

# Solanaceae of New Guinea: recollection and conservation status assessments of two endemic and poorly known species including updated taxonomic descriptions

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**Abstract:** Two lesser-known species of Solanaceae were rediscovered from Indonesian New Guinea between 2016 and 2018. The first rediscovery is *Lycianthes wollastonii* (Wernham) A.R.Bean initially described as *Solanum wollastonii* Wernham in 1916 based on a specimen collected in 1913. The second rediscovery is *Solanum gibbsiae* J.R.Drumm., a species endemic to the Arfak Mountains, which was also collected in 1913. Taxonomic descriptions for both species were updated, accompanied by discussions on the morphology of related species, field photographs, and provisional IUCN Red List conservation assessments. An updated key to *Lycianthes* in New Guinea is also provided.

**Keywords:** Climbers, *Lycianthes*, Montane, Papuasia, *Solanum*, Taxonomy.

## Introduction

The three largest genera in Solanaceae are *Solanum* L. (c. 1200–1400 spp.), *Lycianthes* (Dunal) Hassler (c. 150–250 spp.) (Dean, 2004; Olmstead *et al.*, 2008; Echeverría Londoño *et al.*, 2020) and *Cestrum* L. (c. 250 spp.) (Purdie *et al.*, 1982). *Solanum* and *Lycianthes* both have poricidal anthers that make them distinct from all other Solanaceae genera (Olmstead *et al.*, 2008). The classification of

*Lycianthes* was complex in the past as several authors often considered it to be a synonym of *Solanum* (e.g. Morton, 1944, 1976; Hunziker, 1979; Symon, 1985, 1987) until D’Arcy (1991), followed by Hunziker (2001), considered *Lycianthes* to be distinct from *Solanum*. The classification followed here was proposed by Olmstead *et al.* (2008) that recognised *Lycianthes* as an independent genus based on a comprehensive molecular phylogenetic study involving *ndhF* and *trnL-F* sequences. *Lycianthes* is also distinct from *Solanum* in having an entire calyx rim (*vs.* lobed in *Solanum*) (see Symon, 1985; Zhang *et al.*, 1994).

The latest comprehensive work on Solanaceae of New Guinea was published by Symon in 1985. This monograph treated *Solanum* in a broad taxonomic sense with c. 60 species, including non-native species and *Lycianthes* was recognized as a subgenus. The bulk of the 842 collections studied by Symon (1985) was mostly from the eastern half of the island (755 specimens, 90%), namely Papua New Guinea. In contrast, only a few collections from the western part of the island comprising of the Indonesian provinces of Papua and Papua Barat (87 specimens, 10%) were examined by Symon (1985). Eight species of *Solanum* endemic to New Guinea presented by Symon (1985) were known only from the type specimens.

In recent years, several botanical trips were made mainly by the first author and a few collections of Solanaceae were made. A species of *Solanum* was collected during a trip conducted to Pegunungan Arfak Regency in Anggi district of Papua Barat province in 2016. Another botanical exploration in Tembagapura to the summit area of Mount Java in 2018 resulted in the collection of a climber with flowers and fruits indicative as a member of the Solanaceae family. After a thorough literature review (Wernham, 1916; Bitter, 1920; Symon, 1985; Bean, 2003), these taxa were identified respectively as two lesser-known native species, *viz.*, *S. gibbsiae* J.S.Drumm. and *Lycianthes wollastonii* (Wernham) A.R.Bean. Both taxa were previously known only from the type collections collected over a century ago.

Taxonomic descriptions of these two species are expanded and updated based on live samples and preliminary conservation status assessments are done according to IUCN (2012, 2019). When assessing the preliminary conservation status of these species, the Area of Occupancy (AOO) for the species was calculated using the standard 2 × 2 km grid cell size. Herbarium specimens and images of herbarium specimens from the following herbaria: BO, K, L, and LAE (herbarium acronyms follow Thiers 2021) including type images from JSTOR Global Plants (<http://plants.jstor.org>) were examined in this study.

