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A new section in *Nepenthes* (*Nepenthaceae*) and a new species from Sulawesi

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Abstract *Nepenthes* section *Tentaculatae* of Borneo and Sulawesi is described and delimited, with a key to the nine species, including *N. maryae* of Central Sulawesi, Indonesia, which is here assessed as Vulnerable under criterion D2 using the 2001 IUCN standard. It is hypothesised that this species might trap insects using a 'flick of the lid' mechanism.

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INTRODUCTION

While identifying loans and gifts of *Nepenthes* specimens at the Royal Botanic Gardens, Kew, in preparation for a monograph of the genus, the following taxon new to science was discovered in a consignment from the Royal Botanic Garden Edinburgh. It is named below as *N. maryae* Jebb & Cheek, and is included, with eight other species from Sulawesi and Borneo, in a new section of *Nepenthes*.

The newly described *N. maryae* has blade-like peristome ridges, similar to those of *N. hamata* J.R.Turnbull & A.T.Middleton (1984), which, along with the fasciculate spur, the perfoliate-adnate leaves, and the rhombic mouth, all confirm the placement of this taxon in a group of species including *N. tentaculata* Hook.f. (Cheek & Jebb 2001), formally named below as section *Tentaculatae* Cheek & Jebb. The diagnostic characters separating *N. hamata* and *N. maryae* are presented in Table 1

Nepenthes maryae is unique among the species of section *Tentaculatae* in that the lower surface of the lid is hairy, and also because the majority (c. 75 %) of the flowers are bracteate. Bracts are otherwise absent in the group except in *N. nigra* Nerz, Wistuba, Chi.C.Lee, Bourke, U.Zimm. & S.McPherson (Nerz et al. 2011a), where c. 5 % of the flowers, those at the base of the inflorescence, are bracteate.

Putative novel species in *Nepenthes* always need to be scrutinised to determine whether they might merely be interspecific hybrids, which often occur at low frequency wherever species co-occur. Hybrids in *Nepenthes* are intermediate in character between the two parent species. A hybrid origin for this species can be ruled out, since no other species of *Nepenthes* on Sulawesi has the lower surface of the upper pitcher lid hairy, and of the Sulawesi species of section *Tentaculatae*, only in *N. undulatifolia* Nerz, Wistuba, U.Zimm., Chi.C.Lee, Pirade & Pitopang (Nerz et al. 2011b) are the stems simple-hairy as in *N. maryae*, but *N. undulatifolia* has strongly infundibular upper pitchers and oblanceolate, peltate leaf blades, characters which do not occur in *N. maryae.*

Although only a single specimen of *N. maryae* is known so far, this is not unusual in the genus, in which most species have first been described from a single specimen, and in which many species are known from single mountains.

This paper forms part of studies towards a World Monograph of *Nepenthes* L. building on a Skeletal Revision of *Nepenthes* (Jebb & Cheek 1997) and the Flora Malesiana account (Cheek & Jebb 2001).

Section ***Tentaculatae*** Cheek & Jebb, *sect. nov.*

Terrestrial climbers, lower pitchers with multicellular, filamentous projections (or 'tentacles') from the upper surface of the lid; spur usually fasciculate; most species with leaf bases of climbing stems more or less perfoliate and/or adnate; pitcher mouth rounded to rhombic. — Type species: *Nepenthes tentaculata* Hook.f.

In addition to the type species the section comprises *N. glabrata* J.R.Turnbull & A.T.Middleton, *N. hamata*, *N. muluensis* M.Hotta, *N. murudensis* Culham ex Jebb & Cheek, *N. nigra*, *N. pitopangii* Chi.C.Lee, S.McPherson, Bourke & M.Mansur, *N. undulatifolia* and *N. maryae* Jebb & Cheek, newly described here.

Habitat & Distribution — Submontane forest in Borneo and Sulawesi.

