

A revision of *Ornithoboea* (Gesneriaceae)

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ABSTRACT. The genus *Ornithoboea* C.B. Clarke (Gesneriaceae) from limestone habitats in Peninsular Malaysia, Thailand, Myanmar (Burma), Laos, Vietnam and Southern China is revised. It has 16 species, three of which are newly described: *Ornithoboea maxwellii* S.M. Scott from Thailand, *Ornithoboea puglisiae* S.M. Scott from Thailand and *Ornithoboea obovata* S.M. Scott from Vietnam. The plants are characterised by small, bilabiate flowers with a distinctive palatal beard on the lower lobes and a circlet of hairs around the mouth of the corolla tube. A key is provided, all species are described, and distribution maps and IUCN conservation assessments are given for all species.

Keywords. Karst limestone, *Ornithoboea*, taxonomic revision

Introduction

The genus *Ornithoboea* C.B. Clarke (Gesneriaceae) consists of a group of herbaceous plants on karst limestone from Peninsular Malaysia, Thailand, Myanmar (Burma), Laos, Vietnam and Southern China, its most northerly occurrence. No species have yet been recorded from Cambodia.

Ornithoboea was first described by Clarke (1883) from a specimen sent to him by the Rev. C. Parish from his collections in Burma. The specimen was accompanied by a drawing and analysis by Parish who commented on its resemblance to *Boea* except for the corolla and broader submembranous capsule. Clarke (1883) also compared it to *Boea* but stated that the capsule valves are more twisted, a comment that was probably why three more *Ornithoboea* species published soon thereafter, all of Chinese origin, were included in *Boea* rather than *Ornithoboea*. Three genera, now treated as synonyms of *Ornithoboea*, were also described: *Lepodanthus* Ridl., *Brachiostemon* Hand.-Mazz. and *Sinoboea* Chun. In the case of *Sinoboea*, Chun considered it to be closely related to *Ornithoboea* but that it differed in the rounded, not acuminate corolla lobes, the anther dehiscence and the pilose hairs on the inner surfaces of the corolla. *Brachiostemon* was considered to differ by its lanceolate sepals, branched filaments and many-valved capsules. Ridley (1909) never made any comparison of *Lepodanthus* to *Ornithoboea* but did liken it to the habit of *Rhynchotechum* Blume (“*Rhyncotecum*”)

with a capsular fruit. The fruits in the single species of *Lepadanthus*, *L. flexuosus* (= *Ornithoboea flexuosa*), are very short and show little sign of twisting. Burt (1958) suggested it may have been for this reason that Ridley never made the comparison with *Ornithoboea*. Burt (1958) also observed that had an amended generic description been available for the species already then known, then *Brachistemon* and *Sinoboea* might not have been proposed.

Molecular phylogenetic research in Gesneriaceae has consistently shown *Ornithoboea* to be monophyletic, sister to a clade of *Kaisupeeae* B.L.Burt and *Rhabdothamnopsis* Hemsl. (Möller et al., 2009, 2011; Puglisi pers. comm. [expanded unpublished sampling]). These studies also confirm *Ornithoboea* as belonging to subfamily Didymocarpoideae, tribe Trichosporeae, subtribe Loxocarpinae (Weber et al., 2013).

The last taxonomic account of the entire genus was by Burt (1958). Since then four new species have been described (Wu & Li, 1983; Burt, 2001; Middleton & L y, 2008) and an account of the genus for the *Flora of China* (Wang et al., 1998) has been published. To incorporate these new species into an overall view of the genus and to account for the many new collections from Thailand and Vietnam since the last revision (Burt, 1958), many of which have remained unidentified, *Ornithoboea* is revised anew.

Morphological characters

Burt (1958) gave detailed morphological information on the habit, leaves, indumentum of vegetative parts, inflorescence, gynoecium, and fruit. His work is an excellent introduction to *Ornithoboea* which we expand on slightly here. In summary *Ornithoboea* is readily recognised by the distinctive morphology of its flowers, more specifically the palatal beard and cirlet of hairs round the mouth of the corolla tube (Fig. 1). Most species are rather similar in vegetative characters and, consequently, difficult to distinguish when sterile. The exceptions to this are *Ornithoboea arachnoidea* (Diels) Craib and *O. maxwellii* S.M.Scott due to their distinctive indumentums.

Habit: It is not clear whether most species are annual or perennial. They often have a base which has tightly packed persistent leaf bases, more than would grow in one season, with the bulk of the specimen taken up by the inflorescence. This would suggest a perennial growth pattern and this has been partly confirmed in cultivation. Plants will remain compact in habit until they are ready for flowering. This shoot dies after fruiting but in cultivation *Ornithoboea barbanthera* B.L.Burt produces new shoots at the base and flowers again in subsequent years. Field observations are necessary to ascertain whether the base of the stem does indeed survive the dry season and produce new shoots as the rains start.

Leaves: The leaves are thin and delicate except in *Ornithoboea arachnoidea*. In cultivation the leaves are thicker and fleshier than in the wild except in *Ornithoboea flexuosa* (Ridl.) B.L.Burt, *O. multitorta* B.L.Burt and *O. pseudoflexuosa* B.L.Burt where no observable difference has been noted. The leaves are always opposite, well developed, slightly anisophyllous, petiolate, more or less ovate in outline, crenate/bicrenate to dentate/duplicato-dentate on the margins (rarely serrate), and unequal

sided at the base which is usually cordate to rounded.

Vegetative indumentum: *Ornithoboea arachnoidea* and *O. maxwellii* have a covering of arachnoid hairs (spider web- or felt-like) over all parts of the plant except for the flowers. All other *Ornithoboea* species have glandular hairs. Hair length on any individual usually varies considerably.

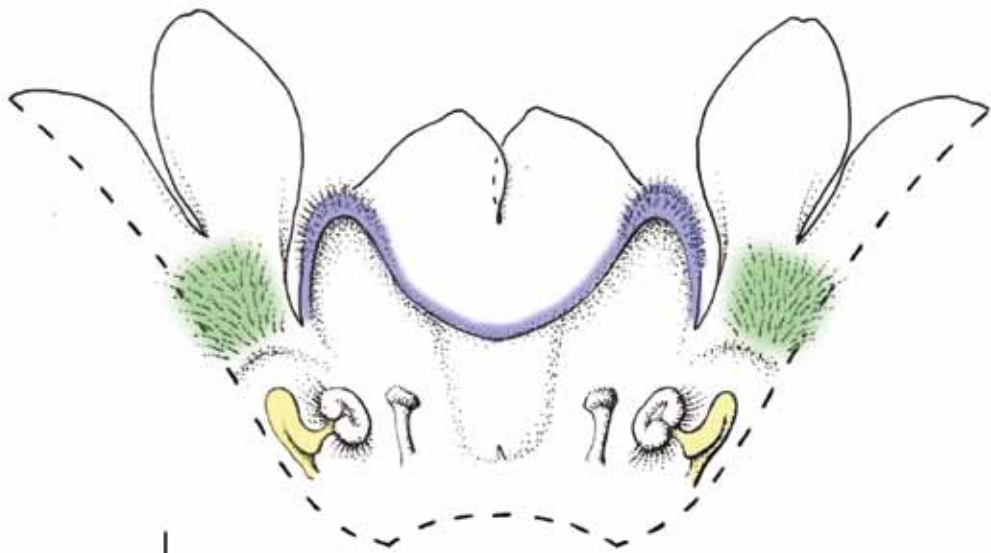
Inflorescence: *Ornithoboea* species have the characteristic “pair-flowered cymes”, found only in Gesneriaceae and a few genera of Scrophulariaceae (Weber, 2004). In this the terminal flower of each cyme unit is associated with an additional flower in a frontal position so that each cyme unit seems to end in a flower pair. In general, the front flower has no subtending bracteole, while the lateral flowers are usually subtended by bracteoles. In many instances this form of cyme is modified by suppression of one branch of the inflorescence on alternate sides of each node resulting in a pseudoracemose as in *Ornithoboea pseudoflexuosa* and *O. flexuosa*.

Calyx: The five lobes are always divided to the base, only weakly imbricate in bud and hairy. They are usually green but can be white, pink or purple. In some species, such as in *Ornithoboea arachnoidea*, they are reflexed when in flower, whilst in others, like *O. obovata* S.M.Scott, they are reflexed when in fruit.

Corolla and androecium: The most important diagnostic characters of the genus *Ornithoboea* are the palatal beard and the circlet of hairs round the mouth of the corolla tube (Fig. 1). Only in *Ornithoboea maxwellii* is there no obvious beard present. The lower lip of the corolla is three lobed and the palatal beard is located at the base of the lip before the division into lobes. On either side of the beard a line of hairs runs marginally across the sinus between the upper and lower lips of the corolla and then along the ridge of tissue at the base of the two-lobed upper lip. This forms a ring of hairs around the mouth of the corolla tube; this is called the circlet (circulus) (Fig. 1).

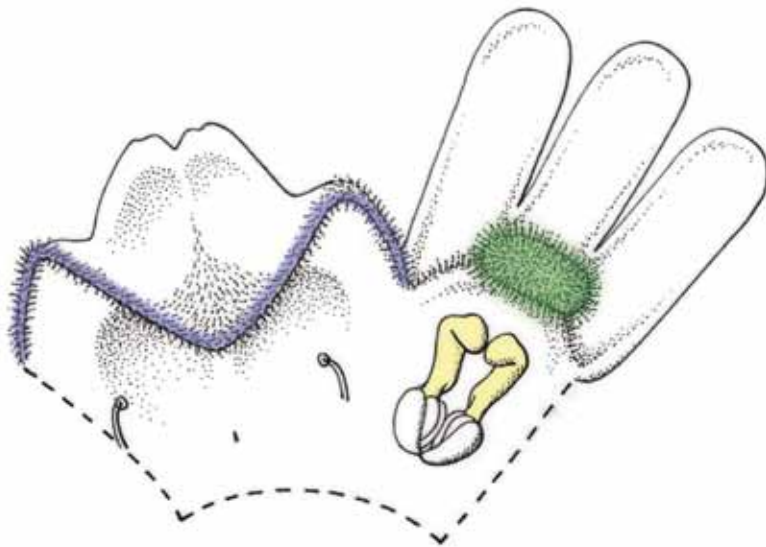
The hairs of the beard and circlet are remarkable structures and differ from the smaller multicellular hairs that form the indumentum on the rest of the plant. They are larger, unicellular, varying in length and colour, flattened to a certain degree, dilated at the tips and the wall has a covering of scattered tubercles (easier to observe on rehydrated flowers). Burt (1958) found very similar hairs when he compared those found at the base of the corolla lobes of *Ramonda myconi* (L.) Rchb. and on the filaments and mouth of the corolla tube in *Verbascum* L. Further comparisons were made with unicellular palatal hairs on *Mimulus* L. and other Scrophulariaceae which lacked the dilated tips.

Other characters of the corolla and androecium vary greatly between species. The most straightforward condition is found in *Ornithoboea feddei* (H.Lév.) B.L.Burt which has long straight filaments and a long tube which widens gradually and evenly towards the mouth. Other species vary from this simple form by the shortening of the corolla tube, the inflation of the tube in the upper part, the increase in size of the lower lip and the shortening and thickening of the filaments and the gradual retraction of the fertile arm so that finally it no longer points towards the mouth of the tube but upwards and backwards. Enantiostyly also occurs where the style is deflected to the left or right. In some species there is a well-marked thickened knee on each filament and the eventual production at the knee of a distinct sterile process and the formation



Ornithoboea barbanthera B.L.Burtt.

1cm



Ornithoboea puglisiae S.M.Scott.

Fig. 1. Illustrations highlighting the characters of the circling (blue); the pronounced sterile projections on the stamens (yellow); and the palatal beard (green). Drawn by Claire Banks.

of a pronounced sterile projection. This sterile process continues along the original line of the filaments along the floor of the corolla tube while the fertile arm branches off upwards and backwards to the roof of the tube. The sterile arm is swollen at the apex, often wrinkled and coloured yellow to blue: these are usually visible when the flower is open and can be mistaken for anthers. With the shortening of the filaments, and their change in direction, it means the anthers are held just below the dorsal side of the corolla tube at the point where the narrow basal tube expands into the upper inflated portion. The anthers of all species are coherent face to face and are connected at the tips by a short delicate process (easily damaged on herbarium specimens).

Gynoecium and fruit: *Ornithoboea* species have a superior ovary which is short and conical and which narrows into a well-developed style. The T-shaped parietal placentae are rather thin, of equal thickness throughout their length but with somewhat swollen curved ends where the production of ovules is usually confined (Weber, 2004). According to Burt (1958), the sterile inner surfaces often abut closely on one another but apparently do not fuse.

The mature fruit varies greatly in length from 4.7–21 mm and also varies from straight to spirally twisted. Burt (1958) suggested that the twisted fruit was a good generic character and that where it was not present this was due to the lack of opportunity for its expression, i.e. small fruits, rather than to its genuine absence. However, both *Ornithoboea maxwellii* and *O. obovata* have consistently non-twisted or almost non-twisted fruits with lengths of up to 5.8 and 11.3 mm respectively, longer than other species with twisted fruits. The style is also persistent in many *Ornithoboea* species and is a good species character.

Reproduction and Dispersal

It is not known what pollinates the flowers of *Ornithoboea* and nothing is written on the specimen labels to indicate a pollinator was observed prior to collection. From the shape of the corolla with its narrow corolla tube, the anthers located dorsally in the tube, and the curved style (enantiostyly) located at the mouth of the tube, bee pollination can be speculated?

Seed dispersal is likely to be over relatively short distances as there is no adaptation to wind or animal dispersal. The seeds are probably dispersed by the wind rocking the whole plant, rain washing the seeds away, and the untwisting of the fruit flinging the seeds for a short distance in response to drying conditions.

Materials and Methods

This work is based primarily on an examination of herbarium material from A, AAU, ABD, B, BK, BKF, BM, E, GH, HNU, K, KEP, KUN, L, MO, NY, P, PSU, SING, US, VNM (Thiers, continuously updated). All specimens have been seen except where indicated by “n.v.” for *non vidi*. The maps are based on coordinates recorded from the specimens or by geo-referencing the localities from gazetteers. Not all localities,

however, could be found so parts of the distribution for some species may be missing from the maps.

All morphological characters were observed or measured from the herbarium material. Floral measurements were taken from pickled or rehydrated flowers. As *Ornithoboea* flowers are morphologically fairly complex our interpretation of them was aided by living collections of *O. barbanthera* at the Royal Botanic Garden Edinburgh (RBGE) and photographs of several species taken by a number of photographers (see Acknowledgements). Measurements were made with an electronic digital caliper, a ruler and with the aid of a trinocular dissecting microscope. As such, measurements using the calipers and microscope were accurate to one tenth of a millimetre. All dissections were photographed using a Nikon Coolpix 4500 camera attached to the microscope.

This revision is based on a traditional taxonomic approach utilising a morphological species concept. Species are delimited based on discontinuous differences assessed by observations and measurements of herbarium specimens. Our knowledge of *Ornithoboea* species is only as good as the specimens that have been collected so far and yet collecting has been sporadic, particularly in Myanmar, Laos, Vietnam and southern China. New collections are necessary in these areas to both improve the descriptions here presented, to clarify difficult species delimitation problems, and potentially to uncover further new taxa.

Ornithoboea Parish ex C.B.Clarke

in A.DC. & C.DC., Monogr. Phan. 5(1): 147 (1883); Hook.f., Fl. Brit. Ind. 4: 365 (1884); Burt, Notes Roy. Bot. Gard. Edinburgh 22: 287 (1958); Wang, Fl. Reipubl. Popularis Sin. 69: 476 (1990); Wang et al., Fl. China 18: 369 (1998); Weber in Kubitzki, Fam. Gen. Vasc. Pl. 7: 147 (2004). TYPE: *Ornithoboea parishii* C.B.Clarke.

Lepadanthus Ridl., J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 74(2): 782 (1909). TYPE: *Lepadanthus flexuosus* Ridl. (= *Ornithoboea flexuosa* (Ridl.) B.L.Burt).

BrachioSTEMON Hand.-Mazz., Sinensia 5: 9 (1934). TYPE: *BrachioSTEMON macrocalyx* Hand.-Mazz. (= *Ornithoboea wildeana* Craib).