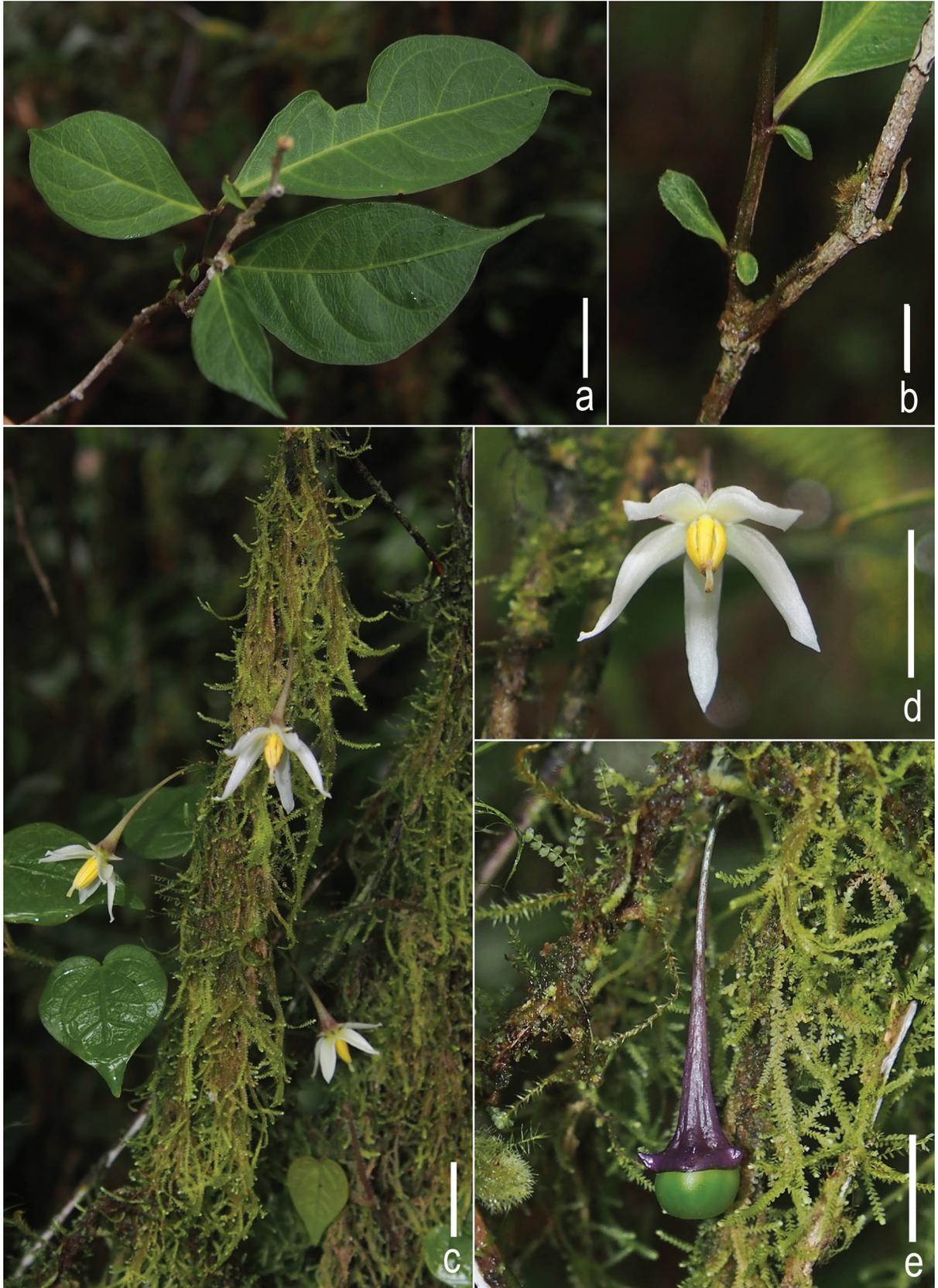
## Taxonomic Treatment

*Lycianthes wollastonii* (Wernham) A.R.Bean, *Austrobaileya* 6(3): 568. 2003. *Solanum wollastonii* Wernham, *Trans. Linn. Soc. London, Bot.* 9(1): 120. 1916. *Lectotype* (designated by Symon, 1985): INDONESIA, Papua Province (=New Guinea), Camp VIII–IX [Mt Carstensz], [01–04. 1913], *Kloss s.n.* (BM [BM001014583 digital image!]). **Fig. 1**

