grey-brown. *Flowers* solitary and terminal, actinomorphic, fungiform, *c.* 12.5 mm long (excluding mitre-process), pink or reddish, apparently borne just above the soil surface. *Perianth* tube *c.* 7 mm long × 5 mm diam., apparently trigonous, ± smooth, white at base, dark grey-purple above with darker vertical lines; inner surface alveolate-reticulate, with transverse scales at base; outer perianth lobes apparently absent; mitre operculate, forming a thickened, fleshy, pink, verrucose cap *c.* 6 mm long, covered with sub-appressed, scale-like, ± triangular verrucae; lower margin of mitre reflexed and extending downwards over the upper perianth tube, with 3 slightly longer, obtuse lobes covering the 3 pores at the junction of the perianth tube and mitre; pores oblong-elliptic, *c.* 2.5 mm wide, 0.7 mm high; mitre-process apical, central, solitary, erect, long-attenuate, *c.* 30 mm long, described by the collectors as 'dark mushroom colour [?dark brown] with greenish tinge in lower half, reddish in upper part', becoming filiform below the clavate, indistinctly lobed, reddish apex. *Stamens* 6, apparently colourless, inverted and the filaments dilated, free at base with pores between the filaments, laterally connate proximally into a cylinder attached at the apex of the perianth tube, *c.* 5.5 mm long, the staminal tube included in and parallel to the perianth tube; anthers extrorse, each with 2 separated, linear thecae *c.* 1.6 mm long lying longitudinally near each suture and extending from 1.4 mm above the point of attachment of staminal tube with the perianth tube to 2 mm below apex of connective; anther appendages *c.* 2 mm long, each with a quadrangular lateral appendage at the lower end on the adaxial surface and protruding outwards to the perianth tube; free apical part of the connective with a rounded to weakly retuse apical lobe; nectariferous gland present between appendages. *Style c.* 1 mm long; stigmatic lobes 3, erect, flattened, oblong, *c.* 1.5 mm long, minutely papillose; ovary inferior, unilocular, *c.* 2 mm long, flattened at apex; placentas 3, free, globular, on columns attached to the base of the loculus; ovules numerous. *Fruit* and *seeds* not seen. (Figure 1)

Diagnostic features. Distinguished from all other *Thismia* species by the thickened, verrucose, cap-like mitre, the margin of which is reflexed to hide the three pores at the apex of the perianth tube. The apparent absence of the three outer perianth lobes and single long, slender appendage are also both unusual in *Thismia*.

Other specimens examined. Known only from the type collection.

Phenology. The single flowering specimen was collected in February. Fruiting: not known.