Sinoboea Chun, Sunyatsenia 6: 271 (1946). TYPE: *Sinoboea microcarpa* Chun (= *Ornithoboea feddei* (H.Lév.) B.L.Burt).

Herbs, lithophytic, annual to perennial, to 200 cm tall, stems simple or branched, erect to decumbent. **Indumentum** of stems, leaves and inflorescences densely arachnoid (*Ornithoboea arachnoidea* and *O. maxwellii*), pilose or pubescent; all hairs are

glandular except those found in the palatal beard and circllet. **Leaves** opposite and petiolate, often slightly anisophyllous, more or less ovate, acute to narrowly acute, base often unequal; cordate to rounded, margin weakly to strongly crenate/bicrenate to dentate/duplicato-dentate; basal leaves often withered and persistent and variable in number, their position indicated by scars or persistent corky peg-like leaf bases. **Inflorescences** axillary, cymose, with paired flowers; sometimes pseudoracemose by abortion of one branch at each dichotomy; **bracts** small, linear to triangular, pubescent. **Calyx** 5-lobed, 3-veined, divided to the base, weakly imbricate, sometimes nearly as long as the corolla, ovate to elliptic, sometimes narrowly so, apex acute to narrowly acute, pubescent, often ciliate, persistent and often reflexed in flower and fruit or both. **Corolla** zygomorphic, with a short tube which is broadly funnel-shaped or distinctly inflated in the upper part, and a bilabiate limb; upper lip 2-lobed, short, often reflexed, with emarginate or notched lobes; lower lip 3-lobed and much larger, often partially reflexed, lobes obovate to oblong; base of lower lip bearded (palatal beard) with large unicellular hairs which are dilated at the tips; the same hairs run across the sinus of the upper lip and lower lip on a ridge of tissue towards the base of the lower lip, thus forming a circllet, a ring of short hairs around the mouth of the corolla tube. **Fertile stamens** 2, adnate to the tube near base of corolla tube; filaments simple and straight or geniculate, or with a pronounced sterile projection at the knee; when geniculate or with a sterile projection the fertile arm is erect or sloping backwards towards the base of the corolla tube; anthers reniform, cohering face to face, connected at the tips. **Staminodes** 3 (2 lateral and 1 medial), adnate to tube near base of corolla tube, 2 laterals well developed, medial small and inconspicuous. **Ovary** conical, puberulent or pubescent; placentae parietal, T-shaped, ovules present on the in-turned ends, not on the inner face. **Style** longer than the ovary, enantiostylous, puberulent to pubescent, ending in a swollen terminal stigma. **Fruit** a capsule, narrowly oblong to short and oblong, either twisting spirally or with a straight line of dehiscence, puberulous to pubescent or arachnoid. **Seeds** small.

Distribution. Southern China, Myanmar, Laos, Vietnam, Thailand and northern Peninsular Malaysia.

Ornithoboea is a genus of 16 species that typically grow on karst limestone in hollows where organic matter collects, in cave mouths and in fissures on vertical or sloping rock faces. They tend to grow near the base of cliffs or slopes of limestone formations rather than at the drier and more exposed summits. Some species have wide ranges of altitudes due to their occurrences in both lowland hills and in mountain ranges where the bases of the hills are still at much higher altitude. In each locality the species tend to occupy the same sort of elevations in the actual formations. The genus can be recognised by the glandular pubescence throughout and the bilabiate flowers with unicellular hairs with dilated tips. These hairs form a palatal beard on the lower corolla lip and a ring of hair around the mouth of the corolla tube (Fig. 1).

Key to *Ornithoboea* species

- 1a. Stems, petioles, leaves and inflorescence with arachnoid (spider web- or felt-like) indumentums 2
- 1b. Stems, petioles, leaves and inflorescence with puberulent, pilose or pubescent indumentums 3
- 2a. Dense arachnoid indumentum; sepals reflexed when in flower and fruit; filaments not thickened, 2–3 mm long; fruit twisted; plant 20–50 cm tall 1. *O. arachnoidea*
- 2b. Sparse arachnoid indumentum; sepals not reflexed; filaments thickened, 1–1.5 mm long; fruit with straight line of dehiscence; plant 6–10.5 cm tall..... 9. *O. maxwellii*
- 3a. Filaments straight or geniculate, without a sterile projection 4
- 3b. Filaments with a pronounced sterile projection 8
- 4a. Filaments 1.7–3.8 mm long, straight 5. *O. feddei*
- 4b. Filaments 1–2 mm long, geniculate 5
- 5a. Fruit with straight line of dehiscence, style persistent in fruit, characteristically curved through 180°; Vietnam 11. *O. obovata*
- 5b. Fruit weakly to strongly twisted, style not persistent in fruit; Thailand, Myanmar, China 6
- 6a. Corolla c. 14 mm long; fruit \leq 6.5 mm long; calyx lobes longer than fruit and slightly reflexed in fruit 12. *O. occulta*
- 6b. Corolla \leq 13 mm long; fruit 8.8–14 mm long; calyx lobes shorter than fruit and reflexed in fruit 7
- 7a. Corolla c. 9.3 mm long; lobes of lower lip narrowly obovate, central lobe slightly reflexed; upper lip lobes glabrous; fruit densely puberulent 7. *O. henryi*
- 7b. Corolla c. 13 mm long; lobes of lower lip oblong, central lobe fully reflexed; upper lip lobes puberulous; fruit puberulous 13. *O. parishii*
- 8a. Inflorescence pseudoracemose; corolla \leq 10 mm long 9
- 8b. Inflorescence a pedunculate cyme; corolla $>$ 10 mm long 11
- 9a. Corolla tube \leq 4 mm long; lobes of lower lip 3–4 mm long, central lobe not fully reflexed; anthers glabrous; fruit barely twisted, less than a quarter turn; sepals 4.5–5.5 mm long 6. *O. flexuosa*
- 9b. Corolla tube \geq 4 mm long; lobes of lower lip 2.2–3.5 mm long, central lobe fully reflexed; anthers bearded; fruit barely twisted to tightly twisted; sepals 5–7.3 mm long 10

- 10a. Corolla tube 4.5–5.1 mm long; sepals 5–6 mm long; fruit tightly twisted, 7.5–12.3 mm long 10. *O. multitorta*
- 10b. Corolla tube c. 6.7 mm long; sepals 5.7–7.3(–10.3) mm long; fruit twisted to over half turn or barely twisted, 6.1–9.6 mm long 14. *O. pseudoflexuosa*
- 11a. Filaments 1.4–1.6 mm long, anthers densely bearded; fruit twisted to barely twisted, densely pubescent 12
- 11b. Filaments 0.3–1.3 mm long, anthers glabrous to sparsely bearded; fruit twisted, puberulous to pilose 13
- 12a. Corolla c. 20 mm long, lower lip c. 13 mm long, lobes not emarginate; peduncle 8–30(–36) mm long; Thailand 2. *O. barbanthera*
- 12b. Corolla c. 16 mm long, lower lip c. 10.5 mm long, lobes distinctly emarginate; peduncle 6–16 mm long; Vietnam 4. *O. emarginata*
- 13a. Corolla 17–25 mm long, tube (6.5–)7.8–11.4 mm long; sepals ovate to elliptic; filaments 0.3–1 mm long; stems 30–150 cm tall 14
- 13b. Corolla 12.7–16.5 mm long, tube 6–8 mm long; sepals elliptic; filaments 1–1.3 mm long; stems 40–62 cm tall 15
- 14a. Corolla 22–25 mm long, pink/purple; each lobe of lower lip oblong, apices distinctly emarginate, central lobe not overlapping lateral lobes 8. *O. lacei*
- 14b. Corolla c. 17 mm long, blue/purple; each lobe of lower lip obovate, apices rounded, not emarginate, central lobe overlapping lateral lobes 16. *O. wildeana*
- 15a. Corolla c. 16.5 mm long, tube c. 8 mm long, deep violet/blue throughout, pubescent outside; lower lip reflexed through 90°, lobes 2.5–3.1 mm long, apices slightly triangular; tube c. 8 mm long; fruit 18–21 mm long, style not persistent 3. *O. calcicola*
- 15b. Corolla c. 12.7 mm long, tube c. 6 mm long, light purple/pink to white, glabrous outside; lower lip slightly reflexed, lobes 3.5–4.5 mm long, oblong, apices rounded; fruit 11.6–14.3 mm long, style often persistent 15. *O. puglisiae*

1. *Ornithoboea arachnoidea* (Diels) Craib

Notes Roy. Bot. Gard. Edinburgh 11: 251 (1920); Burt, Notes Roy. Bot. Gard. Edinburgh 22: 294 (1958); Wang, Fl. Reipubl. Popularis Sin. 69: 477 (1990); Wang et al., Fl. China 18: 369 (1998); Burt, Thai Forest Bull., Bot. 29: 100 (2001). — *Boea arachnoidea* Diels, Notes Roy. Bot. Gard. Edinburgh 5: 225 (1912). TYPE: China, Yunnan, Ming kwang valley, Near Pei sha, 1828–2137 m, October 1905, *G. Forrest* 929 (holotype E; isotypes BM, K). (Fig. 2, 3).

Ornithoboea lanata Craib, Bull. Misc. Info. Kew. 1914: 130 (1914); Pellegrin in Lecomte, Fl. Indo-Chine 4: 551 (1930). TYPE: Thailand, Doi Chiang Dao, 670 m, 27 January 1913, *A.F.G. Kerr* 2852 (holotype K; isotypes ABD, BM).

Ornithoboea forrestii Craib, Notes Roy. Bot. Gard. Edinburgh 11: 252 (1920). TYPE: China, Yunnan, Shwei-Salween divide, 1917–1919, *G. Forrest* 17557 (holotype E; isotypes BM, E, K, P).

Herb; stem 20–50 cm tall, to 2–5.4 mm diameter, brown to white glandular arachnoid throughout, leaf internodes (3.3–)5.5–10 cm. **Leaves** opposite; petiole (2–)4.3–9.8(–12.3) cm long; blade herbaceous, broadly to narrowly ovate, 7.8–16.3(–24) × 5–11(–22) cm, apex acute to acuminate, base unequal, oblique to rounded/cordate, margin narrowly crenate/bicrenate to dentate, the teeth 0.5–2.9 mm; 8–10(–12) pairs of secondary veins, tertiary venation reticulate; glandular puberulous above, lanate to arachnoid below. **Inflorescence** axillary, 3–7(–8.3) cm long, arachnoid throughout; peduncle 1.8–4.8 cm long; bracts linear to elliptic, c. 5 × 1 mm; pedicels 9.7–19.6 mm long. **Sepals** broadly elliptic, white to pink, 3-veined, c. 6.5–10 × 2.5–4 mm, apices acute to narrowly acute, puberulous on inside, arachnoid on outside, ciliate; sepals reflexed when in flower and fruit. **Corolla** bilabiate, c. 13 mm long, glabrous



Fig. 2. *Ornithoboea arachnoidea* (Diels) Craib. Photograph of *Middleton et al.* 4523 by Preecha Karaket.

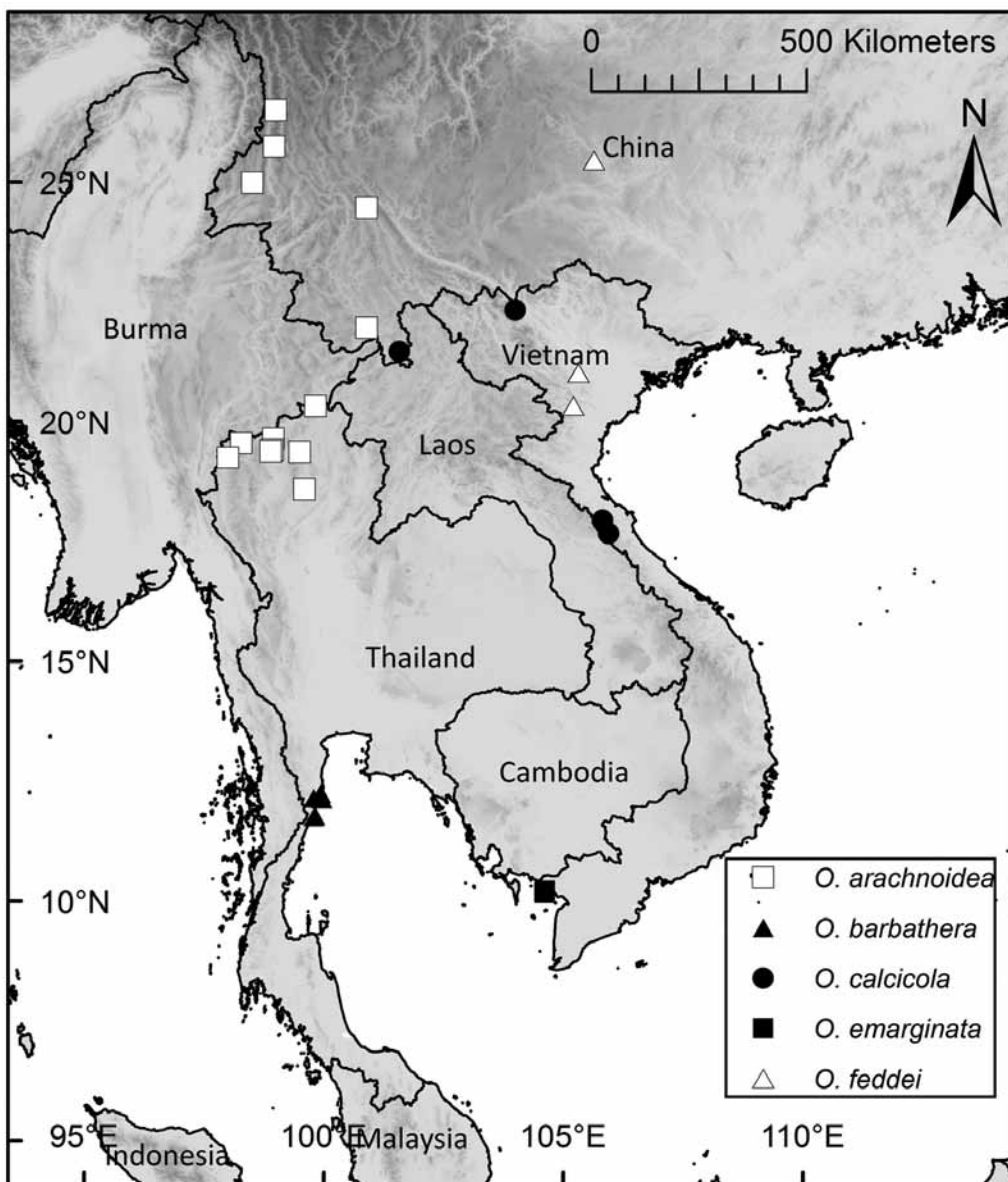


Fig. 3. Distribution of *Ornithoboea arachnoidea* (Diels) Craib (□); *Ornithoboea barbathera* B.L.Burt (▲); *Ornithoboea calcicola* C.Y.Wu ex H.W.Li (●); *Ornithoboea emarginata* D.J.Middleton & N.S.Lý (■); and *Ornithoboea feddei* (H.Lév.) B.L.Burt (△).

outside; tube c. 5.2 mm long, white to blue, puberulent on inside; upper lip slightly 2-lobed, each lobe 0.2 mm long, blue, apices rounded, glabrous except for a ring of blue short hairs on the ridge of tissue at the base of the lip which runs down to the sinus

with the lower lip; lower lip 3-lobed, slightly reflexed, c. 8 mm long, blue, glabrous except for a large palatal beard at base of lobes, each lobe 3.5–4 × 2.4–3.5 mm, oblong to slightly obovate, apices broadly acute to rounded. **Stamens** without a pronounced sterile projection; filaments 2–3 mm long, geniculate and curved through 90°; anthers c. 1 × 2.1 mm, glabrous, lightly fused at the tips; staminodes 3, two of which 1.5–1.8 mm long, the third 0.2 mm long. **Ovary** c. 2 × 1.5 mm, densely glandular pubescent throughout; style c. 5 mm long; stigma globose/rounded. **Fruit** 9.1–16.7 × 1.9–2.2 mm, twisted, glandular pilose, style persistent.

Distribution. Southern China and Thailand. Very likely to also occur in Myanmar and Laos.