Slender woody perennial climber, or epiphytic (*vide* Wernham, 1916; Symon, 1985). Stems up to *c.* 3 m in length, flushed with violet when young, at first clad with appressed minute simple hairs, later rupturing and only partially persistent and then

becoming very laxly set with blackish glandular points. Leaves green above, paler below, geminate, minor leaves finally caducous; major leaf lamina obliquely elliptic, (3.3–)7.5–11.3 × (1.3–)3.3–4 cm, base cuneate or attenuate, margin entire, apex caudate or rarely abruptly acuminate, minor leaves obovate or broadly elliptic, up to 1.8 × 1.5 cm, base attenuate, margins entire, apex acute or obtuse, midrib sharply raised above, primary lateral veins 4–7 on each side of the midrib, venations prominent on both surfaces especially in the abaxial side, glabrous on both sides, lower surfaces with scattered blackish points and later verruculose due to the presence of many circular to oblong cystoliths; petioles *c.* 5 mm long. Inflorescences axillary, 1–5-flowered, peduncle *c.* 1 mm long, rachis 1.75 mm long, only one flower bloom at a time, not accompanied by developed young (bud) or older flower, pedicels slender, 2–2.1 cm long, very laxly clad with hairs similar to those on stem, glandular. Calyx with a tube 2.75–3 mm long, rim entire, with 5 prominent perpendicular conical teeth 2–2.5 mm long, positioned 0.75–1 mm below the rim, apex rounded. Corolla *c.* 2 cm across at full anthesis, white, deeply divided to near the base, the tube *c.* 3.25 mm long, interpetalar membrane narrow, slightly fleshy, lobes lanceolate, 10–10.5 × 2–3.5 mm, tapering to a narrow acute apex, dorsally glabrous, margins fringed with hairs similar to those on young stem, hairs on the apical area of the calyx glandular. Stamens equal, connivent filaments *c.* 1.2 mm long, white, glabrous, attached slightly above the middle of the corolla tube, anthers yellow, 5.8–8 mm long, *c.* 1 mm wide, oblong, slightly tapering to apex, pores apical, slightly latrorse. Ovary glabrous, *c.* 1.75 mm across. Style *c.* 7.25 mm long, exceeding the anthers by 1.75–2 mm, glabrous, white, with wart-like projections surrounding the stigma, stigma erect. Berries sub-depressed globose, green when immature, subtended by dull violet, incrassate calyx.

*Flowering & fruiting:* Collected in flower and fruit (immature) in November. We concluded that the species is also flowering around January to April



**Fig. 1.** *Lycianthes wollastonii* (Wernham) A.R.Bean: **a.** Leafy branch; **b.** Minor leaves; **c.** Flowers in natural position; **d.** Close-up of flower; **e.** Immature fruit (scale bars: a = 5 cm; b–e = 1 cm; photos by W.A. Mustaqim).

according to the date when the Wollaston Expedition was carried out.

*Habitat:* Mossy mid-montane forests, growing in a relatively shaded area, and is locally abundant amongst ericaceous plants, at *c.* 1500–2090 m elevation.

*Distribution:* Endemic to Indonesian New Guinea, Mount Jaya (Fig. 2).