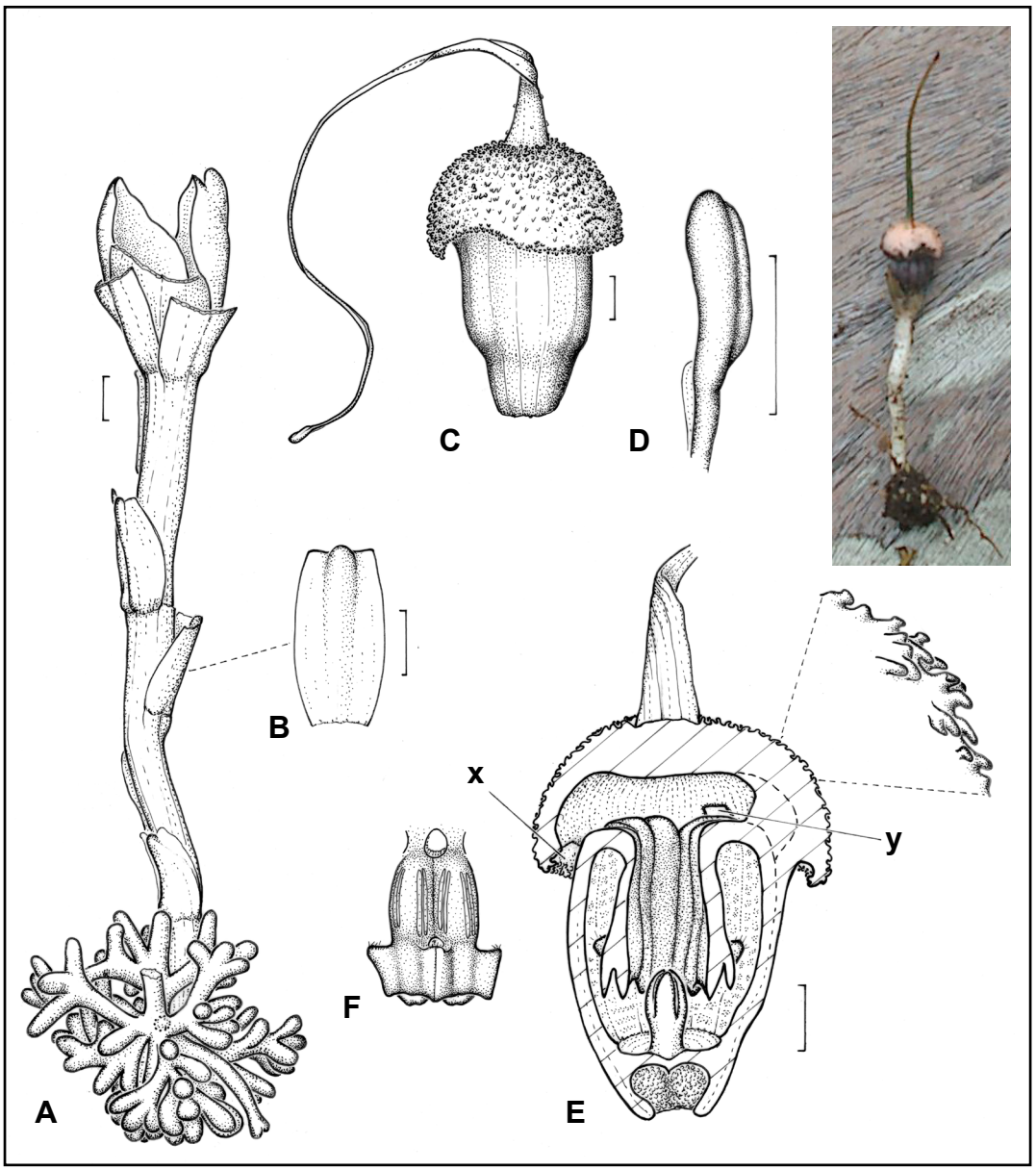

Figure 1. *Thismia tectipora*. A – root system with stem, leaves and floral bracts; B – individual leaf; C – flower showing perianth and appendage (mitre-process); D – apex of appendage; E – longitudinal section of flower (with surface of mitra shown in detail), pore (x) and apex of pore (y); F – abaxial view of two stamens; photographic inset – whole plant. Scale bars = 1 mm (D); 2 mm (A – C, E, F); scale bar for B applies to F. Images from *D.T. Liddle, N.A. Trikojus & N. Hunter* 3603. Illustration by M. Osterkamp-Madsen.Photograph by D.T. Liddle.

Distribution and habitat. *Thismia tectipora* is known only from a single collection from near Paru on Melville Island, north of Darwin, in the Northern Territory (Figure 2). It was collected from the ecotone between a spring-fed evergreen rainforest and open forest, growing beneath the leguminous tree *Erythrophleum chlorostachys* and the understorey herb *Curcuma australasica*. The area had been burned in the early wet season. It is possible that the fire, associated release of nutrients and removal of leaf litter may have had a role in triggering flowering, or at least in increasing the visibility of plants.