Ecology. On karst limestone, usually in shade or in cave mouths or soil pockets on cliffs and slopes, over a wide altitudinal range of 490–2420 m.

Provisional IUCN Conservation Assessment. Least Concern (LC). This species is widespread and locally common.

Additional specimens examined: CHINA. **Yunnan:** Unknown Yunnan, *Howell, E.B.* 67 (E); ibidem, Oct 1924, *Forrest, G.* 25273 (E, K); Baoshan, Tengchong, Oct 1912, *Forrest, G.* 9272 (E); Pu'er City, Jingdong Yi Autonomous County, 18 Aug 1959, *Unknown* 5134 (KUN); Salween-Chu-kiang divide, Aug 2013, *Forrest, G.* 11962 (BM); Xishuangbanna, Menghai County, 7 Oct 1989, *Unknown* 39452 (KUN).

THAILAND: **Chiang Mai:** Chiang Dao, Road to Wiang Haeng, 21 Sep 2008, *Middleton, D.J. et al.* 4538 (E); Chiang Dao, Doi Chiang Dao Wildlife Sanctuary, 5 Nov 1961, *Bunchuai, K.* 1174 (BKF); ibidem, 4 Nov 1995, *Gardner, S. & Gardner, N.* H238 (L); ibidem, 15 Aug 1935, *Garrett, H.B.G.* 979 (E, K); ibidem, 10 Aug 1935, *Garrett, H.B.G.* 973 (A, ABD, L, P); ibidem, 17 Aug 1935, *Garrett, H.B.G.* 982 (K, P); ibidem, 8 Oct 1995, *Maxwell, J.F.* 95858 (A, BKF, L); ibidem, 13 Aug 1995, *Parnell, J. et al.* 95048 (BKF, K); ibidem, 23 Oct 1926, *Put, N.* 429 (ABD, BM, K); ibidem, 11 Sep 1967, *Tagawa, M. et al.* 9783 (BKF); Chiang Dao, Doi Chiang Dao Wildlife Sanctuary, Pha Blong Cave area, 10 Sep 1989, *Maxwell, J.F.* 891070 (A, E, L, MO); Chiang Dao, Doi Chiang Dao Wildlife Sanctuary, Tham Pha Phlong, 20 Sep 2008, *Middleton, D.J. et al.* 4523 (E); Mae Taeng, Doi Mawn Ngaw, 12 Aug 2002, *Palee, P.* 542 (L). **Chiang Rai:** Mae Sai, Doi Tung, 14 Nov 2010, *van de Bult, M.* 1122 (BKF); Wiang Pa Pao, 28 Sep 1996, *Pooma, R.* 1390 (BKF). **Lampang:** Mueang Pan, Jae Son National Park, Wang Di, Doi Pha Ngam, 25 Aug 1996, *Maxwell, J.F.* 961149 (BKF, L). **Maehongson:** 10 Sep 1974, *Larsen, K. & Larsen, S.S.* 34327 (AAU, E); Pangmapha, Tham Lot cave area, *Middleton, D.J. et al.* 5232 (E).

Notes. This species is recognisable by the distinct arachnoid (woolly, spider-web-like) indumentum which covers the whole plant. *Ornithoboea maxwellii*, far smaller in size, is the only other species to have this type of indumentum, but not nearly as densely. The flowers of *Ornithoboea arachnoidea* might be mistaken for those of *O. occulta* but the corollas of the latter species are slightly larger, but with a shorter corolla tube and lower lip, and the sepals are longer and elliptic.

2. *Ornithoboea barbanthera* B.L. Burt

Notes Roy. Bot. Gard. Edinburgh 22: 297 (1958); Burt, Thai Forest Bull., Bot. 29: 101 (2001). TYPE: Thailand, Prachuap Khiri Khan, Sam Roi Yot, 50 m, 13 July 1926, *A.F.G. Kerr 10977* (holotype ABD; isotypes BM, E, K). (Fig. 3, 4, 5).

Herb; stem 11–32(–39) cm tall, to 2–5.6 mm diameter, glandular pubescent throughout, leaf internodes 7–48(–90) mm. **Leaves** opposite; petiole 2.4–7(–9) cm long, densely glandular pubescent; blade herbaceous, ovate, 3.5–7.5(–11) × 2.2–6.7 cm, apex acute, base slightly unequal, rounded to cordate, margin weakly to strongly crenate to bicrenate, the teeth 1.5–3.1(–7.6) mm; 7–10 pairs of secondary veins, tertiary venation reticulate; glandular puberulous above, more densely so beneath with hairs of various lengths throughout. **Inflorescence** axillary, 2.5–8 cm long, densely glandular pubescent throughout; peduncle 8–30(–36) mm long; bracts linear to triangular, 3.9–5.5 × 0.8–1.3 mm; pedicels 5–17 mm long. **Sepals** narrowly elliptic, green, 3-veined, 7–9.2 × 3.2–3.5 mm, apices narrowly acute, sparsely puberulous above, more densely so beneath, ciliate; sepals mostly reflexed when in fruit. **Corolla** bilabiate, c. 20 mm long, lilac throughout, glabrous outside; tube c. 7.5 mm long; upper lip slightly 2-lobed, erect, each lobe 1.5–3 mm long, apices rounded, glabrous except for a ring of short hairs on the ridge of tissue at the base of the lip which runs down to the sinus with the lower lip; lower lip 3-lobed, slightly reflexed, c. 13 mm long, glabrous except for palatal beard at base of lobes, each lobe c. 6.5 × 6.5 mm, obovate, central lobe overlapping lateral lobes, lobes not ciliate. **Stamens** with a pronounced sterile projection, yellow, 1.8–2 mm long; filaments 1.4–1.6 mm long; anthers 1 × 2–2.2 mm, densely bearded, lightly fused at the tips; staminodes 3, two of which c. 1.5 mm long, yellow, the third 0.3 mm long. **Ovary** 2.8–3 × 1.7 mm, glandular puberulent; style c. 8.5 mm long, glandular puberulent; stigma globose/rounded. **Fruit** 4.7–12.4 × 2.2–3.4 mm, twisted to barely twisted, densely pubescent.

Distribution. Thailand (Prachuap Khiri Khan Province).

Ecology. Growing on karst limestone, often in full sun, at 0–500 m altitude.

IUCN Conservation Assessment. Least Concern (LC) (Middleton & Suksathan, 2012a). *Ornithoboea barbanthera* is restricted to a very small area, mostly within a national park. It is still common and no major threats are known to affect the species. However the mangrove areas around the national park have been converted to shrimp farms which could affect the local microclimate. The population needs to be monitored to ensure that this species is not impacted by this.

Additional specimens examined: THAILAND: **Prachuap Khiri Khan:** Muang Prachuap Khiri Khan, Khao Klong Wan, 23 Aug 1982, *Shimizu, T. et al. T-28746* (BKF); Khao Loom Muak, 5 Sep 2008, *Middleton, D.J. et al. 4274* (BKF, E); Pran Buri, Sam Roi Yot, 14 Sep 1926, *Put, N. 249* (ABD, BM, K); *ibidem*, 12 Jul 1926, *Kerr, A.F.G. 10956* (ABD, BM, K); *ibidem*, Jul



Fig. 4. *Ornithoboea barbanthera* B.L.Burt. Photograph of RBGE cultivated collection 20081569 by David Middleton.

1966 - Aug 1966, *Larsen, K. et al. 1236* (AAU, BKF, L); *ibidem*, 29 Jun 2000, *Newman, M.F. et al. 1138* (BKF); *ibidem*, 29 Jun 2000, *Newman, M.F. et al. 288* (E, KEP); *ibidem*, 14 Aug 1992, *Niyomdham, C. 3012* (BKF); *ibidem*, 16 Aug 1992, *Niyomdham, C. 3027* (BKF); *ibidem*, 3 Dec 1929, *Put, N. 2513* (ABD, BM); Pran Buri, Sam Roi Yot, Ban Khao Daeng, 15 Jul 2004, *Pooma, R. et al. 4288* (BKF, E); Pran Buri, Sam Roi Yot, Khao Chrongwan, 18 Aug 1967, *Shimizu, T. et al. T-7675* (BKF); Pran Buri, Sam Roi Yot, Khao Daeng Trail, 17 Aug 2002, *Middleton, D.J. et al. 1150* (BKF [2], E, SING); *ibidem*, 4 Sep 2008, *Middleton, D.J. et al. 4257* (BKF, E); Pran Buri, Sam Roi Yot, Khao Pha Daeng, 30 Aug 2006, *Triboun, P. 3639* (E).

Notes. This species is very similar to *Ornithoboea emarginata* from Vietnam. They both have light blue flowers with a pronounced sterile projection but *Ornithoboea barbanthera* has larger flowers with a longer corolla tube and larger corolla lobes. The fruit is also nearly twice as long as that found in *Ornithoboea emarginata*. The whole plant is small when compared to other species of *Ornithoboea*. The leaves are small and somewhat thicker than other species. In addition, the plant has remnants of the previous year's growth in the form of dried leaf bases and a corky base to the plant. This was evident in all specimens examined, including plants in the living collections at RBGE. This might indicate a perennial growth habit, as was suggested by Burt (1958), and the thicker leaves may be an adaptation to exposed conditions.

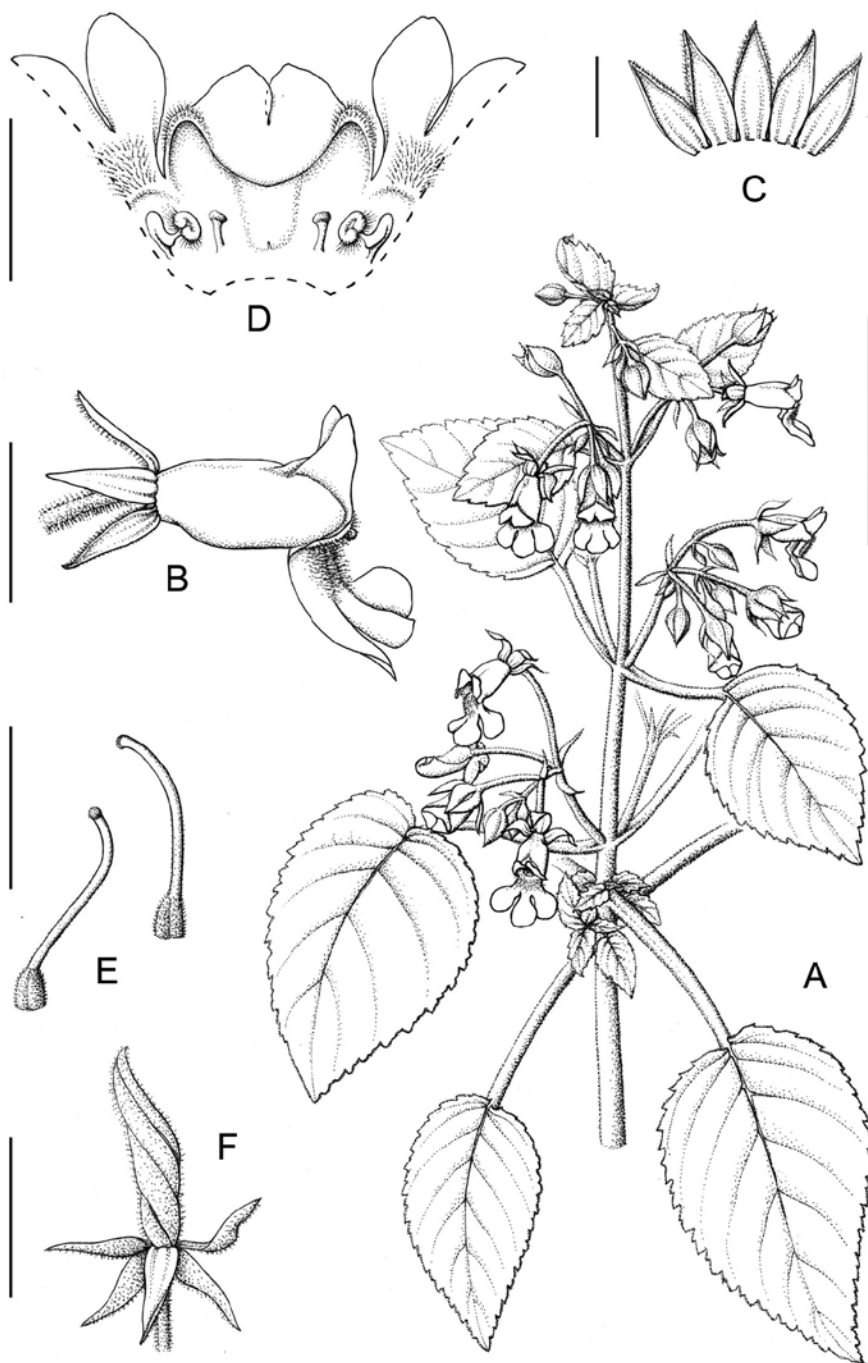


Fig. 5. *Ornithoboea barbanthera* B.L.Burt. **A.** Habit. **B.** Flower. **C.** Calyx opened out. **D.** Corolla dissection showing the two small lobes of the upper lip, the three larger lobes of the upper lip, two stamens and three staminodes. **E.** Pistil. **F.** Fruit. All parts from RBGE cultivated collection 20081569 except fruit from *Middleton et al.* 4257 (E). Scale bars: A = 5 cm; B, D–F = 1 cm; C = 0.5 cm. Drawn by Claire Banks.

3. *Ornithoboea calcicola* C.Y.Wu ex H.W.Li

Bull. Bot. Res., Harbin 3(2): 42 (1983); Wang, Fl. Reipubl. Popularis Sin. 69: 481 (1990); Wang et al., Fl. China 18: 370 (1998). TYPE: China, Yunnan, Mengla Xian, Yiwu, Xiangming, Manpei, 1000 m, 9 September 1959, *S.J. Pei 5910072* (holotype KUN *n.v.*; isotype KUN). (Fig. 3).

Herb; stem 50–62 cm tall, to 2.9–4.1 mm diameter, yellow glandular pilose throughout, leaf internodes 4.7–8.5 cm. **Leaves** opposite; petiole 5–10(–13) cm long; blade herbaceous, ovate to broadly ovate, 5.5–12 × 3.2–10 cm, apex acute to narrowly acute, base unequal, oblique to narrowly cordate, margin weakly to strongly crenate/bicrenate to dentate/duplicato-dentate, the teeth 1.2–4.5 mm; 8–10 pairs of secondary veins, tertiary venation reticulate; glandular puberulous above, more densely so beneath with hairs of various lengths throughout. **Inflorescence** axillary, 5.5–6 cm long, yellow glandular pilose throughout; peduncle 1.4–4.1 cm long; bracts elliptic, 7–14.3 × 1.4–3.9 mm; pedicels 11.8–16.8(–24.9) mm long. **Sepals** elliptic, green, 3-veined, 7.3–9.7 × 2–2.7 mm, apices narrowly acute, glandular puberulous above, more densely so beneath, ciliate. **Corolla** bilabiate, c. 16.5 mm long, blue/violet throughout, pubescent outside; tube c. 8 mm long, glabrous inside; upper lip slightly 2-lobed, triangular, erect, each lobe 0.6–0.7 mm long, apices acute to emarginate, glabrous except for a ring of blue short hairs on the ridge of tissue at the base of the lip which runs down to the sinus with the lower lip; lower lip 3-lobed, reflexed 90° downwards, 7.3–9.5 mm long, glabrous except for blue palatal beard at base of lobes, each lobe 2.5–3.1 × 2–3 mm, orbicular, apices slightly triangular, central lobe overlapping lateral lobes. **Stamens** with a pronounced sterile projection, yellow, projection 1.5–1.7 mm long; filaments 1–1.3 mm long; anthers 0.5 × 2.3–2.5 mm, sparsely hairy, lightly fused at the tips; staminodes 3, two of which 1.5–2.3 mm long, the third 0.2(–0.5) mm long. **Ovary** 1.7–3 × 1.3–1.7 mm, glandular pubescent throughout; style 6.1–9 mm long; stigma globose/rounded. **Fruit** 18–21 × 1.7–2.4 mm, twisted, puberulous, style not persistent.

Distribution. China and Vietnam.

Ecology. Growing on karst limestone in seasonal evergreen and mixed forests at 150–1000 m altitude.