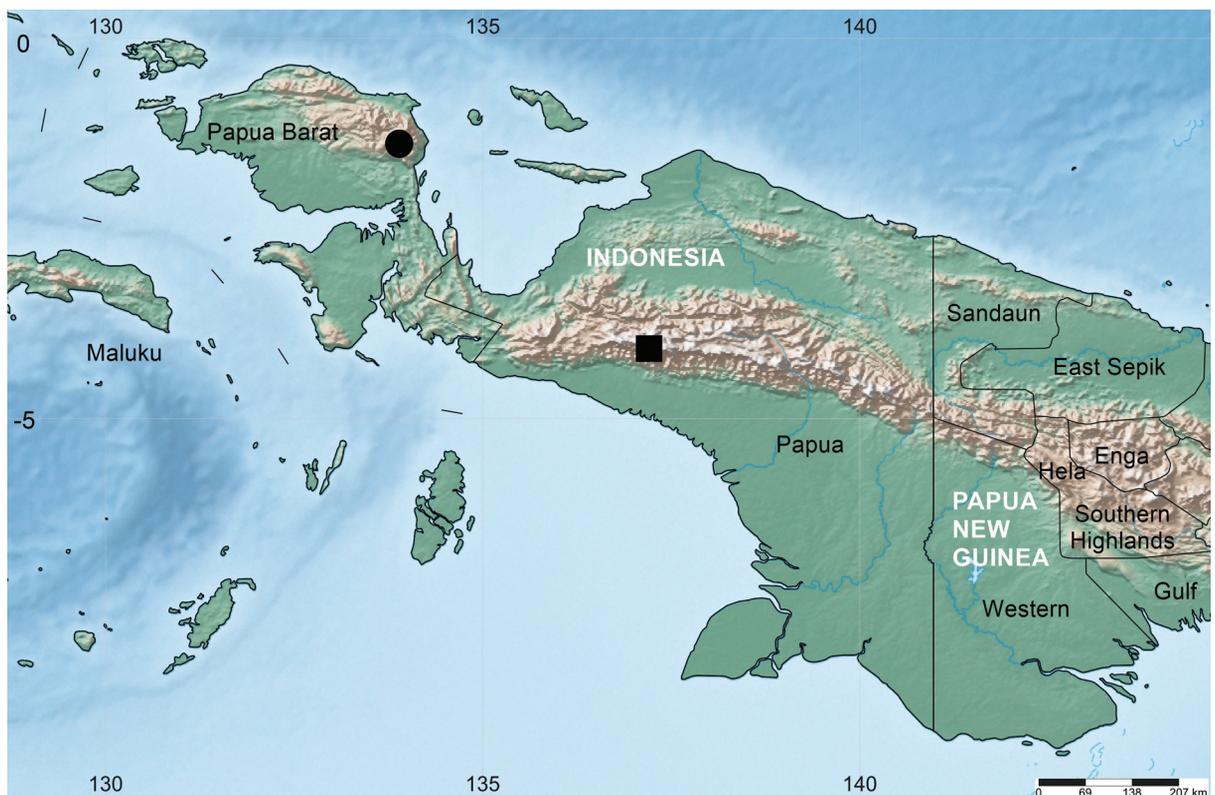
*Specimen examined:* INDONESIA, Papua Province, Timika Regency, Mount Jaya, Tembagapura, Borobudur, S 4°08'26.82", E 137°05'55.82", 2090 m, 21.11.2018, *Mustaqim & Manurung* 2213 (BO).

*Conservation status:* The type material was collected from an area at 1500–1670 m elevations (Ridley, 1916). The recent collection was made in a small forest patch at the edge of the Tembagapura settlements. These forests are threatened by cutting and possible expansion of the mining company operating in the area. Any single activity that clears the forest could endanger all plants known in this locality. With the current data available, this species

has an AOO of 8 km<sup>2</sup> that falls within CR under criterion B2 of subcriterion a. With the fragmented occurrence and threat to individuals and habitat, a provisional conservation assessment of CR, B2ab(iii,v) can be proposed (IUCN, 2012, 2019).

*Notes:* *Lycianthes wollastonii* was first discovered by Cecil B. Kloss from a location known as Camp VIII-IX at 1500–1670 m elevation (4900–5500 feet) (Ridley, 1916). This is an area on the southern side of Mount Jaya where the Wollaston Expedition was carried out. The 2018 collecting was done in forests near the Tembagapura settlements, at 2090 m elevation, slightly higher than the elevation of the type material locality.

Although Bean (2003) did not provide the specimen collection date, it is now clear that the specimen was collected in 1913, around January to April (Steenis-Kruseman & van Welzen, 2007), about three years before the species was formally described by Wernham (1916). The species was not recollected again for 105 years ago until its rediscovery in 2018.