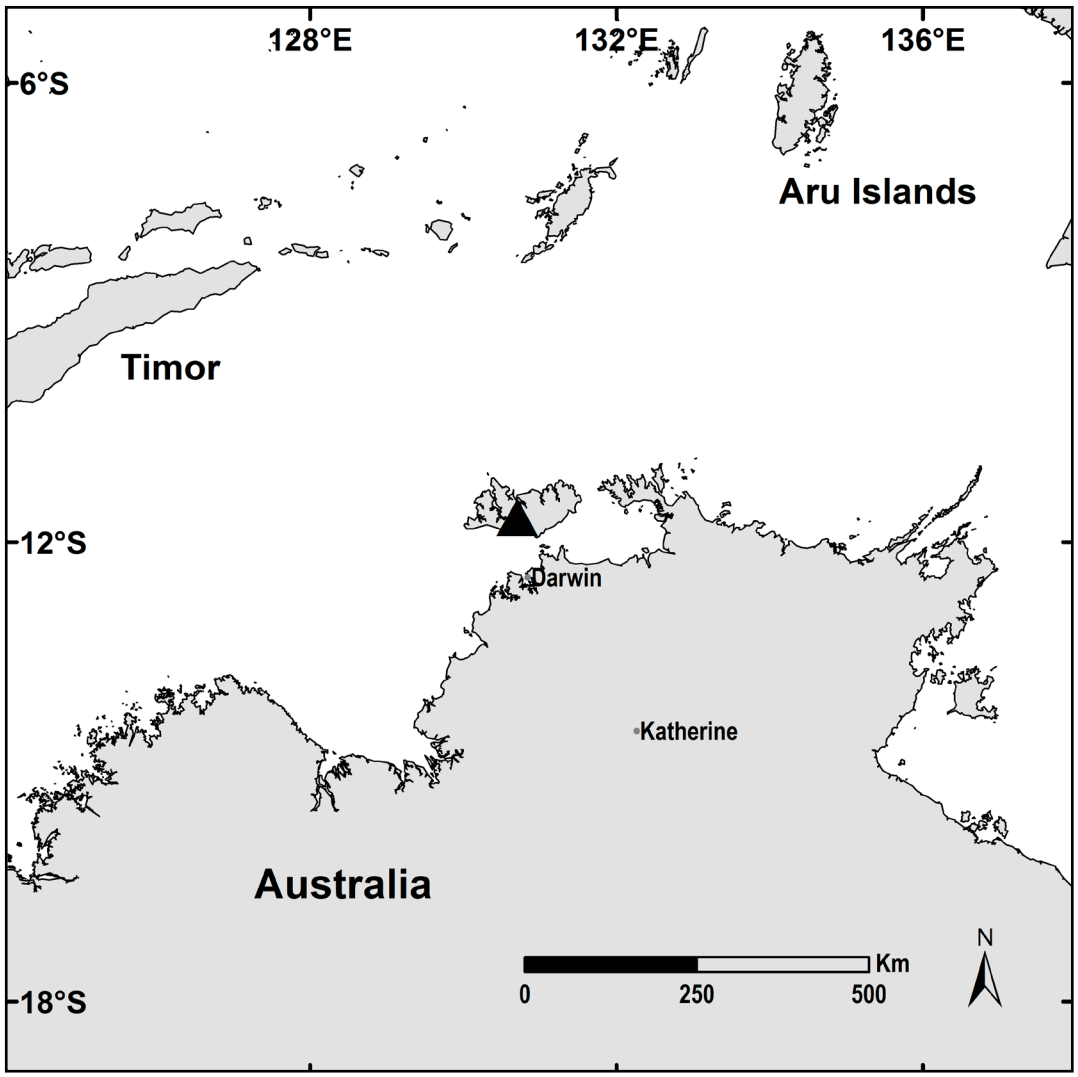

Figure 2. Location of *Thismia tectipora*, Melville Island, Northern Territory, Australia.

Conservation status. Following IUCN guidelines and criteria, it appears appropriate that *T. tectipora* be listed as Endangered (IUCN 2012; IUCN Standards and Petitions Subcommittee 2014). While field and collection data on the species are limited, there is strong circumstantial evidence for presuming that the species is rare and likely to be restricted to the Tiwi Islands. As discussed above, the Tiwi Islands support an unusual concentration of restricted, endemic or highly disjunct rainforest plant taxa, several of which are listed as threatened under the *Territory Parks and Wildlife Conservation Act 2000* or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