Provisional IUCN Conservation Assessment. Data Deficient (DD). This species has a wide Area of Occurrence but is known from fairly few collections in a region that is poorly collected. Its precise distribution, population stability, and potential threats are all unknown.

Additional specimens examined: VIETNAM: **Lao Cai:** 16 Nov 1963, *Unknown 3426* (HNU). **Quang Binh:** Minh Hoa, Thong Hoa Municipality, 17 May 1997, *Averyanov, L. et al. VH4770* (E); Tuyen Hoa District, Chuoi Village, 3 May 2011, *Averyanov, L. et al. CPC2708* (E); Tuyen Hoa District, Hung Village, 29 Apr 2011, *Averyanov, L. et al. CPC2501* (E).

Notes. Only an isotype was available to study but the holotype is also at KUN. This species was previously only known from Yunnan province in China. It is similar to two other species, *Ornithoboea lacei* and *O. wildeana*. However, it can be differentiated by its flowers that have a violet/blue corolla, the lower lip reflexed through 90°, and the lower lobes which are small and rounded with a slightly triangular apex. The plant is smaller in height and has longer fruits than *Ornithoboea lacei* and *O. wildeana*. From *Ornithoboea wildeana* it also differs in its smaller inflorescences and leaves which are broader and shorter. From *Ornithoboea lacei* it differs in its longer bracts, shorter corolla tube and longer filaments. The new collections from Vietnam confirm *Ornithoboea calcicola* as a distinct species and with a wider distribution than previously known.

4. *Ornithoboea emarginata* D.J.Middleton & N.S.Lý

Edinburgh J. Bot. 65: 354 (2008). TYPE: Vietnam, Kieng Giang Province, Kien Luong District, Hang Ca Sau Hill, 10–50 m. 14 July 2007, *N.S. Lý 94* (holotype E). (Fig. 3).

Herb; stem 20–80 cm tall, to c. 4 mm diameter, glandular pubescent throughout, leaf internodes 18–26 mm. **Leaves** opposite; petiole 2.5–8.6 cm long, densely glandular pubescent; blade herbaceous, ovate to elliptic 3–11 × 2.4–7.3 cm, apex obtuse, base slightly unequal, rounded to cordate, margin weakly to strongly dentate to duplicato-dentate, the teeth 1.5–5.8 mm; 8–11 pairs of secondary veins, tertiary venation reticulate; glandular puberulous above, more densely so beneath with hairs of various lengths throughout. **Inflorescence** axillary, 3.3–8 cm long, densely glandular pubescent throughout; peduncle 6–16 mm long; bracts linear to triangular, c. 3.8 × 0.8 mm; pedicels 12–16 mm long. **Sepals** narrowly elliptic, green, 3-veined, 8.5–9 × 2–2.5 mm, apices narrowly attenuate, sparsely glandular puberulous above, more densely so beneath, ciliate; sepals not reflexed when in fruit. **Corolla** bilabiate, c. 16 mm long, lilac throughout, glabrous outside except lobes ciliate; tube c. 4.5 mm long; upper lip slightly 2-lobed, c. 2 mm long, somewhat erect to slightly reflexed, each lobe c. 0.6 mm long, apices rounded, each lobe slightly notched towards the sinus side, glabrous except for a ring of short hairs on the ridge of tissue at the base of the lip which runs down to the sinus with the lower lip; lower lip 3-lobed, slightly reflexed, c. 10.5 mm long, glabrous except for palatal beard at base of lobes, each lobe c. 3.2 × 3.8 mm, ciliate, obovate, distinctly notched at each apex, central lobe overlapping lateral lobes. **Stamens** with a pronounced sterile projection, c. 1.7 mm long, yellow; filaments c. 1.5 mm long; anthers 1.8 × 2.5 mm, densely bearded, lightly fused at the tips; staminodes 3, two of which c. 1.5 mm long, the third 0.2 mm long. **Ovary** 1.8 × 1.5 mm, densely glandular puberulent; style 9 mm long, glandular puberulent; stigma globose/rounded. **Fruit** 6–7 × 3 mm, twisted to barely twisted, densely pubescent, style persistent.

Distribution. Southern Vietnam.

Ecology. In fissures and small soil pockets on karst limestone at 10–50 m altitude.

IUCN Conservation Assessment. Critically Endangered B1ab(i,ii,iii,v)+2ab(i,ii,iii,v) (Middleton, 2012a). The habitat where this species is found has suffered from human impacts such as small scale agriculture (Middleton & Lý, 2008). In at least one of the dolines there has been firewood collection, the caves are sometimes used, and there have been problems with invasive alien species. Lime exploitation and cement production have been especially devastating. Bai Voi Hill is scheduled for quarrying, with about two-thirds of the hill to be exploited for cement production (Truong *et al.*, 2004). By the time the limestone exploitation contract is completed, less than 2 km² in several separate limestone blocks will be left in the Vietnamese portion of the karst, making the Kien Giang hills one of the most threatened karst ecosystems in the world (Truong *et al.*, 2004).

Additional specimens examined: VIETNAM: **Kien Giang:** Kien Luong, Ba Tai Hill, 12 Jul 2007, Lý, *N.S.* 54 (VNM); Kien Luong, Bai Voi Hill, 19 Aug 2007, Lý, *N.S.* 108 (VNM).

Notes. This species is similar to *Ornithoboea lacei* Craib from Myanmar with which it shares the character of emarginate lower corolla lobe apices. It differs from *Ornithoboea lacei*, however, in its densely bearded anthers, barely twisted fruit, shorter corollas and much shorter peduncles. It shares the characters of densely bearded anthers and fruit barely twisted with *Ornithoboea barbanthera*. It differs from *Ornithoboea barbanthera* in having shorter peduncles, corolla lobes with emarginate apices and lacks the remnants of the previous year's growth in the form of dried leaf bases at the base of the stem. This species is from very close to the Cambodian border although no species of the genus are yet recorded from Cambodia.

5. *Ornithoboea feddei* (H.Lév.) B.L.Burtt

Notes Roy. Bot. Gard. Edinburgh 22: 296 (1958); Wang *et al.*, Fl. China 18: 369 (1998). – *Boea feddei* H.Lév., Repert. Spec. Nov. Regni Veg. 9: 449 (1911). – *Boea darrisii* H.Lév., Repert. Spec. Nov. Regni Veg. 11: 494 (1913). – *Ornithoboea darrisii* (H.Lév.) Craib, Notes Roy. Bot. Gard. Edinburgh 11: 252 (1920). TYPE: China, Kweichow [Ghuizhou], *J. Esquirol* 730 (lectotype E, designated here; isotype K). (Fig. 3).

Sinoboea microcarpa Chun, Sunyatsenia 6: 271 (1946). TYPE: China, Pin-Jao, Chenfeng, 23 September 1936, *S.W. Teng* 91032 (lectotype KUN, designated here; isotype A *n.v.*)

Ornithoboea leptonema B.L.Burtt, Notes Roy. Bot. Gard. Edinburgh 22: 295 (1958). TYPE: Vietnam, Hoa Binh, Cho Che, August 1887, *B. Balansa* 4310 (holotype P; isotype P).

Herb; stem 18–51(–100) cm tall, to 2.1–4.7 mm diameter, glandular pubescent throughout, leaf internodes 2.5–10 cm. **Leaves** opposite; petiole 1.6–8.7 cm long, pubescent; blade herbaceous, broadly to narrowly ovate, 2.5–11.5 × 2.4–8.9 cm, apex

acute to narrowly acute, base slightly cordate, occasionally oblique, margin crenate/bicrenate, the teeth 1.6–5.5 mm; 9–10 pairs of secondary veins, tertiary venation weakly percurrent; glandular puberulous above and below with hairs of various lengths throughout. **Inflorescence** axillary, 3.5–7.9 cm long, glandular pubescent throughout; peduncle 1.3–2.7 cm long; bracts linear to triangular, 3.1–4.5 × 0.4–0.9 mm; pedicels 6.7–15.3 mm long, weakly or strongly curved. **Sepals** ovate to elliptic, 3-veined, 4.5–8.1 × 2–2.4 mm, apices narrowly acute, sparsely puberulous above, more densely so beneath, ciliate. **Corolla** bilabiate, c. 15.5 mm long, light blue, glabrous outside, densely pilose inside; tube 5.4–6.5 mm long; upper lip 2-lobed, each lobe 2–3.5 mm long, apices retuse, pubescent inside in addition to the ring of thick short hairs on the ridge of tissue at the base of the lip which runs down to the sinus with the lower lip; lower lip 3-lobed, 5.5–9.1 mm long, pubescent in addition to the palatal beard at base of lobes, each lobe 2–3.5 × 1.8–2.3 mm, lobes orbicular, apices broadly pyramidal. **Stamens** without pronounced sterile projection; filaments thin, long and straight, 1.7–3.8 mm long; anthers 0.5–1 × 1.5–1.8 mm, glabrous, lightly fused at the tips; staminodes 3, two of which 0.7–1.4 mm long, the third 0.1–0.2 mm long. **Ovary** 0.5–1.3 × 1.3–2.5 mm, conical, glandular puberulent; style 4.1–5 mm long, glandular puberulent, often persisting on the fruit; stigma swollen and flat headed. **Fruit** 6.3–14 × 2.3–2.7 mm, twisted, puberulous.

Distribution. China and Vietnam.

Ecology. On karst limestone at 500–550 m altitude.

Provisional IUCN Conservation Assessment. Data Deficient (DD). This species is known from a small number of localities in China and Vietnam. The precise localities of the Chinese specimens and all but one of the Vietnamese specimens is unknown. There is only one recent collection, in 2003, from Vietnam with most of the specimens dating back over a hundred years. Middleton (2012b) also published an assessment of DD for *Ornithoboea leptoneuma*, now treated as a synonym of *O. feddei*.

Additional specimens examined: CHINA: **Guizhou:** June 1912, *Cavalerie, J. 3975* (E, P); ibidem, Aug 1911, *Esquirol, J. 3012* (E).

VIETNAM: ‘Tonkin’, Apr 1908, *Alleizette, A.C.d. 5412* (L). **Hoa Binh:** Cho Che, Sep 1887, *Balansa, B. 4311* (K, P). **Thanh Hoa:** Ba Thuoc District, 15 Oct 2003, *Averyanov, L. et al. HAL 4331* (MO).

Notes. Burt (1958) suggested that *Boea feddei* and *B. darrisii* were based on the same specimen, *Esquirol 730* (E), and that, when describing *B. darrisii*, Lévillé (1913) failed to recognise it as a species he had already described based on the same collection. This may be true but as no single specimen is stated in either protologue and as there is more than one specimen of this collection there is no holotype for either name. Burt assumed the holotype for both names was the Edinburgh specimen, in which case they would be homotypic and *Boea darrisii* would be illegitimate under Art. 52.1 of the

ICN (McNeill et al., 2012). This is not correct because there is no holotype and when *Boea darrisii* was described it did not “definitely included the type of a name that ought to have been adopted” (Art. 52.1, McNeill et al., 2012) or “all syntypes” (Art. 52.2, McNeill et al., 2012) and must, therefore, be treated as legitimate. Burt (1958) did, however, effectively lectotypify both names on *Esquirol 730* (E).

This species is distinguished by the long and narrow corolla tube, which is densely pilose inside, and by its straight thin filaments. It has the simplest androecium structure found in the genus. *Ornithoboa feddei* is similar to *O. parishii* with which it shares the character of long filaments. However, in *Ornithoboa parishii* they are much thicker and geniculate. *Ornithoboa parishii* differs further in having a shorter corolla, oblong lower lobes and short inflorescences.

The specimen *Thorel 2347* (P) from Champasak in Laos was included in *Ornithoboa feddei* by Burt (1958). However, this specimen has stamens with a pronounced sterile projection rather than the straight filaments found in *Ornithoboa feddei*. The assignment of *Thorel 2347* to a species has still not been established and further collections from the region are necessary to clarify its status (see note under *Ornithoboa lacei*).

6. *Ornithoboa flexuosa* (Ridl.) B.L. Burt

Notes Roy. Bot. Gard. Edinburgh 22: 297 (1958); Burt, Thai Forest Bull., Bot. 29: 101 (2001). – *Lepanthus flexuosus* Ridl., J. Asiat. Soc. Bengal, Pt. 2, Nat. Hist. 74(2): 782 (1909); Ridley, Fl. Mal. Pen. 2: 538 (1923); Henderson, Journ. Malay. Br. Roy. As. Soc. 17: 61 (1939). TYPE: Malaysia, Kedah, Gunung Geriang [Keriang], March 1910, H.N. Ridley 14912 (neotype BM, designated here; isoneotypes E, K, SING, US). (Fig. 6).

Herb; stem 10–45(–200) cm tall, to 1.9–4.5 mm diameter, glandular pubescent throughout, leaf internodes (1.3–)2.5–5.5 cm. **Leaves** opposite; petiole (1.3–)2.8–11.5(–25.1) cm long, densely puberulous, blade herbaceous, ovate to elliptic, 6–20 × 4–12 cm, apex acute to broadly acute, base unequal, oblique to rounded, margin weakly to strongly crenate/bicrenate to dentate/duplicato-dentate, the teeth 1.9–4.7(–5.7) mm; 8–10 pairs of secondary veins, tertiary venation reticulate; light green above, paler below, glandular puberulous above, more dense beneath with hairs of various lengths throughout. **Inflorescence** axillary, 3–9.1(–10.8) cm long, pseudoracemose, densely glandular pubescent throughout; peduncle (1.5–)1.9–4.7(–5.7) cm long; bracts linear to lanceolate, c. 4 × 1 mm; pedicels 8–11(–13) mm long. **Sepals** ovate, green to white, 3-veined, 4.5–5.5 × 1.5–2.2 mm, apices narrowly acute, glandular puberulous outside, more densely so beneath, ciliate. **Corolla** bilabiate, c. 9.5–10 mm long, purple/lilac throughout, glabrous outside; tube 3.2–4 mm long; upper lip very slightly 2-lobed, 1.2 mm long, lobes c. 0.7 mm long, white, erect to reflexed, notched in centre, glabrous except for a ring of short white hairs on the ridge of tissue at the base of the lip which runs down to the sinus with the lower lip; lower lip 3-lobed, c. 7 mm long, lip slightly reflexed, glabrous except for white palatal beard at base of lobes, each lobe c. 3–4 ×

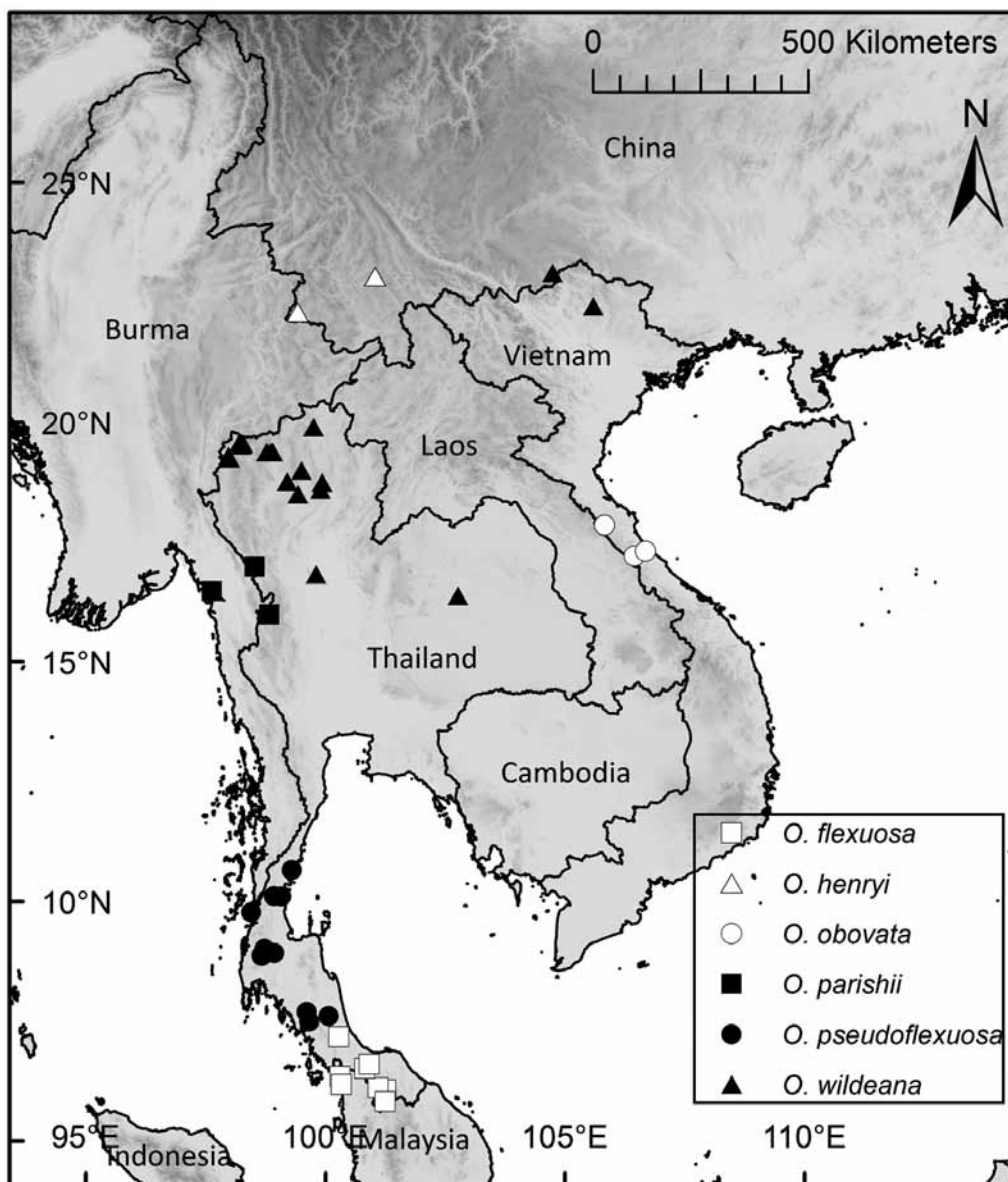


Fig. 6. Distribution of *Ornithoboea flexuosa* (Ridl.) B.L.Burt (□); *Ornithoboea henryi* Craib (Δ); *Ornithoboea obovata* S.M.Scott (○); *Ornithoboea parishii* C.B.Clark (■); *Ornithoboea pseudoflexuosa* B.L.Burt (●); and *Ornithoboea wildeana* Craib (▲).