**Fig. 2.** Geographic distribution of *Lycianthes wollastonii* (Wernham) A.R.Bean (●) and *Solanum gibbsiae* J.R.Drumm. (■). Created using Simplemapp (Shorthouse, 2010).

Despite the short description provided by Wernham (1916) and Symon (1985), *L. wollastonii* cannot be mistaken with other *Lycianthes* species. This species is unique in having an inflorescence bearing 1–5, pentamerous flowers, truncate calyx, with lateral teeth, minute hairs on young parts of the plant (discernible with a hand lens) and short minor leaves (up to 18 mm long or sometimes absent). A species morphologically closely related to *L. wollastonii* from New Guinea is *L. rostellata* (Merr. & L.M.Perry) A.R.Bean, but the latter differs in the absence of teeth in the calyx, conspicuous hairs that are easily observed with naked eye, and the purple corolla (*vs.* white in *L. wollastonii*).

Symon (1985) stated that this species is morphologically similar to *L. peranomala* (Wernham ex Ridl.) A.R.Bean (listed by Symon (1985) as *S. peranomalum* Wernham ex Ridl.), another lesser-known species. *Lycianthes wollastonii* differs from *L. peranomala* in having up to 7 lateral nerves (*vs.* 8–9 in *L. peranomala*), fewer flowers per inflorescence (1–5 *vs.* 7–9 in *L. peranomala*), longer pedicels (20–21 mm *vs. c.* 8 mm long), the absence of rufous hairs (*vs.* sparsely rufous pubescent), and longer corollas ( $\geq 13.25$  mm *vs. c.* 4 mm long).

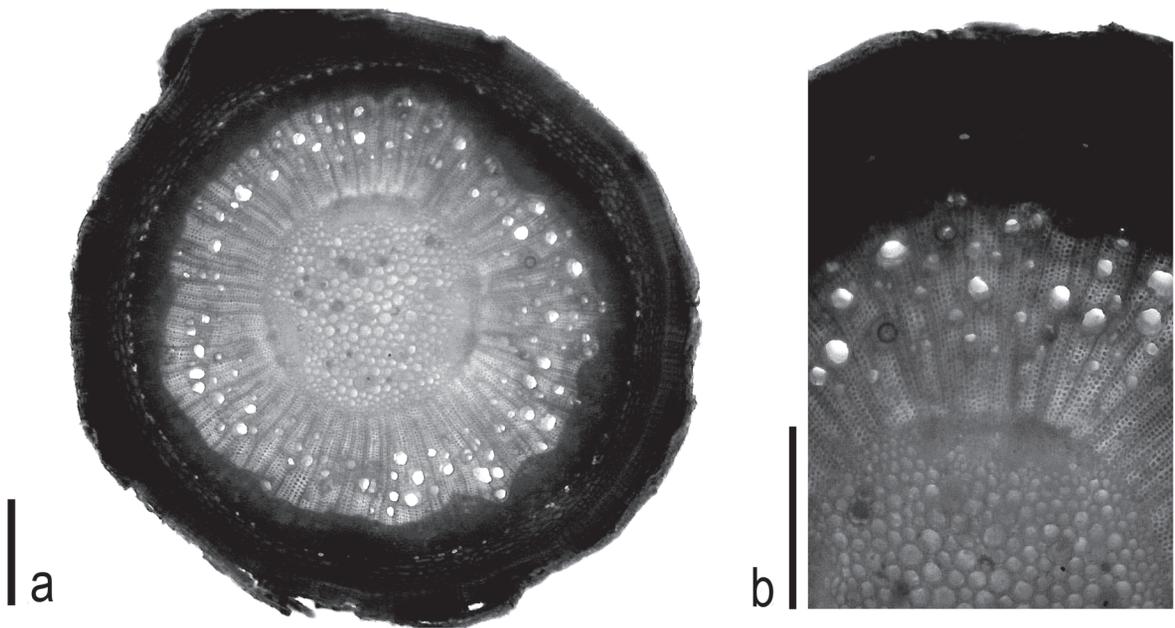
Wernham (1916) and Symon (1985) described *L. wollastonii* as an epiphytic shrub. This is interesting since only a few species of *Lycianthes* or Solanaceae in general are reported to be epiphytic (Barboza & Hunziker, 1992; Zhang *et al.*, 1994; de Rojas & D'Arcy, 1997). Our recently collected specimen matches well with the original description of the species with the exception of the habitat which is terrestrial and not epiphytic. Our field observations showed that the stems were slender and most parts covered by moss (Fig. 1c). It is possible that Kloss overlooked the stems which are obscured by moss, or that the species varies in its habit. Since there are species of *Lycianthes* that have been recorded as an epiphytic, such as the Meso-American species - *L. synanthera* (Sendtn.) Bitter (Woodson *et al.*, 1973), it is important for future collectors to carefully observe this matter. The large xylem vessels (Fig. 3) are a general characteristic of climbers that seem not depend on the substrate of the plant species