Some of the characters that delimit this section appear to be neotenous. The presence of multicellular projections from the upper surface of the lid, and the fasciculate spur are widespread, perhaps ubiquitous, in the seedlings of species of *Nepenthes*, but rarely expressed in the lower pitchers of any species except those of section *Tentaculatae*, possibly the only exception being *N. weda* Cheek (Cheek 2015). In some species of section *Tentaculatae*, such as *N. tentaculata* and *N. hamata*, these neotenous features are also expressed in the upper pitchers, together with fringed wings which are normal in lower pitchers (and also seedlings) but in most other species of the genus usually absent or reduced to inconspicuous ridges in the upper pitchers.

Besides being 'tentaculate', the majority of the section is also distinctive for the (sub)perfoliate-adnate leaf bases, unique in the genus apart from *N. adnata* Tamin & M.Hotta ex Schlauer, *N. gracilis* Korth., *N. lamii* Jebb & Cheek and *N. mikei* B.R. Salmon & Maulder, none of which share the other characteristics. Leaf bases of this sort are absent in *N. glabrata* and *N. muluensis*, which resemble some species of section *Montanae* Danser, such as *N. tobaica* Danser. However, the placement of

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Table 1 Diagnostic characters of the climbing stems which separate *Nepenthes hamata* and *Nepenthes maryae*.

	Nepenthes hamata	*Nepenthes maryae*
Stem indumentum	Glabrous	Densely covered in persistent, patent, simple hairs 0.5–0.6 mm long
Leaves of climbing stems (shape and dimensions)	Oblong-elliptic, rarely lanceolate, 5–7(–15) by 1.8–2.5 cm	Lanceolate-oblong, (12.5–)14–17(–21.5) by 2.7–3.2 cm
Blade-like peristome ridges: dimensions and spacing	12–16 mm wide, 2–3 mm high, 2.5–6 mm apart	1.8–2.5 mm wide, 0.3–0.5 mm high, 1–1.5 mm apart
Outer pitcher indumentum	Arachnoid-tomentose with branched brown, often prostrate and crinkled hairs 0.3–1.5 mm long	Simple, patent, pale brown multicellular hairs 0.5–0.6 mm long, 2–50 % cover
Nectar glands and indumentum of lower surface of the lid	Nectar glands sparse and inconspicuous; surface glabrous	Nectar glands dense, 3–6 per mm^2 conspicuous; surface with patent simple or inconspicuously branched hairs (0.2–)0.3–0.6(–0.8) mm long, 2–7 per mm^2
Bracts on male inflorescence	Absent from all partial peduncles	Present on the proximal c. 60 of the c. 80 partial peduncles
Ratio of lengths of combined partial-peduncle and pedicel : androphore	c. 5 : 1	c. 1 : 1

N. glabrata and *N. muluensis* here is confirmed by the nature of their lower pitchers.

Section *Tentaculatae* is an addition to the six sections of the genus proposed by Danser (1928). Of the nine species included in *Tentaculatae* here, only one, *N. tentaculata* was known to Danser, which he placed in section *Vulgatae* Danser (1928) with 21 other species of diverse affinities. There is good molecular phylogenetic support for the section *Tentaculatae*. Mullins (2000) included *N. muluensis*, *N. murudensis*, *N. tentaculata*, *N. glabrata* and *N. hamata* in his sampling of 85 *Nepenthes* species. In his analysis of the biparentally inherited nuclear gene region 5S-NTS, all five species were retrieved in a crown clade with 99 % jack-knife support, while in the analysis of the maternally inherited chloroplast gene region *trn*L-*trn*F, *N. muluensis*, *N. murudensis*, *N. glabrata* and *N. hamata* form a clade with 87 % jack-knife support which is sister to a clade with a single species, *N. tentaculata* (Mullins 2000: 43).