Among the highly disjunct or endemic rainforest species on the Tiwi Islands, the most likely analogue to *T. tectipora* in terms of abundance, distribution and threats is the small herb *Burmannia* sp. Bathurst Island (R. Fensham 1021), which is also achlorophyllous and likely to be mycoheterotrophic, but is less cryptic. It is listed as Endangered under both the *Territory Parks and Wildlife Conservation Act 2000* and the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. The species has been subject to some targeted survey and is recorded from just seven evergreen, spring-

fed rainforest patches on the adjacent Bathurst Island, with a total extent of occurrence of 8.8 km^2, an area of occupancy of approx. 12 ha and a population size estimated at between 500 and 2,000 plants (Kerrigan *et al.* 2007; Liddle & Elliott 2008; Liddle *et al.* unpubl. data). It is apparently absent from Melville Island. *Thismia tectipora* is likely to be equally restricted.

The Tiwi Islands support some 1,300 rainforest patches (in the broad sense, including evergreen, semi-evergreen, monsoon and deciduous forest) with a total area of around 160 km^2 or 7–15% of the total rainforest area of the Northern Territory (Woinarski *et al.* 2003). Of these, the evergreen rainforest patches in the west of Melville Island (where *T. tectipora* occurs) and northern part of Bathurst Island, are particularly rich in highly disjunct or Tiwi endemic species (e.g. *Dendromyza reinwardtiana*, *Elaeocarpus miegei*, *Embelia tiwiensis*, *Endiandra limnophila*, *Hypserpa polyandra*, *Litsea breviumbellata*, *Mitrella tiwiensis*, *Syzygium claviflorum*, *S. hemilamprum* and *Xylopia monosperma*) (Woinarski *et al.* 2003; Northern Territory Herbarium 2015). The concentration of Tiwi endemic and highly disjunct species (including *T. tectipora*) at these spring-fed evergreen rainforests fringing the highest ridges on the two islands, suggests that these forests may have persisted as refugial areas during periods of presumed drier climate, such as past ice ages. While apparently similar forests are currently more extensive, including on the mainland, many of these restricted species do not occur in forests away from these islands. It appears very likely that *T. tectipora*, like these other species, does not occur on the Northern Territory mainland, despite the existence of some apparently suitable habitat there.

Additional indirect evidence that *T. tectipora* is rare and is likely to have a restricted distribution is that most species of *Thismia* are apparently rare and known from only one or a few collections, with several presumed extinct following habitat loss (Jonkers 1948; Maas *et al.* 1986). *Thismia tectipora* is likely to be highly host-specific in its fungal association, as are many other mycoheterotrophic plants (Bidartondo *et al.* 2002; Merckx & Bidartondo 2008; Merckx & Wapstra 2013).

Conversely, *T. tectipora* may be more common than the single record indicates, perhaps with similar population parameters to *Burmannia* sp. Bathurst Island. The species is cryptic and the only flowering plant was collected at the height of the wet (rainy) season, a time when access is most difficult and few collectors are engaged in field work. Information on other *Thismia* species indicates that flowers are ephemeral and cryptic, and that flowering is irregular and occurs primarily during the wet season (Stone 1980; Cribb 1995; Larsen 1987; Larsen & Averyanov 2007; Chantanaorrapint 2008). Further surveys of potentially suitable habitat are necessary to provide better estimates of population and distribution parameters. In the absence of more specific knowledge, the survey methods described for *T. rodwayi* by Wapstra *et al.* (2005) may provide an appropriate starting point.

There are developing threats to *T. tectipora* and its habitat. Because of their small size and often linear shape, evergreen rainforest patches in the Northern Territory have a high ratio of ecotone to forest area and may be highly susceptible to edge effects from fire, weed invasion and other disturbance. On the mainland, one of the foremost threats to rainforest is invasion of the ecotone by introduced weed species, especially gamba grass (*Andropogon gayanus*) and perennial mission grass (*Cenchrus polystachios*), which form tall, dense stands that promote intense fires resulting in erosion of rainforest boundaries (Panton 1993; Rossiter *et al.* 2003; Ferdinands *et al.* 2006).

Feral pigs may be a future threat. Digging by feral pigs in its wet rainforest habitat is regarded as a threat to *Burmannia* sp. Bathurst Island (Fensham 1993) and has been observed to be very intense in some rainforest patches on moist sandy substrates. However, digging activities appear less intense in the habitat favoured by *T. tectipora*. While feral pigs have been almost eradicated on Melville Island at present, there is a risk that they may reinvade from Bathurst Island and become more abundant in future.