whether its terrestrial or epiphytic (Acevedo-Rodriguez, 2005; Salas *et al.*, 2018). Therefore, it is likely that *L. wollastonii* lives either as a terrestrial or epiphytic climber (*i.e.*, facultative epiphyte).

A total of 18 species of *Lycianthes* are known from New Guinea. A key to eight Indonesian New Guinean species of *Lycianthes* with the updated names following POWO (2021) is given below.

**Key to *Lycianthes* in Indonesian New Guinea**  
(modified from Symon, 1985)

1. Calyx with distinct 10 subulate lobes, not umbo ..... *L. biflora*
1. Calyx truncate or very shortly lobed (umbo), without subulate lobes ..... 2
2. Second or minor leaf usually well developed, mostly > 4 cm long ..... *L. oliveriana*
2. Second or minor leaf usually smaller (< 4 cm long), sometimes minute (few mm) or absent ..... 3
3. Minor leaf usually up to 1.8 cm long, sometimes absent ..... 4
3. Minor leaf mostly > 2 cm long, never absent ..... 5
4. Inflorescence 7–9-flowered, corolla 4 mm long; secondary veins 8–9 pairs .....  
..... *L. peranomala*
4. Inflorescence 1–5-flowered, corolla 10–10.5 mm long; secondary veins up to 7 pairs .....  
..... *L. wollastonii*
5. Flowers (1–)6–12(–19) per inflorescence; fruits blue (unknown in *L. memecylonoides*) .....  
..... 6
5. Flowers few (1–6) per inflorescence; fruits red ..... 7
6. Indumentum of short erect hairs or almost glabrous; large leaves falcate, minor leaf orbicular ..... *L. impar*
6. Indumentum of sparse pubescence of minute, crisped, brownish hairs; large and minor leaves elliptic ..... *L. memecylonoides*



**Fig. 3.** *Lycianthes wollastonii* (Wernham) A.R.Bean: **a.** cross section of stem; **b.** An enlarged view (scale bars: a, b = 0.5 mm; photos by W.A. Mustaqim).

- 7. Flowers several per inflorescence; indumentum of minute, brownish wavy hairs .....  
..... *L. belensis*
- 7. Flowers usually solitary; indumentum of dense, short ± erect curved hairs ..... *L. multifolia*

**Solanum gibbsiae** J.S.Drumm. in L.S.Gibbs, Fl. Arfak Mts: 177. 1917. *Type:* INDONESIA, **Papua Barat province**, Arfak mts., Angi lakes, edge of forest by female lake (now lake Anggi Gida), 7,000 ft, *Gibbs* 5974 (holo BM [BM000886173 digital image!]).