1.3–1.6(–2.5) mm, lateral lobes slightly falcate, apices narrowly rounded to acute, central lobe oblong to slightly ovate, apex narrowly rounded to acute. **Stamens** with a pronounced sterile projection, 1–1.5 mm long; filaments c. 1 mm long; anthers 0.5 × 1.5(–3) mm, glabrous, lightly fused at the tips; staminodes 3, two of which 1.2–1.4 mm long, the third 0.2 mm long. **Ovary** 1.2 × 0.7–1.2 mm, densely glandular puberulent;

style 3–5.5 mm long, densely glandular pubescent; stigma globose/rounded. **Fruit** 4.3–7(–8.2) × 1.6–2.5 mm, barely twisted by quarter turn to non-twisted, glandular puberulous.

Distribution. Peninsular Malaysia and Peninsular Thailand.

Ecology. Growing in fissures or small soil pockets on cliff faces and cave mouths on karst limestone at 10–150 m altitude.

Provisional IUCN Conservation Assessment. Endangered (EN B2ab(iii)). This species has an Area of Occupancy of about 32 km² and the known localities are mostly not in protected areas. Gunung Keriang in Kedah is heavily impacted by tourism.

Additional specimens examined: THAILAND: **Pattani:** 23 Jul 1923, *Kerr, A.F.G. 7307* (BM, K); *ibidem*, 26 Jul 1923, *Kerr, A.F.G. 7307A* (BM, K). **Songkhla:** Khao Chang Low, 24 Jul 1928, *Kerr, A.F.G. 15892* (BM, K); Saba Yoi, 25 Nov. 1990, *Larsen, K. et al. 41696* (AAU); *ibidem*, 4 Jun 2001, *Pooma, R. et al. 2052* (BKF). **Yala:** Bukit Tapang, May 1917, *Gwynne-Vaughan, D.T. 480* (K); Tham Talu, 16 Jun 1970, *Smitinand, T. 11008* (BKF); Than To, 22 Apr 2005, *Pooma, R. et al. 5147* (BKF); *ibidem*, 17 Jul 2004, *Poopath, M. 104* (BKF, E).

PENINSULAR MALAYSIA: **Kedah:** Alor Star, Gunung Keriang, 15 Nov 1915, *Haniff, M. 640* (SING); *ibidem*, 18 May 1938, *Kiah 35419* (SING); *ibidem*, 18 May 1938, *Kiah* s.n. (SING); *ibidem*, 1986, *Weber, A. s.n.* (SING); Bukit Hantu, 23 May 1957, *Chew, W-L. CWL203* (SING).

Notes. The type of *Ornithoboea flexuosa* is *Fox 3811*. According to Ridley (1909) this was a poor specimen from Gunong Geriang [Keriang], Kedah. We have been unable to locate this specimen and it was also not referenced by Burt (1958) as having been seen. We, therefore, designate *H.N. Ridley 14912* (BM), collected near to the type locality, as a neotype.

This species is only found in northern Peninsular Malaysia and the far south of Peninsular Thailand. It is very similar to *Ornithoboea pseudoflexuosa* and *O. multitorta* with which it shares large delicate leaves, leaf margins crenate/bicrenate to dentate and stamens with a pronounced sterile projection. It differs from these species in the shape of the corolla.

When Burt (1958) described *Ornithoboea pseudoflexuosa* in 1958 he stated it bore a resemblance to *O. flexuosa*, but that its much larger flowers and bearded anthers distinguished it. Although the two species do indeed differ in the anther character we have found that the flowers do not differ appreciably in size. The character that most easily distinguishes the two species is whether the central lobe of the lower lip is reflexed or not: it is reflexed in *Ornithoboea pseudoflexuosa* (and in *O. multitorta*) but not reflexed in *O. flexuosa*. This is not always easily observed in herbarium specimens but is very evident in fresh material and we have seen no material or photographs of either species which contradicts this observation. The fruits also differ: *Ornithoboea flexuosa* generally has short straight fruits and any twist is no greater than a quarter turn; *O. pseudoflexuosa* can have a twist to over half turn; and *O. multitorta* is distinctly

twisted. The fruits of *Ornithoboea pseudoflexuosa* and *O. multitoria* are generally longer than those of *Ornithoboea flexuosa*. The distribution of *Ornithoboea flexuosa* does not overlap with any other species in the genus.

7. *Ornithoboea henryi* Craib

Bull. Misc. Info. Kew. 1913: 115 (1913); Burt, Notes Roy. Bot. Gard. Edinburgh 22: 297 (1958); Wang, Fl. Reipubl. Popularis Sin. 69: 479 (1990); Wang et al., Fl. China 18: 369 (1998). TYPE: China, Yunnan, Pu'er, 1350 m, *A. Henry* 13378 (holotype K; isotypes E, NY). (Fig. 6).

Herb; stem 9–23 cm tall, to 1.8–4.1 mm diameter, glandular pubescent throughout, leaf internodes 2.5–5.5 cm. **Leaves** opposite; petiole 2.5–11.2 cm long, puberulous; blade herbaceous, ovate to narrowly ovate, 4.5–13 × 3.5–6.5 cm, broadly attenuate, base slightly unequal, broadly oblique, margin weakly to strongly crenate/bicrenate to dentate/duplicato-dentate, the teeth 1.2–2.9 mm; 7–8 pairs of secondary veins, tertiary venation reticulate; glandular puberulous above and below with hairs of various lengths throughout. **Inflorescence** axillary, 3.5–8 cm long, colour unknown, glandular pubescent throughout; peduncle 8.1–11.5 mm long; bracts linear to triangular, 3.6–3.9 × 0.8–1 mm; pedicels 9–20 mm long. **Sepals** ovate to elliptic, 3-veined, 5–5.8 × 1.7–2.8 mm, apices attenuate, sparsely puberulous above, more densely so beneath, ciliate, sepals reflexed when in fruit. **Corolla** bilabiate, c. 9.3 mm long, glabrous outside; tube 4–4.8 mm long; upper lip 2-lobed, erect or slightly reflexed, each lobe c. 2 mm long, apices rounded, glabrous except for the addition of a ring of short hairs on the ridge of tissue at the base of the lip which runs down to the sinus with the lower lip; lower lip 3-lobed, slightly reflexed, c. 5.5 mm long, glabrous except for palatal beard at base of lobes, lobes 2.5–3 × 2 mm, lobes obovate, apices rounded with occasional notch in central lobe. **Stamens** without pronounced sterile projection; filaments thickened and curved with slight twist, c. 1.7 mm long; anthers 0.4–0.7 × 1.2–1.7 mm, glabrous, lightly fused at the tips; staminodes 3, two of which 1–1.2 mm long, the third 0.1–0.3 mm long. **Ovary** 1.3–2.3 × 0.8–1.3 mm, glandular puberulent; style c. 1 mm long (immature), glandular puberulent; stigma globose/rounded. **Fruit** 8.8–14 × 2–3.2 mm, twisted, densely puberulent.

Distribution. Southern China.

Ecology. On karst limestone at around 1360 m.

Provisional IUCN Conservation Assessment. Data Deficient (DD). This species is known from very few collections and its precise distribution, population stability, and any potential threats are all unknown.

Additional specimens examined: CHINA: **Yunnan:** Pu'er City, Menglian Dai, Lahu and Va Autonomous City, 22 Aug 1973, *Unknown* 010292 (KUN); Xishuangbanna, Menghai County, 18 Aug 1959, *Unknown* 720 (KUN).

Notes. This species is recognisable by its short corolla, lower lip with a dense palatal beard and lobes which are short and narrowly obovate. It is similar to *Ornithoboea occulta* and *O. obovata* with which it shares the characters of thickened geniculate filaments, glabrous anthers, reflexed sepals, and crenate/bicrenate to dentate/duplicato-dentate leaf margins. It differs from both species particularly in the twisted fruits, from *Ornithoboea obovata* also in the lack of a persistent style in fruit and from *Ornithoboea occulta* in its lack of a red-glandular indumentum.

Burt (1958) suggested an affinity to *Ornithoboea flexuosa*. It differs from *Ornithoboea flexuosa* particularly in lacking a pronounced sterile projection on the stamens but also in the size of the leaves and overall size of the plant.

8. *Ornithoboea lacei* Craib

Bull. Misc. Info. Kew. 1913: 115 (1913); Craib, Curtis's Bot. Mag. t. 8627 (1915); Burt, Notes Roy. Bot. Gard. Edinburgh 22: 297 (1958). TYPE: Burma, Anisakan, Maymyo Plateau, 900 m, 25 August 1912, *Lace* 5926 (holotype K; isotype E). (Fig. 7).

Herb; stem 37–80 cm tall, to 2.5–5.2 mm diameter, glandular pubescent throughout, leaf internodes 3.7–7.6 cm. **Leaves** opposite, light green above, paler below; petiole 2.3–8.6 cm long, densely yellow-glandular puberulous; blade herbaceous, broad to narrowly ovate, 4–11.8 × 2.3–8 cm, apex acute or somewhat acuminate, base unequal, oblique to rounded, margin weakly to strongly crenate to bicrenate, the teeth 1–3.2 mm; c. 9 pairs of prominent secondary veins, tertiary venation reticulate; glandular puberulous above, more densely so beneath, red-glandular spots on the under surface of the leaf blades. **Inflorescence** axillary, 5–9.5 cm long, yellow-glandular pubescent throughout; peduncle 1.8–3.7 cm long; bracts linear to triangular, 5.3–8.8 × 1–1.8 mm; pedicels 11–20 mm long. **Sepals** elliptic, green with white tips, 3-veined, 7.5–10.1 × 2.5–3.5 mm, apices narrowly acute, red-glandular puberulous above, more densely so beneath, ciliate, sepals rarely reflexed when in fruit. **Corolla** bilabiate, 22–25 mm long, pink/purple throughout, glabrous outside; tube c. 11.4 mm long; upper lip barely 2-lobed, erect, tips white, each lobe 0.6–0.8 mm long, apices emarginate, puberulous at the base and the central part of the lobe towards the ring of thick white hairs on the ridge of tissue at the base of the lip which runs down to the sinus with the lower lip; lower lip 3-lobed, slightly reflexed, c. 9.4 mm long, glabrous except for white palatal beard at base of lobes, each lobe c. 3.5 × 3–3.5 mm, oblong, apices distinctly emarginate. **Stamens** with a pronounced sterile projection, yellow, c. 1.9 mm long; filaments 0.3–0.7 mm long; anthers 1–1.2 × 2–2.5 mm, sparsely bearded, lightly fused at the tips; staminodes 3, two of which c. 1 mm long, yellow, the third 0.2 mm long. **Ovary** 1–1.8 × 1.8–2 mm, glandular puberulent; style 6–8.3 mm long, glandular puberulent; stigma globose/rounded. **Fruit** 10.1–16.1 × 1.8–3.1 mm, twisted, glandular puberulous, style persistent.

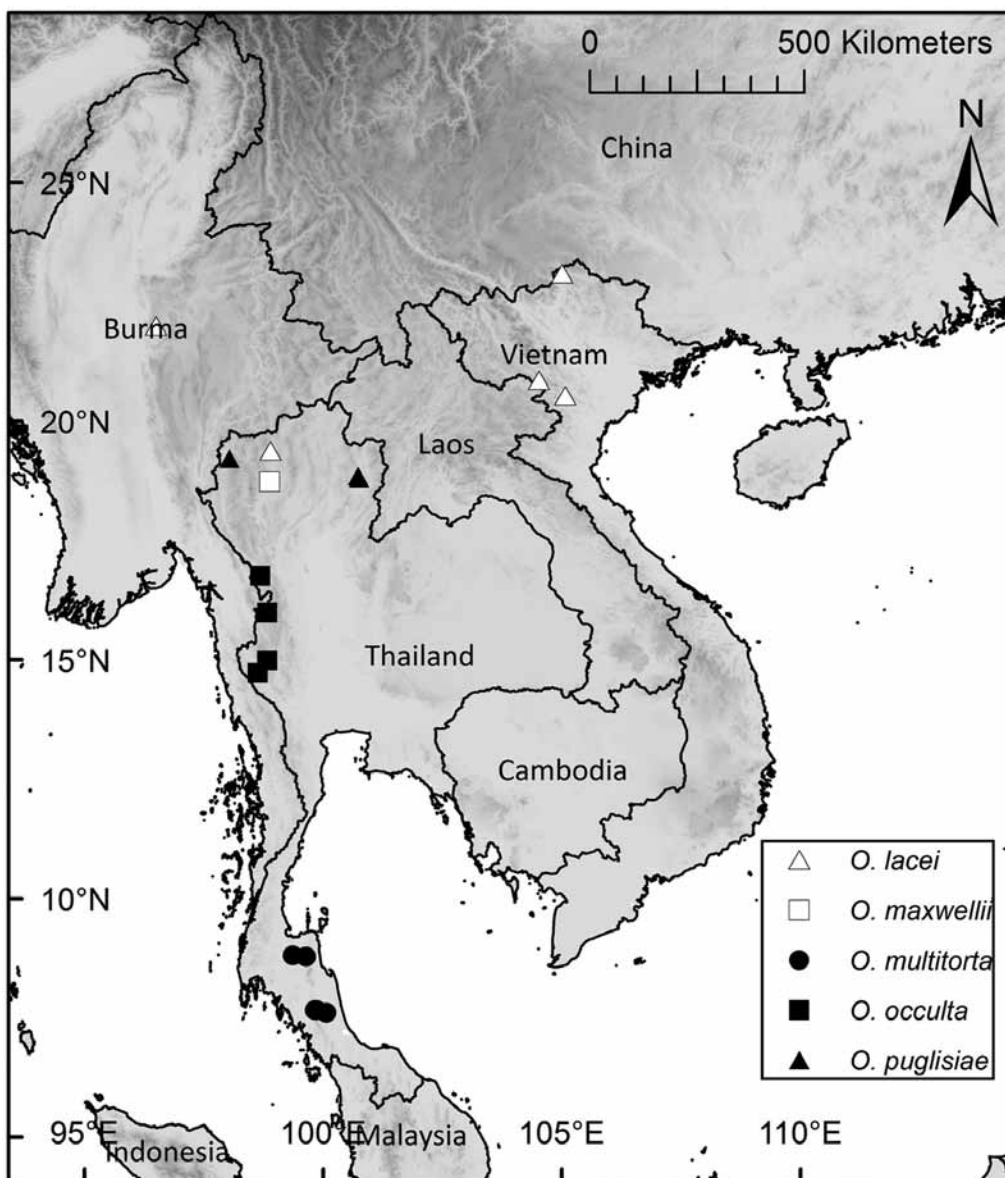


Fig. 7. Distribution of *Ornithoboea lacei* Craib (Δ); *Ornithoboea maxwellii* S.M.Scott (◻); *Ornithoboea multitorta* B.L.Burt (●); *Ornithoboea occulta* B.L.Burt (■); and *Ornithoboea puglisiae* S.M.Scott (▲).