Key to the species of Nepenthes section Tentaculatae

1. Leaves of climbing stems tapering gradually to the base, clasping the stem by 1/2 its circumference 2
1. Leaves of climbing stems not tapering to the base, more or less perfoliate (clasping the stem for the entire circumference) and/or adnate 3
2. Upper pitchers with wings reduced to inconspicuous ridges. — Borneo . . . . . *N. muluensis*
2. Upper pitchers with wings fully developed but not fringed, or with fringed elements inconspicuous. — Sulawesi . . . . . *N. glabrata*
3. Leaves of climbing stems not adnate but subperfoliate, pitchers strongly infundibuliform, mouth circular 4
3. Leaves of climbing stems perfoliate-adnate, pitchers ovoid-cylindric or cylindric, mouth rhombic 5
4. Stem densely pubescent, climbing stem leaf apex rounded, with tendril peltate . . . . . *N. undulatifolia*
4. Stem glabrous, climbing stem leaf apex obtuse to acute, tendril apical . . . . . *N. pitopangii*
5. Peristome of upper pitchers with ridges like curved blades 1–several mm high, widely spaced, 1–6 mm apart. — Sulawesi 6
5. Peristome of upper pitchers with ridges well defined or not, but not like blades, < 0.5 mm high, not spaced apart but ± contiguous with each other. — Sulawesi and Borneo . 7
6. Stems densely and persistently patent hairy; lower surface of the lid hairy . . . . . *N. maryae*
6. Stems glabrous; lower surface of lid glabrous . . *N. hamata*
7. Stems hairy; pitchers usually 12–25 by 2–5 cm. — Borneo, Mt Murud . . . . . *N. murudensis*
7. Stems glabrous; pitchers usually 6.5–12(–14) by 1.5–3(–3.5) cm. — Borneo and Sulawesi 8
8. In dried specimens, peristome ridges well defined, c. 0.5 mm high; leaf blades of climbing stems to 22 by 4.5 cm . . . . . *N. nigra*
8. In dried specimens, peristome ridges inconspicuous; leaf blades of climbing stems 6–9 by 1.8–2.5 cm . . . . . *N. tentaculata*

Nepenthes maryae Jebb & Cheek, *sp. nov.* — Fig. 1

Differing from *N. hamata* in the stems densely and persistently brown patent hairy (not glabrous); the blade-like peristome ridges 1.8–2.5 mm in length (not 12–16 mm); leaves of climbing stems (12.5–)14–17(–21.5) by 2.7–3.2 cm (not 5–7(–15) by 1.8–2.5 cm); male inflorescence partial peduncles short, < 7.5 mm (not > 10 mm) and bracteate. — Type: *Argent*, *Mendum & Hendrian 205* (holotype K; isotypes BO n.v., E), Indonesia, Central Sulawesi, exact location withheld for conservation reasons, fl. 27 Feb. 2000.

Etymology. Named for Mary Mendum, born Bates (1945–2004), staff botanist of the Royal Botanic Gardens, Edinburgh, botanical artist and taxonomist, specialising in *Gesneriaceae* of Southeast Asia, especially the genus *Aeschynanthus* Jack. She co-collected many specimens on expeditions in the Philippines and Indonesia, often with George Argent, including the type and currently only known specimen of *Nepenthes maryae*.