**Fig. 4**

Slender shrubs, to 1.5 m high. Stems cylindrical when young, prickly; prickles acicular, up to 1 cm long, prickles also on leaves, especially along main veins; bark black or chestnut; densely pubescent with short-stalked stellate trichomes, 4–5 mm across, the rays 8–10, acicular, 1–2.5 mm long. Leaves unpaired, simple to deeply pinnatifid, lobes 2–6 on each side with rounded sinuses, elliptic in overall shape, 3.1–12 × 1.2–4 cm, base truncate to broadly cuneate, margin coarsely repand-dentate, the apex of lobes rounded to acute, leaf apex acuminate or acute, hairs similar to stem, upper surfaces along

veins only, lower surfaces furfuraceous with stellate hairs across lamina; petiole 5–10 mm long, mostly armed. Inflorescences simple extra-axillary cymes, 1–3-flowered, peduncle 1–2 cm long, covered with hairs similar to stem, rachis up to 2 cm long, densely to sparsely covered with hairs similar to stem, flowering pedicels 5–7 mm long, covered with stellate hairs similar to stem. Calyx campanulate, *c.* 2 mm long, lobes minute or teeth-like, acumen *c.* 0.5 mm long, surfaces covered with hairs similar to stem, especially at the base. Corolla rotate or nearly so, white to rose-purple, midrib purple inside, lobes 5, ovate-lanceolate, 3.25–3.5 × 0.8 mm, apex gradually acuminate, covered with hairs on the outside except at the base, hairs similar to those on stem, smaller; stamens sub-connivent, anthers 2-celled, *c.* 2.2 mm long, pores apical, glabrous, style exceeding the stamens by *c.* 0.7 mm, stigma sub-capitate. Fruiting pedicels up to 2 cm long, gradually thicker towards distal end. Fruit a globose or depressed globose fleshy berry, red at maturity, 7.5–10 mm in diameter, 1–3 per infructescence; calyx enlarged in fruit. Seeds *c.* 12 per fruit, yellowish, sub-reniform, *c.* 3 × 2.25 mm, planoconvex.



**Fig. 4.** *Solanum gibbsiae* J.R.Drumm.: **a.** Leafy branch with prickles; **b.** Close-up of flower; **c.** Immature (green) and mature (red) fruits (scale bars: a = 2 cm; b = 1 mm; c = 5 mm; photos by W.A. Mustaqim).

*Flowering & fruiting:* Flowering in April and December; fruiting in December.

*Habitat:* The plants are growing in riverine montane forests, along forest margins in shaded localities at 1900 m elevation. The population from lake Angi Gigi (now Anggi Gigi) was made in valley forests near a small stream.

*Distribution:* The plant is known only from the Arfak Mountains of the Birds Head peninsula in New Guinea (Fig. 2). Only two populations are known, one from the female lake Angi (now lake Anggi Gida) and another from north of the male lake Angi (now lake Anggi Gigi).

*Specimen examined:* INDONESIA, Papua Barat

province, Pegunungan Arfak Regency, Anggi district, Irbos, 1900 m, 15.04.2016, *Mustaqim* 1891 (BO).

*Conservation status:* With the uncertainty of the precise location of the type specimen collection, it is quite hard to assess the current condition of the forests. Fieldtrips made in 2016 and 2018 showed some forest conversion surrounding the location, especially in the lake Anggi Gida, with a decrease in the amount and quality of forests for the species. Forests surrounding lake Anggi Gigi are in better condition and remain relatively undisturbed. The AOO of 8 km<sup>2</sup> falls within CR under criterion B2 (<10 km<sup>2</sup>), and the fragmented occurrence of the species and threat from land conversion merits this status. A provisional status of CR, B2ab(iii), is thus proposed (IUCN, 2012, 2019).

*Notes:* *Solanum gibbsiae* can be recognized by its dense indumentum of stellate trichomes across the lower leaf surfaces, straight prickles densely covering the stems, narrowly elliptic or sub-ovate solitary leaves up to 12 × 4 cm in size, and internodal inflorescences. In New Guinea, a species similar to *S. gibbsiae* is *S. rivicola* Symon, but the latter differs in having the curved or hooked stem prickles.

*Solanum gibbsiae* was described in 1917 by Drummond (1917) as part of a pioneering book on the flora of the Arfak Mountains by Gibbs (1917) with incomplete morphological detail. Symon (1985) cited the description by Drummond (1917) where the corolla was detailed to be rose-purple in colour differing from the individuals found during the recent botanical trip which had white corollas, but colour variation is relatively common in some *Solanum* species (Ugent, 1967; Knapp, 2013). The colour of the berry documented here supports Symon's (1985) original hypothesis that berries are likely to be red at maturity.

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