Distribution. Myanmar, Thailand and Vietnam.

Ecology. On karst limestone at around 1060 m.

Provisional IUCN Conservation Assessment. Data Deficient (DD). This species is known from very few collections and its precise distribution, population stability, and any potential threats are all unknown.

Additional specimens examined: THAILAND: **Chiang Mai:** Doi Chiang Dao, vouchered from cultivated collection, 4 Dec 1961, *Unknown C.4080* (E).

VIETNAM: **Ha Giang:** Hang Co mountain, vouchered from cultivated collection, 16 Apr 2004, *Scott s.n.* (E). **Son La:** Moc Chau, Chieng Hac Municipality, 31 Oct 2006, *Hiep, N.T. et al. HAL9419* (MO). **Thanh Hoa:** Quan Hoa District, Phu Le Municipality, Hang Village, 4 Oct 2003, *Averyanov, L. et al. HAL3889* (MO).

Notes. This species is known from very few collections but the description and material available is full and complete and is based on a specimen sent to Craib in 1923 by Mr J.H. Lace. The emarginate lower corolla lobes are very distinct and make it easy to recognise but it does closely resembles a few other species of *Ornithoboea*. It is similar to *Ornithoboea wildeana* in the sparsely bearded anthers and elliptic to ovate sepals. It differs from *Ornithoboea wildeana* in having a much longer corolla, emarginate corolla lobes, shorter pedicels, and sepals which are shorter with narrowly acute apices. *Ornithoboea lacei* is generally a smaller plant and has distinctive red-glandular spots on the leaves. It is also similar to *Ornithoboea calcicola* with the same elliptic sepals and short peduncles but it differs from *O. calcicola* in having shorter bracts, a longer corolla tube and shorter filaments. Its differences to the only other species with emarginate corolla lobes, *Ornithoboea emarginata*, are discussed under that species. *Munzinger 247* (P) from Champasak in southern Laos is very similar to this species but the flowers on the specimens are too poor to be certain and this collection is from much further south than the other collections. *Thorel 2347* (B, GH, K, P), also from Champasak, could also be *Ornithoboea lacei* but again the available material is too poor (see note under *O. feddei*).

9. *Ornithoboea maxwellii* S.M.Scott, **sp. nov.**

Differs from all other *Ornithoboea* species in not having the palatal beard found on the lower corolla lip and from all except *O. arachnoidea* in having an arachnoid indumentum. It is most similar to *Ornithoboea obovata* with which *O. maxwellii* shares the character of non-twisted fruits with straight dehiscence but differs in having lanceolate sepals and arachnoid indumentum throughout. TYPE: Thailand, Chiang Mai Province, Hang Dong Subdistrict, Ban Pong, 850 m, 3 September 2003, *J.F. Maxwell 03-268* (holotype E; isotypes A, CMU *n.v.*, L). (Fig. 7–9).

Herb; stem c. 6–10.5 cm tall, to 1.3–2.4 mm diameter, glandular arachnoid pubescence throughout, leaf internodes 2.5–8 mm. **Leaves** opposite, deep green above, purple/red below; petiole 2.2–5.5 cm long; blade herbaceous, orbicular, 2.6–5.6 × 3–3.5 cm, apex obtuse, base slightly unequal, oblique to cordate, margin weakly to strongly dentate to crenate, rarely bicrenate, the teeth 1.5–4.6 mm; 5–6 pairs of secondary veins, tertiary

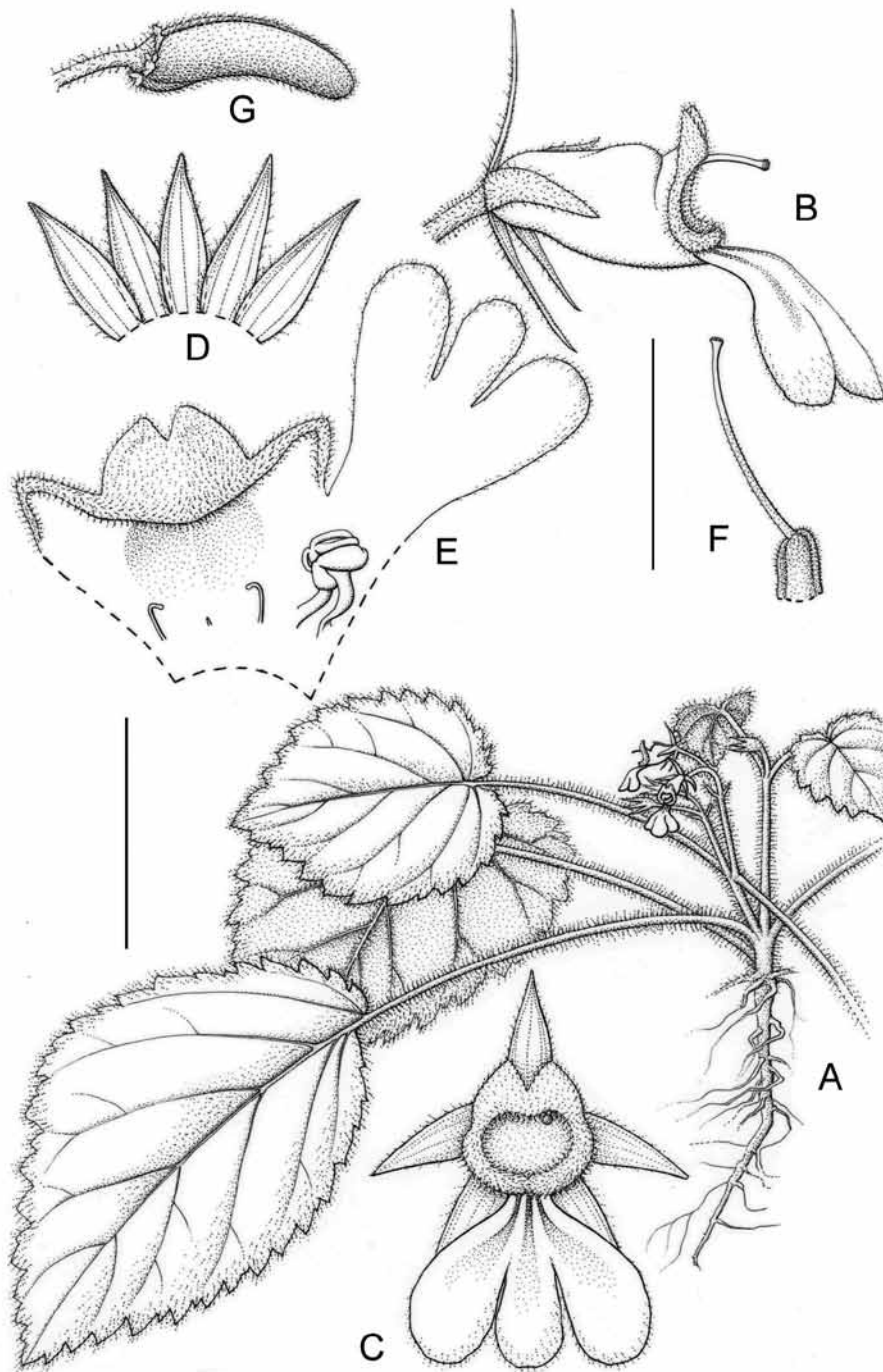


Fig. 8. *Ornithoboea maxwellii* S.M.Scott. **A.** Habit. **B.** Flower, side view. **C.** Flower, front view. **D.** Calyx opened out. **E.** Corolla dissection showing the two small lobes of the upper lip, the three larger lobes of the upper lip, two stamens and three staminodes. **F.** Pistil. **G.** Fruit. A = *J.F.Maxwell* 03-268 (E); B–F = *J.F.Maxwell* 694 (BKF); G = *M.Möller* 04-439 (E). Scale bars: A = 2.5 cm; B–G = 0.5 cm. Drawn by Claire Banks.



Fig. 9. *Ornithoboea maxwellii* S.M.Scott. (Photo: Pranee Nangngam).

venation reticulate. **Inflorescence** axillary, 18–31 mm long, glandular arachnoid pubescence throughout; peduncle 6.3–7.1 mm long; bracts lanceolate, c. 1.6×1 mm; pedicels 4.5–6 mm long. **Sepals** lanceolate, light green, 3-veined, $3.7\text{--}4 \times 1.2\text{--}1.7$ mm, apices narrowly acute, sparsely arachnoid above, more densely so beneath, ciliate. **Corolla** bilabiate, c. 14 mm long, white, glandular pubescence throughout; tube c. 4.3 mm long; upper lip slightly 2-lobed, erect, each lobe c. 0.5 mm long, apices rounded, hairy in addition to a ring of short white hairs on the ridge of tissue at the base of the lip which runs down to the sinus with the lower lip; lower lip 3-lobed, slightly reflexed, c. 5 mm long, lobes hairy but without characteristic palatal beard, lobes c. $1.5\text{--}2.3 \times 0.6\text{--}1.7$ mm, slightly obovate, apices rounded. **Stamens** without pronounced sterile projection; filaments thickened, geniculate and curved through 90° , 1–1.5 mm long; anthers $0.6 \times 1.5\text{--}2.3$ mm, slightly hairy, lightly fused at the tips; staminodes 3, two of which c. 1 mm long, the third 0.2 mm long. **Ovary** c. $1\text{--}1.5 \times 1$ mm, glandular puberulent; style (5–)6–8 mm long, glandular puberulent; stigma globose/rounded. **Fruit** $5.8 \times 1.4\text{--}1.9$ mm, slightly curved with no twist, slightly arachnoid to densely puberulous.

Distribution. Northern Thailand.

Ecology. On karst limestone at 850–925 m altitude.

Etymology. Named after the prolific collector J.F. Maxwell (1945–).

Provisional IUCN Conservation Assessment. Data Deficient (DD). This species is known from very few collections from only one locality. It is not known if it also occurs in other areas or what the threats are where it is known.

Additional specimens examined: THAILAND: **Chiang Mai:** Hang Dong, Ban Pong, 19 Aug 2004, *Maxwell, J.F.* 694 (A, BKF); *ibidem*, 2004, *Möller, M.* 04-439 (E).

Notes. This new species differs from all other *Ornithoboea* species in not having the distinctive palatal beard found on the lower corolla lip. There is some hair present but it does not resemble the palatal beard found in all other *Ornithoboea* species. *Ornithoboea maxwellii* does have the circlet of hairs around the mouth of the corolla tube and geniculate filaments which curve through 90°. *Ornithoboea maxwellii* shares the distinctive character of an arachnoid indumentum with one other species, *Ornithoboea arachnoidea*. It is most similar to *Ornithoboea obovata* from Vietnam with which *O. maxwellii* shares the character of non-twisted fruits with a straight line of dehiscence. It differs from *Ornithoboea obovata* in having lanceolate sepals and an arachnoid indumentum throughout. It is also similar to *Ornithoboea calcicola* but differs in its short fruits and stamens without pronounced sterile projections.

Ornithoboea maxwellii is known from a small number of collections, all from the same area, the Hang Dong Subdistrict in Thailand.

10. *Ornithoboea multitorata* B.L.Burt

Thai Forest Bull., Bot. 29: 101 (2001). TYPE: Thailand, Phatthalung, Amphoe Sii Ban Phot, Khao Pu-Khao Ya National Park, 140 m, 14 Jul 2000, *D.J. Middleton, T. Boonthavikoon, S.J. Davies, C.Hemrat & M.F. Newman* 444 (holotype E, untraced; lectotype K, designated here; isotypes AAU, BKF, P, SING). (Fig. 7).

Herb; stem 30–100(–150) cm tall, to 2.7–5.2 mm diameter, glandular pubescent throughout, leaf internodes 2–11.5 cm. **Leaves** opposite, green above, paler below; petiole 3.5–13(–17.5) cm long, densely glandular puberulous, blade herbaceous, ovate to broadly ovate, 4–17.8(–22) × 4–12.5 cm, apex narrowly acute to attenuate, base slightly unequal, oblique to slightly cordate, margin weakly to strongly crenate/bicrenate to dentate, the teeth 1.3–4.7 mm; 9–11 pairs of secondary veins, tertiary venation reticulate; glandular puberulous above, more dense beneath with hairs of various lengths throughout. **Inflorescence** axillary, 4–9.5 cm long, pseudoracemose, densely glandular pubescent throughout; peduncle 1.7–4.4 cm long; bracts linear to triangular, c. 3.5 × 0.4 mm; pedicels 7.1–10.9 mm long. **Sepals** ovate to lanceolate, green, 3-veined, 5–6 × 1.8–2.7 mm, apices narrowly acute, sparsely puberulous above, more densely so beneath, ciliate; sepals often reflexed when in fruit. **Corolla** bilabiate, c. 10 mm long, pale lavender/lilac throughout, glabrous outside; tube 4.5–5.1 mm long; upper lip very slightly 2-lobed, c. 1.5 mm long, reflexed, emarginate in centre, c. 0.6 mm deep, glabrous except for a ring of short white hairs on the ridge of tissue at the base of the lip which runs down to the sinus with the lower lip; lower lip 3-lobed,

c. 5 mm long, central lobe reflexed, glabrous except for palatal beard at base of lobes, each lobe c. 3.5×1.8 – 2.6 mm, lateral lobes slightly falcate, central lobe slightly ovate, apices rounded, fully reflexed. **Stamens** with a pronounced sterile projection, 0.7–1 mm long, yellow; filaments 1.2–1.6 mm long; anthers 0.6 – 1×1.5 – 2.1 mm, hairy, lightly fused at the tips; staminodes 3, two of which 1–1.5 mm long, the third 0.2 mm long. **Ovary** 1 – 1.4 (– 2) $\times 1.5$ – 2.1 mm, glandular pubescent; style 5.5–6.1 mm long, glandular pubescent; stigma globose/rounded. **Fruit** 7.5 – 12.3×1.9 – 2.4 mm, tightly twisted, pubescent to densely pubescent.

Distribution. Southern Thailand.

Ecology. On karst limestone, usually shaded, at 80–350 m altitude.

Provisional IUCN Conservation Assessment. Near Threatened (NT). The currently known EOO of this species is < 5000 km² and the AOO 16 km², both of which would qualify it for Endangered if there were associated threats. However, most of the known localities are in National Parks where there is some disturbance but the extent of which is not currently likely to qualify the species as Endangered. Therefore, it is given a category of Near Threatened and its status should be monitored. Middleton (2012c) gave this species an assessment of Data Deficient but at that time the species delimitation only included the type collection.

Additional specimens examined: THAILAND: **Nakhon Si Thammarat:** Nopphitam, Tham Lot Cave, 13 Feb. 2005, *Williams, K. et al. 1460* (BKF, E, K, KEP). **Phatthalung:** 23 Sep. 1986, *Maxwell, J.F. 86-700* (A, BKF, PSU); Ban Phot, 20 Dec. 1979, *Shimizu, T. et al. T-27741* (BKF); Si Banphot, Khao Pu-Khao Ya National Park, 26 Oct. 1993, *Larsen, K. et al. 44040* (A, AAU, BKF, K). **Surat Thani:** Tai Rom Yen National Park, Tham Khamin, 18 Dec. 2006, *Pooma, R. et al. 6411* (A, BKF).

Notes. Even though the species was described only relatively recently the holotype at E could not be traced in spite of concerted effort. Therefore, the isotype at Kew has been designated as the lectotype.