Terrestrial climber to c. 2 m tall. Rosette and short stems unknown. Climbing stems terete, internodes (3.5–)4.5–5.5 cm long, (2.5–)4–5 mm diam, drying black, c. 50 % covered in persistent patent pale brown hairs 0.5–0.6 mm long, hairs simple, multicellular, mixed with sessile depressed globose glands drying black, 0.06 mm diam. *Leaf blades* of climbing stems coriaceous, sessile, lanceolate-oblong, (12.5–)14–17(–21.5) by 2.7–3.2 cm, apex acute, subpeltate, base perfoliate-adnate, decurrent by (0.9–)1.5–1.8 cm. Longitudinal nerves 2 pairs, in the marginal half, visible on both surfaces. Pennate nerves inconspicuous, irregular, patent to midrib, 5–8 mm apart. Indumentum of upper surface as the stem, but sometimes with a minute, inconspicuous branch 0.05 mm long, cover 5 %, hairs 0.3 mm long, midrib with 30–50 % cover, hairs 0.5 mm long; lower surface 50 % cover, hairs 0.3–0.5 mm long, denser on midrib. Tendrils (10–)15–17(–20) cm long, densely patent hairy, indumentum as stem. *Upper pitchers* (tendrils coiled) cylindrical 11–15 by (1.7–)2–3 cm, green, slightly suffused with purplish red, wings running full length of pitchers, 3–5 mm wide, fringed only in upper 1/2–1/5, fringe elements 2–4 mm apart, 1–1.5 mm long, outer surface 2–50 % covered in a mixture of indumentum as stem, densest at pitcher base. Mouth rhombic, obtuse; straight, not concave, inner surface waxy white-grey; peristome 0.5–0.9 mm diam, ridges blade-like, in overall length to 1.8–2.5 mm diam, c. 1 mm high, 1–1.5 mm apart (Fig. 1o–q), column absent; lid elevated 45° above the horizontal, 90° above the mouth, ovate-elliptic 2.5–3.5 by 1.5–2 cm, lower surface