Etymology. From the Latin *tectus* (hidden) and *porus* (a pore), in reference to the pores in the perianth tube, which are hidden by the mitre cap (Figure 1).

Affinities. The inner perianth lobes that are fully connate into a well-developed three-holed mitre, the presence of coralloid roots, and the reduced to very reduced outer perianth lobes are all characters common to *Thismia* sect. *Sarcosiphon* (Blume) Jonker, as well as taxa placed by Jonker (1938) in *Geomitra* and *Scaphiophora*. Species in sect. *Sarcosiphon* or previously placed in *Geomitra* and *Scaphiophora* are prominent among the species found geographically closest to *T. tectipora*, occurring scattered over an area extending from Thailand, through Malesia to New Guinea and northern Australia (Cape York Peninsula, Queensland and the Northern Territory). This group comprises *T. appendiculata* Schltr. and *T. crocea* (Becc.) J.J.Sm. (New Guinea and West Papua); *T. betung-kerihunensis* Tsukaya & H. Okada, *T. brunneomitra* Hroneš, Kobrlová & Dančák, *T. episcopalis* (Becc.) F.Muell. and *T. goodii* Kiew (all from Borneo); *T. clandestina* (Blume) Miq. (Java); *T. clavigera* (Becc.) F.Muell. (Thailand, Borneo, Peninsular Malaysia, Sumatra); *T. gigantea* (Jonker) Hroneš (Philippines); *T. tectipora* and *T. yorkensis* (Australia).

The mitre morphology of *T. tectipora* appears to be unique in *Thismia.* The general aspect of the plant and the shape of the thickened, verrucose, cap-like mitre with a rim extending over the upper perianth tube is reminiscent of the young cap of a small, gilled or fleshy-pored agaricomycete fungus. The neotropical *T. fungiformis* (Taubert ex Warming) Maas & H.Maas is similarly regarded as a fungus mimic, but in this species the three, free inner tepals are modified to resemble small fungi (Maas *et al.* 1986); similarly, in *T. clavarioides* the elongate dorsal processes from the mitre-forming perianth lobes resemble small coral fungi (Thiele & Jordan 2002). *Thismia tectipora* may attract insects that would normally frequent young caps of fungi. Mar and Saunders (2015) recorded fungus gnats (Mycetophilidae or Sciaridae) and scuttle flies (Phoridae) visiting flowers of *T. hongkongensis* S.S.Mar & R.M.K.Saunders. Stone (1980) noted that the mitriform perianth apex of *T. clavigera* is structurally similar to the flowers of myophilous taxa such as *Sterculia* (e.g. *S. quadrifida*) and *Mitrephora* species, and postulated that it is likewise myophilous. Wapstra *et al.* (2005) noted that plants of *T. rodwayi* produce a smell of rotten fish and suggested that this may attract flies or other invertebrates.

Key to Australian species of *Thismia*

1. Mitre-processes absent or solitary and apical; roots coralloid; tropical **2**

2. Mitre-processes absent; mitre pores conspicuous; outer perianth lobes present ..... **T. yorkensis**

2: Mitre-process solitary, apical; mitre pores hidden; outer perianth lobes absent ..... **T. tectipora**

1: Mitre-processes 3, apical or subapical; roots vermiform; temperate or subtropical **3**

3. Mitre-processes terminal, spreading or appressed to mitre, < 5 mm long; outer perianth lobes lacking bristles ..... **T. rodwayi**

3: Mitre-processes dorsal, erect or spreading, usually > 3 mm long; a bristle present on the abaxial surface of each outer perianth lobe **4**

4. Bristles of outer perianth lobes slender, 3–6 mm long; mitre-processes slender, 4–6 mm long; perianth red to orange ..... **T. megalongensis**

4: Bristles of outer perianth lobes thick, 9–11 mm long; mitre-processes well-developed, 20–25 mm long; perianth very pale or white ..... **T. clavarioides**

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