This species, like *Ornithoboea pseudoflexuosa* and *O. flexuosa*, is only found in southern Thailand. It can be recognised by the fully reflexed central lobe of the lower corolla lip, tightly twisted fruit and short corolla tube. It shares the characters of a reflexed corolla lobe, a pseudoracemose inflorescence and ovate to lanceolate sepals with *Ornithoboea pseudoflexuosa*. There has been much confusion between *Ornithoboea flexuosa*, *O. pseudoflexuosa* and *O. multitorta* and the three species are often misidentified, especially when sterile (see notes on *O. flexuosa* and *O. pseudoflexuosa*). *Ornithoboea flexuosa* does not have the reflexed central lobe and its fruits are smaller and almost straight. In addition *Ornithoboea multitorta* has a longer corolla tube and sepals and bearded anthers. *Ornithoboea multitorta* shares a greater affinity to *O. pseudoflexuosa* but they can be distinguished by the tightly twisted fruits, longer internodes, shorter inflorescences, and longer sepals of *O. multitorta*.

11. *Ornithoboea obovata* S.M.Scott, sp. nov.

Most similar to *Ornithoboea maxwellii* in non-twisted fruits with straight dehiscence but differing in having fully reflexed sepals, shorter fruits and a palatal beard. It differs from *Ornithoboea barbanthera* in its smaller fruits and stamens without a pronounced sterile projection. TYPE: Vietnam, Quang Binh Province, Minh Hoa District, Hoa Tien municipality, La Van village, 200–450 m, 30 April 2011, L. Averyanov, P.K. Loc, N.Q. Hieu, P.V. The & N.T. Vinh CPC2552 (holotype E; isotype HN n.v.). (Fig. 6, 10).

Herb; 16–32(–40) cm tall, to (1.1–)2.3–3.4 mm diameter, red glandular pubescent throughout with hairs of various lengths, leaf internodes 5.4–16(–76) mm. **Leaves** opposite, bright green; petiole 12.1–13.1 cm long; blade herbaceous, ovate, 3.3–8.7 × 2.9–6.5 cm, apex acute, base slightly unequal, oblique to rounded, margin weakly to strongly crenate/bicrenate to dentate/duplicato-dentate, the teeth 1.4–4.2 mm; 6–7 pairs of prominent secondary veins, tertiary venation reticulate. **Inflorescence** axillary, 2.3–3 cm long, red glandular pubescent throughout; peduncle 9–26 mm long; bracts linear to lanceolate, c. 2.7 × 1 mm; pedicels 9–13 mm long, pilose. **Sepals** ovate, 3-veined, c. 4.5 × 2 mm, apices narrowly acute, puberulent above, puberulous below, ciliate; sepals fully reflexed when in fruit. **Corolla** bilabiate, c. 10.5 mm long, light to dark blue, glabrous outside; tube c. 4.5 mm long, light blue; upper lip slightly 2-lobed, 2 mm long, each lobe c. 1.5 mm long, broadly rounded and notched, pubescent with a ring of short hairs on the ridge of tissue at the base of the lip which runs down to the sinus with the lower lip; lower lip 3-lobed, c. 6.2 mm long, glabrous except for palatal beard at base of lobes, lobes 2.5–3.5 × 2.8–3.5 mm, lobes distinctly obovate and overlapping, apices rounded. **Stamens** without pronounced sterile projection; filaments curved through 90°, 1.5–2 mm long; anthers 0.5 × 1.5–2 mm, white, glabrous, lightly fused at the tips; staminodes 3, two of which 1.2–1.8 mm long, the third 0.2–0.4 mm long. **Ovary** 1.2–1.5 × 1.2 mm, glandular puberulent; style 4.5–6 mm long, glandular puberulent; stigma globose/rounded. **Fruit** 8.1–11.3 × 1.8–2 mm, non-twisted, red glandular pubescent; style persistent and characteristically curved through 180°.

Distribution. Vietnam.

Ecology. On karst limestone at 200–450 m altitude.

Etymology. Named for the distinctly obovate lobes found on the lower corolla lip.

Provisional IUCN Conservation Assessment. Data Deficient (DD). This species is known from very few collections and its precise distribution, population stability, and any potential threats are all unknown.

Additional specimens examined: VIETNAM: **Quang Binh:** Minh Hoa, Hoa Tien municipality, la Van Village, 30 Apr 2011, Averyanov, L. et al. CPC2556 (E); Quang Ninh District, Truong Son, long Son Village, 12 Apr 2008, Averyanov, L. et al. HAL11510 (E); Van Xuan Village, 26 Mar 1936, Pételot, A. 2234 (P).

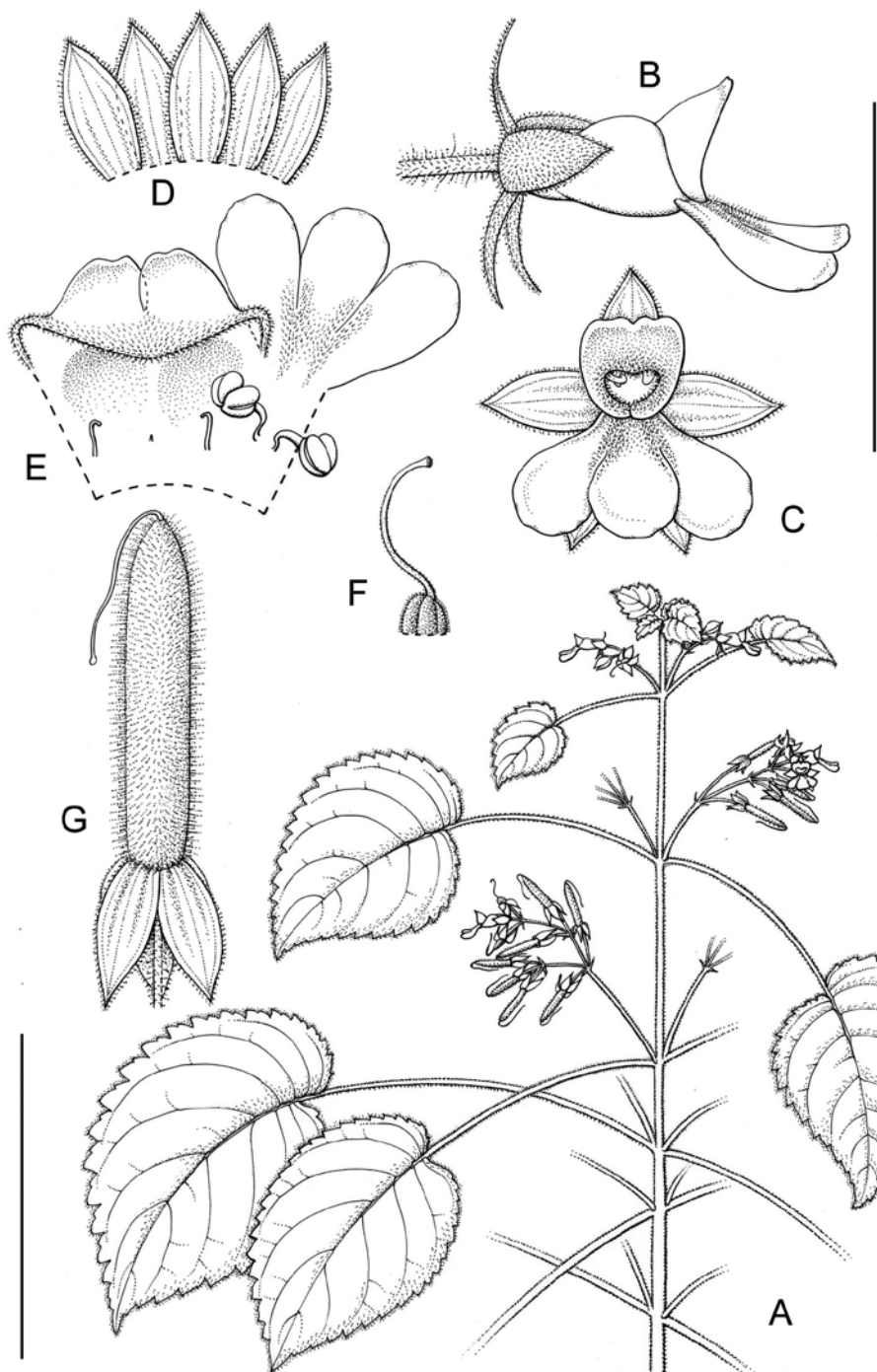


Fig. 10. *Ornithoboea obovata* S.M.Scott. **A.** Habit. **B.** Flower, side view. **C.** Flower, front view. **D.** Calyx opened out. **E.** Corolla dissection showing the two small lobes of the upper lip, the three larger lobes of the upper lip, two stamens and three staminodes. **F.** Pistil. **G.** Fruit. A–G = Averyanov *et al.* CPC2552 (E). Scale bars: A = 7 cm; B–G = 1 cm. Drawn by Claire Banks.

Notes. This new species is most similar to *Ornithoboea maxwellii* from Thailand with which it shares the character of non-twisted fruits with straight dehiscence. It differs from *Ornithoboea maxwellii*, however, in having fully reflexed sepals, shorter fruits and a palatal beard. It differs from *Ornithoboea barbanthera* B.L.Burt in its smaller fruits and stamens without a pronounced sterile projection.

This species can be distinguished by the lobes on the lower corolla lip which are large and obovate, fruits which are long and tubular with no twist and a straight dehiscence, and an indumentum of long red glandular hairs. These characters, and the small habit, make it easily recognisable.

12. *Ornithoboea occulta* B.L.Burt

Thai Forest Bull., Bot. 29: 101 (2001). TYPE: Thailand, Kanchanaburi, Between Huay Ban Kao and Kritee, 500 m, 4 July 1973, *R. Geesink & C. Phengklai 6078* (holotype E; isotypes AAU, K, L, P). (Fig. 7, 11–13).

Herb; stem 9–30 cm tall, to 1.9–4.8 mm diameter, glandular pubescent throughout, leaf internodes 1.7–6.2 cm. **Leaves** opposite; petiole 4.5–11.5(–15) cm long, puberulous; blade herbaceous, ovate to elliptic, 4–21 × 2.5–12 cm, apex narrowly acute, base slightly unequal, broadly oblique, margin weakly to strongly crenate/bicrenate to dentate/duplicato-dentate, the teeth 1.3–4.8 mm; 7–10 pairs of secondary veins, tertiary venation reticulate; glandular puberulous above and below with hairs of various lengths throughout. **Inflorescence** axillary, 3–7 cm long, glandular pubescent throughout; peduncle 9–26 mm long; bracts linear to triangular, 2.5–5.1 × 0.8–1.3 mm; pedicels 9–21 mm long. **Sepals** ovate to elliptic, white, 3-veined, 5.8–7.3 × 2.5–3.2 mm, apices narrowly acute, sparsely puberulous above, more densely so beneath, ciliate; sepals slightly reflexed when in fruit. **Corolla** bilabiate, c. 14 mm long, dark blue, glabrous outside; tube 3.5–4.6 mm long, white; upper lip slightly 2-lobed, erect, each lobe c. 2 mm long, apices retuse, pubescent on inside lower half of lobe in addition to a ring of short hairs on the ridge of tissue at the base of the lip which runs down to the sinus with the lower lip; lower lip 3-lobed, slightly reflexed, c. 6.8 mm long, glabrous except for palatal beard at base of lobes, lateral lobes c. 6.8 × 4.2 mm, central lobe c. 5.7 × 4.2 mm, lobes oblong, apices rounded with occasional notch. **Stamens** without pronounced sterile projection; filaments thickened, geniculate and curved through 90°, 1–1.7 mm long; anthers 0.6–0.8 × 1.2–1.8 mm, glabrous, lightly fused at the tips; staminodes 3, two of which 1–2.2 mm long, the third 0.3 mm long. **Ovary** c. 1.2 × 0.7–0.9 mm, glandular puberulent; style c. 5.5 mm long, glandular puberulent; stigma globose/rounded. **Fruit** 5–6.5 × 1.8–2.8 mm, smaller than the calyx lobes, barely twisted, densely pubescent.

Distribution. Western Thailand.

Ecology. On karst limestone at 500–800 m altitude.

IUCN Conservation Assessment. Data Deficient (DD) (Middleton & Suksathan, 2012b). This species is known from a relatively small area and most of the collections are from unprotected areas. However, the known localities are all in Thailand close to the border with Myanmar and the limestone areas on the Myanmar side of the border have not been explored for this species.

Additional specimens examined: THAILAND: **Kanchanaburi**: s.l., 16 Aug 1971, *Unknown* 2983 (BKF); Thong Pha Phum, 4 Jul 1973, *Maxwell, J.F. 73-105* (AAU); *ibidem*, *Maxwell, J.F. 73-105* (AAU); *ibidem*, 22 Aug 2006, *Triboun, P. 3638* (E); Thong Pha Phum, Huai Lam Khlong Ngu, *Suthasorn 2490* (BK). **Tak**: Khao Pha Wo, 23 Jul 1973, *Murata, G. et al. 16925* (L); Mae Sot, Phawo Shrine, 11 Sep 2009, *Middleton, D.J. & Triboun, P. 4858* (E); Umphang, 14 Apr 1999, *Chayamarit, K. 1588* (BKF).

Notes. There are many similarities between *Ornithoboea occulta* and *O. obovata* and they share the characters of geniculate filaments, long peduncles and slightly reflexed lower corolla lobes. However, *Ornithoboea occulta* has slightly twisted fruits, longer inflorescences, a large palatal beard, and oblong corolla lobes. *Ornithoboea obovata* differs in having almost non-twisted fruits with a distinctive persistent style curved through 180°, a shorter inflorescence, a small palatal beard, and obovate corolla lobes.



Fig. 11. Young fruit of *Ornithoboea occulta* B.L.Burtt. Photograph of *Middleton & Triboun 4858* by David Middleton.



Fig. 12. Flower of *Ornithoboea occulta* B.L.Burt. Photograph of *Middleton & Triboun 4858* by David Middleton.

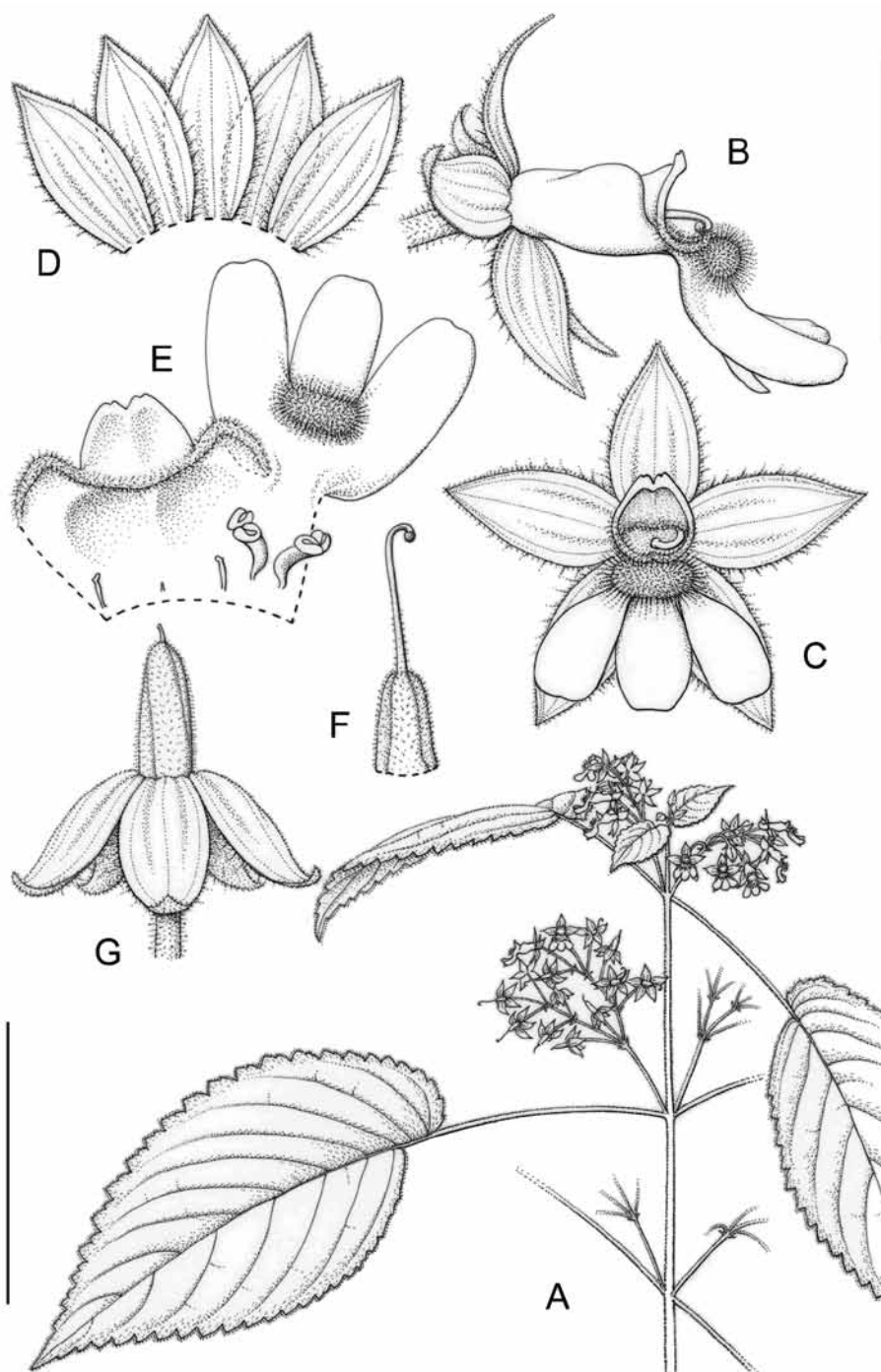


Fig. 13. *Ornithoboea occulta* B.L.Burt. **A.** Habit. **B.** Flower, side view. **C.** Flower, front view. **D.** Calyx opened out. **E.** Corolla dissection showing the two small lobes of the upper lip, the three larger lobes of the upper lip, two stamens and three staminodes. **F.** Pistil. **G.** Fruit. From Middleton & Triboun 4858 (E). Scale bars: A = 9 cm; B–G = 1 cm. Drawn by Claire Banks.