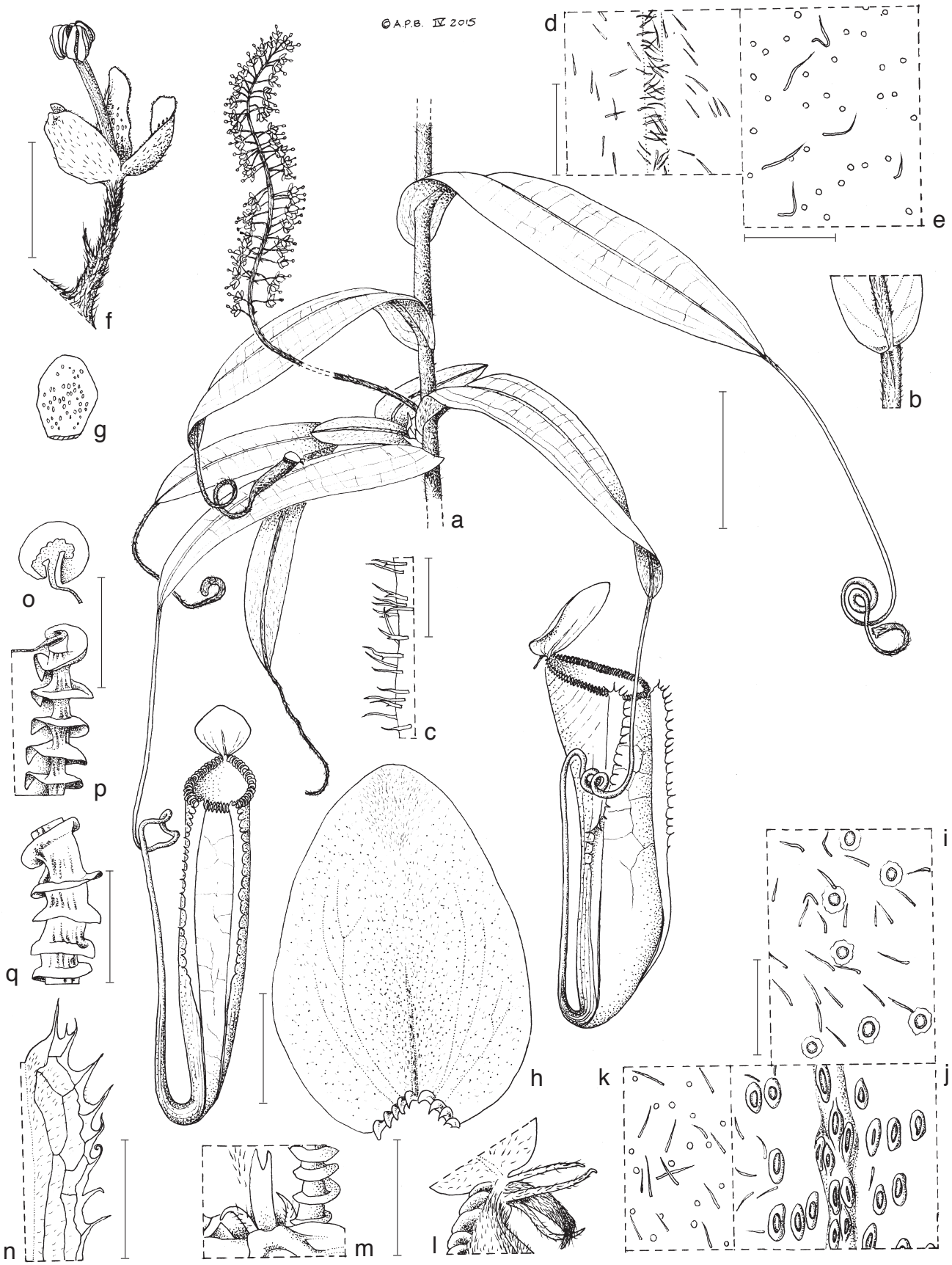

Fig. 1 *Nepenthes maryae* Jebb & Cheek. a. Habit, climbing stem with male inflorescence and upper pitcher; b. subperfoliate-adnate leaf-base, adaxial surface, climbing stem; c. stem indumentum; d. detail of adaxial surface of leaf, including midrib; e. detail of abaxial surface of leaf; f. male flower; g. tepal, upper surface; h. lower surface of lid (base of lid concealed by mouth of upper pitcher); i. detail from h, midlateral section; j. detail from h, midline near base; k. indumentum, outer pitcher surface; l, m. details of the fasciculate spurs, upper pitcher (in l; lid lowermost; in m: lid uppermost); n. fringed wing, showing indumentum, upper pitcher; o. peristome, transverse section; p. peristome viewed from inside upper pitcher; q. peristome viewed from above (all from *Argent et al. 205*). — Scale bars: a, b = 5 cm; c, e, i–k = 1 mm; d = 2 mm; f, g, l, m, o–q = 5 mm; h, n = 1 cm. — Drawn by Andrew Brown.

without appendages, densely covered in orbicular and elliptic, thinly bordered nectar glands 0.2–0.25 mm diam, midline ridge at base with narrow elliptic nectar glands 0.6 by 0.06 mm, mixed with depressed globose glands 0.03 mm diam (drying black); hairs 2–7 per mm^2, patent, copper-coloured, simple or inconspicuously branched (0.2–)0.3–0.6(–0.8) mm long; spur dorsiventrally flattened, oblong-acute, slightly recurved, 4–5 by 1.5 mm, flanked by 1–2 cylindrical appendages of same length. *Male inflorescence* c. 15 by 2.5 cm, peduncle c. 6 cm long, 2 mm diam at base, 50 % covered in mainly appressed copper-coloured hairs 0.2 mm long; rachis c. 9 cm long, with c. 80–84 partial peduncles, partial peduncles 1-flowered, 4–7.5 mm long, 0.5 mm wide; bracts present on pedicels of proximal c. 60 flowers, each 0.8–1 mm long, acute, inserted 0–2.5 mm from base of partial-peduncle; flower colour unknown; tepals 4, oblanceolate-obovate, 3.5–4 by 1.5–1.9 mm, apex rounded, outer surface 5 % covered in minute copper-coloured simple appressed hairs 0.05 mm long, densest on margins; adaxial surface with nectar glands occupying c. 50 % of surface, glands elliptic, c. 0.25 by 0.15 mm, cohering or up to 0.1 mm apart, thinly bordered, deeply sunken; androphore terete, 5 mm long, 0.3 mm wide, glabrous; anther head 1–1.5 by 1.5–1.75 mm, anthers 4, in a single whorl, head of androphore conspicuous, glabrous. Female inflorescence, infructescence and seed unknown.

Distribution & Ecology — Indonesia, Central Sulawesi. Submontane mossy forest, along ridge with *N. nigra*, *N. tentaculata* and *N. eymae* Sh.Kurata; 2100 m altitude.

Conservation — Currently no imminent threats are known at the only known location of this species. According to the lead collector, only one or two plants were seen at the single known location for *N. maryae* (Argent pers. comm. to Cheek). It is possible that less than 50 mature individuals are present. In the same section, and also from Sulawesi, *N. pitopangii* has a small population size reported of 13 individuals at just two widely separated sites, despite lengthy and dedicated searching (McPherson 2011: 507–515).

Nepenthes maryae, like other species of the genus, may be restricted to the single mountain on which it was discovered, or to a small number of peaks. This is supported by the fact that so much dedicated exploration for *Nepenthes* novelties has taken place in the last 10 years on the mountains of Sulawesi that, had the species been present elsewhere, it would probably already have been discovered. Since on current evidence *N. maryae* is known only from a small population at a single site, it is here assessed as Vulnerable under criterion D2 of IUCN (2001).

DISCUSSION

The conspicuously hairy lower surface of the pitcher lid seen in *N. maryae* (Fig. 1i), is otherwise recorded only in *N. lowii* Hook.f. and *N. ephippiata* Danser of Borneo and *N. macfarlanei* Hemsl. of Peninsular Malaysia. These species belong to different sections of *Nepenthes* and the hairy lower surface of the lid character appears to have developed independently. In the case of the Bornean species the hairs are elaborated into robust bristles up to 1 mm diam quite different to those of *N. macfarlanei* and *N. maryae* which have fine hairs less than 0.1 mm diam. In *N. lowii*, *N. rajah* Hook.f. and *N. macrophylla* (Marabini) Jebb & Cheek, nutrients are obtained not only by trapping insects, but predominantly by attracting tree shrews, which lick the nectar secreted on the lids and then defecate into the pitcher mouth (Chin et al. 2010). These species have 10–15 cm broad, woody, robust pitchers with large, reflexed, concave lids. In contrast, the pitchers of *N. macfarlanei* and *N. maryae* are papery, 2–4 cm broad, with lids flat, and held over the pitcher mouths and can be supposed to trap insects as in most species of the genus where observations on animal-protein capture have been made. Examination of the pitcher contents of both species confirms the presence of insect remains (two *N. maryae* upper pitchers examined contained Diptera, Coleoptera and Hymenoptera, but no ants: *Argent et al. 205*, K ; while two upper pitchers of *N. macfarlanei* contained Coleoptera and Hymenoptera, but no ants: *Wray 3849*, K). It is here conjectured that the function of the fine hairs of the lids in both species is to impair secure footing of insects of these groups (but not ants) as they seek nectar from the glands of the lower leaf surface, analogous to the case of *N. gracilis* as revealed by Bauer et al. (2012).

The flick of the lid mechanism

Bauer et al. (2012) showed that the lower surface of the lid in *N. gracilis* has a waxy coating of plates (unlike in most other species of the genus, where wax plates are absent from the lid) similar but differing in microstructure, to those of the detentive zone of the inner pitcher wall. Ants have no difficulty negotiating this surface in an inverted position to obtain nectar from the glands of the lower surface, except when it starts to rain. Raindrops striking the lid flick ants on its lower surface through the mouth, into the liquid at the bottom of the pitcher where they are readily wetted by the pitcher fluid and trapped (Bauer et al. 2012). The wax coating was proven to be crucial in the mechanism since once the coating was stabilised by experimental means, the percentage of ants dislodged by raindrops from the lid was greatly reduced (Bauer et al. 2012). Experimental evidence is needed to test the conjecture that the hairs on the lower surface of the lids of *N. macfarlanei* and *N. maryae* might have an analogous function.

An alternative secondary function of these hairs might be to reduce ‘robbing’ of nectar by animals which might be unlikely to be trapped, by acting as a barrier, much as hairs on a plant surface can act to reduce predation, however, this conjecture seems less likely than the first.

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