13. *Ornithoboea parishii* C.B. Clarke

in A.DC. & C.DC., Monogr. Phan. 5(1): 148 (1883); Hook.f., Fl. Brit. India 4: 366 (1884); Burt, Notes Roy. Bot. Gard. Edinburgh 22: 296 (1958). TYPE: Burma, Moulmein, 1060 m, 1862, *C.S.P. Parish 434* (holotype K). (Fig. 6).

Stem 18 cm tall, to 2.6 mm diameter, glandular pubescent throughout, leaf internodes 30–40 mm. **Leaves** opposite; petiole 5–8 cm long, puberulous; blade herbaceous, ovate to elliptic, 6–14 × 5–7 cm, apex acute, base oblique, rounded, margin weakly to strongly crenate/bicrenate to dentate, the teeth 1–1.5 mm; c. 10 pairs of secondary veins, tertiary venation reticulate; glandular puberulous above and below with hairs of various lengths throughout. **Inflorescence** axillary, 4.2–4.5 cm long, puberulent throughout; peduncle 1.4–1.8 cm long; bracts linear to triangular, 6.4–11.4 × 2.2–2.7 cm; pedicels 8.7–12.4 mm long. **Sepals** narrowly ovate, green, 3-veined, c. 5.7 × 2.2 mm, apices narrowly acute, sparsely puberulous above, more densely so beneath, ciliate; sepals mostly reflexed in mature fruit. **Corolla** bilabiate, c. 13 mm long, pale blue; tube c. 5.5 mm long, glabrous; upper lip slightly 2-lobed, erect, each lobe c. 1 mm long, apices obtuse, reflexed, puberulous in addition to a ring of short hairs on a ridge of tissue at the base of the lip which runs down to the sinus with the lower lip; lower lip 3-lobed, slightly reflexed with central lobe fully reflexed and flush against tube, glabrous except for a thick palatal beard at base of lobes, lateral lobes c. 9 × 1.8 mm, oblong, apices rounded, central lobe c. 7 × 2.3 mm, oblong, apices rounded. **Stamens** without a pronounced sterile projection; filaments 1.5 mm long, thickened, geniculate; anthers 0.5 × 2 mm, glabrous, lightly fused at the tips; staminodes 3, two of which c. 0.8 mm long, the third 0.2 mm long. **Ovary** 1.5 × 2 mm, glandular puberulent; style c. 4.5 mm long, glandular puberulent; stigma globose/rounded. **Fruit** c. 12 × 2 mm, green, slightly twisted, puberulous.

Distribution. Myanmar and Thailand.

Ecology. On karst limestone at 500–700 m altitude.

Provisional IUCN Conservation Assessment. Data Deficient (DD). This species is known from only the 19th century type collection from Burma and two more recent collections from western Thailand. Its true distribution is unknown, as are any potential threats.

Additional specimens examined: THAILAND: **Tak:** Umphang, 24 Apr 2004, *Pooma, R. et al.* 4644 (BKF); *ibidem*, 14 Jul 1999, *Wongprasert, T.* 99753 (BKF).

Notes. This species is known from very few and somewhat inadequate collections. It bears a resemblance to *Ornithoboea pseudoflexuosa* with its reflexed lobes. However, in *Ornithoboea pseudoflexuosa* only the middle lobe of the lower lip is reflexed whereas in *O. parishii* it would appear that all three lobes are reflexed. *Ornithoboea*

parishii also has geniculate filaments whereas *O. pseudoflexuosa* has pronounced sterile projections.

The hairs of the circlet are very short but none the less visible.

14. *Ornithoboea pseudoflexuosa* B.L. Burt

Notes Roy. Bot. Gard. Edinburgh 22: 299 (1958); Burt, Thai Forest Bull., Bot. 29: 101 (2001). TYPE: Thailand, Chumphon Province, Siepyuan, [Ban Siepyuan], 6 September 1927, *N. Put 964* (holotype K (see note below); isotypes E, BM). (Fig. 6, 14).

Herb; stem 18–80 cm tall, to 2.1×5.2 mm diameter, glandular pubescent throughout, leaf internodes 2.8–7.7 cm. **Leaves** opposite, pale green above, paler below; petiole 2.8–12(–18.5) cm long; blade herbaceous, elliptic to ovate, 6–19(–26) \times 3.9–9.7 cm, apex acute to attenuate, base unequal, oblique to slightly rounded, margin weakly to strongly crenate/bicrenate to dentate/duplicato-dentate, the teeth 1.7–6.7 mm; 8–10 pairs of secondary veins, tertiary venation reticulate; densely to sparsely yellow-glandular puberulous throughout with hairs of various lengths. **Inflorescence** axillary, 3–8.2(–13.3) cm long, pseudoracemose, densely glandular pubescent throughout; peduncle 2.2–4.7(–6) cm long; bracts linear to lanceolate, 3.1–5.6(–25.6) \times 1(–4.9) mm; pedicels 6–12.1(–16.4) mm long. **Sepals** ovate to lanceolate, green, 3-veined, 5.5–7.3(–10.3) \times 2.1–2.5 mm, apices narrowly acute, puberulous above, more densely so beneath, ciliate; some sepals reflexed when in fruit. **Corolla** bilabiate, c. 10 mm long, purple/white to violet throughout, glabrous outside; tube c. 6.7 mm long; upper lip very slightly 2-lobed, erect to reflexed, 1.5–2 mm long, lobes c. 0.5 mm long, emarginate in centre, c. 0.6 mm deep, glabrous except for a ring of short white hairs on the ridge of tissue at the base of the lip which runs down to the sinus with the lower lip; lower lip 3-lobed, c. 6.6 mm long, central lobe completely reflexed, glabrous except for palatal beard at base of lobes, each lobe 2.2–3.5 \times 2.2 mm, lateral lobes slightly falcate, apices rounded, central lobe slightly ovate. **Stamens** with a pronounced sterile projection, projection 1.5–1.9 mm long, yellow; filaments 0.6–1(–1.5) mm long; anthers 0.5–0.7(–1.3) \times 1.8–2.2 mm, hairy, lightly fused at the tips; staminodes 3, two of which 1.3–2 mm long, the third 0.2 mm long. **Ovary** 0.9–2.1 \times 0.9–1.2 mm, glandular puberulous throughout; style 5.5–6 mm long; stigma globose/rounded. **Fruit** 6.1–9.6 \times 2.1–3.3 mm, twisted to more than half a turn or barely twisted, glandular puberulous.

Distribution. Thailand.

Ecology. On karst limestone, usually in shade, at 30–200 m altitude.

IUCN Conservation Assessment. Least Concern (LC) (Middleton 2012d). This species has a fairly large extent of occurrence and is locally common. Some of the sites are found within protected areas and there do not appear to be any major threats at the moment.



Fig. 14. *Ornithoboea pseudoflexuosa* B.L.Burtt. Photograph of *Middleton et al.* 5545 by Preecha Karaket.

Additional specimens examined: THAILAND: **Chumphon:** Sawi, Khao Khai, Tham Thip Prida San Chang Len, 26 Dec 2006, *Pooma, R. et al.* 6679 (A, BKF, E); Thung Tako, Ban Khao Talu, 4 Dec 2002, *Koonkhunyhod, N. & de Wilde-Duyffes, B.E.E.* 309 (BKF). **Phatthalung:** 12 Apr 1928, *Kerr, A.F.G.* 15145 (BM, K). **Ranong:** Ko Thalu, 3 Feb 1927, *Kerr, A.F.G.* 11790 (ABD). **Surat Thani:** Khao Wong, 24 Sep 1963, *Smitinand, T. & Sleumer, H.O.* 1236 (BKF); Phanom, 16 Feb 2005, *Williams, K. & Pooma, R.* 1546 (BKF); Phanom, Khao Sok National Park, 6 Sep 2008, *Middleton, D.J. et al.* 4318 (E); Phanom, Khlong Phanom National Park, 21 Oct 2010, *Middleton, D.J.* 5230 (E); *ibidem*, 26 Sep 2010, *Middleton, D.J. et al.* 5545 (E); *ibidem*, 7 Sep 2008, *Middleton, D.J. et al.* 4336 (E). **Trang:** Huay Yot, Wat Tham Iso, 9 Sep 2008, *Middleton, D.J. et al.* 4426 (E, KEP); *ibidem*, 10 Aug 2005, *Pooma, R. et al.* 5630 (BKF); *ibidem*, 14 Jun 2006, *Williams, K. et al.* 1741 (A, BKF, E); Lamphura, 15 Nov 1990, *Larsen, K. et al.* 41388 (AAU, BKF).

Notes. In the protologue Burtt (1958) cited the holotype as being at ABD but no specimens of this collection could be found there. However, there is a specimen at K (over two sheets labelled sheet 1 and 2) which has clearly been labelled as the holotype by Burtt. We consider this to have been an error in the protologue to be corrected rather than that the K material requires lectotypification.

This species is only found in the south of Thailand and is recognisable by its large leaves, longish pseudoracemose inflorescences and the distinct character of a fully reflexed central lobe on the 3-lobed lower lip, a character it shares with *Ornithoboea multitorta*. Many other *Ornithoboea* species have a reflexed central lobe, such as

O. calcicola, *O. emarginata*, *O. flexuosa* and *O. puglisiae*, but in none of these does the lobe reflex past 90° as in *O. multitorta* and *O. pseudoflexuosa*.

There has been much confusion between *Ornithoboea pseudoflexuosa*, *O. flexuosa* and *O. multitorta*. *Ornithoboea pseudoflexuosa* can be separated from *Ornithoboea flexuosa* by the fully reflexed central lobe of the lower corolla lip. In *Ornithoboea flexuosa* the central lobe is not or only slightly reflexed. It differs further in having a fruit which is longer and more twisted, and anthers which are distinctly bearded.

Ornithoboea pseudoflexuosa bears a strong resemblance to *Ornithoboea multitorta* but differs in the barely twisted fruit, the longer corolla tube and longer sepals.

15. *Ornithoboea puglisiae* S.M.Scott, **sp. nov.**

Most similar to *Ornithoboea calcicola* in the elliptic sepals with a narrowly acute apex but differs in having shorter fruits with a persistent style, glabrous anthers, and petioles up to twice as long. Differs from *Ornithoboea wildeana* in its shorter corolla, smaller lower lobes with triangular apices and shorter sepals. TYPE: Thailand, Nan, Muang Nan, Tham Pha Toop, Trail to Phra Cave, 300 m, 16 August 2012, *D.J. Middleton, P. Karaket, S. Suddee & P. Triboun 5617* (holotype E; isotypes BKF, P). (Fig. 7, 15, 16).

Herb; stem 40–50 cm tall, to 2.7–6.5 mm diameter, pubescent, leaf internodes 3.8–6.7 cm. **Leaves** opposite, light green; petiole 6–20 cm long; blade herbaceous, ovate to elliptic, 4–21(–25) × 4–11.8 cm, apex acuminate to narrowly acute, base slightly unequal, oblique to narrowly cordate, margin weakly to strongly crenate to dentate, rarely bicrenate to duplicato-dentate, the teeth 0.8–3 mm; c. 8 pairs of secondary veins, tertiary venation reticulate; glandular puberulous above, more densely so beneath, ciliate. **Inflorescence** axillary, 7–13 cm long, glandular pubescent throughout; peduncle 2.3–3.6 cm long; bracts linear to lanceolate, 4.1–13 × 0.5–1.6 mm; pedicels 6.7–19.1 mm long. **Sepals** elliptic, pale green, 3-veined, 8.2–8.7 × 3–3.3 mm, apices narrowly acute, glabrous inside, densely glandular puberulous outside, ciliate. **Corolla** bilabiate, c. 12.7 mm long, light purple to white throughout, glabrous outside; tube c. 6 mm long; upper lip 2-lobed, erect, each lobe 0.2–0.4 mm long, apices notched, puberulous in addition to a ring of short hairs on the ridge of tissue at the base of the lip which runs down to the sinus with the lower lip; lower lip 3-lobed, slightly reflexed, 6.8–9 mm long, glabrous except for palatal beard at base of lobes, each lobe 3.5–4.5 × 2.5–3 mm, oblong, apices rounded. **Stamens** with a pronounced sterile projection, projection 1.4–2 mm long, yellow; filaments c. 1 mm long; anthers 1.2–1.6 × 2.4–2.7 mm, slightly bearded, lightly fused at the tips; staminodes 3, two of which 1.8–2.5 mm long, the third 0.3–0.4 mm long. **Ovary** 1.5–1.8 × 1.2–1.5 mm, glandular puberulent throughout; style c. 9.2 mm long; stigma globose/rounded. **Fruit** 11.6–14.3 × 1.7–2.1 mm, twisted, puberulous, style often persistent.

Distribution. Northern Thailand.

Ecology. On karst limestone at 300–800 m.

Etymology. Named after Carmen Puglisi for her contribution to our understanding of the Loxocarpinae, the subtribe of Gesneriaceae that includes *Ornithoboea*.

Provisional IUCN Conservation Assessment. Data Deficient (DD). This species is only known from three collections with one of the collections quite widely disjunct from the others. Its occurrence between these areas, where there are many suitable habitats, is unknown.

Additional specimens examined: THAILAND: **Mae Hong Son:** Muang Mae Hong Son, Doi Pui, 23 Sep 1995, *Larsen, K. et al.* 46865 (AAU, BKF). **Nan:** Tham Pha Toop, 13 Sep 1995, *Larsen, K. et al.* 46424 (AAU).

Notes. In addition to the similarities noted in the diagnosis *Ornithoboea puglisiae* shares some similarities with *O. wildeana*: a long style, long peduncles and twisted fruits. It differs, however, in the shorter inflorescences, elliptic sepals and oblong lobes on the lower lip each having a rounded apex. *Ornithoboea puglisiae* is also small in stature compared to *O. wildeana* and *O. lacei*.

16. *Ornithoboea wildeana* Craib

Bull. Misc. Info. Kew. 1916: 268 (1916); Burtt, Notes Roy. Bot. Gard. Edinburgh 22: 298 (1958); Li, Bull. Bot. Res., Harbin 3(2): 42 (1983); Wang, Fl. Reipubl. Popularis Sin. 69: 479 (1990); Wang et al., Fl. China 18: 370 (1998); Burtt, Thai Forest Bull., Bot. 29: 101 (2001). TYPE: Thailand, Chiang Mai, Doi Chiang Dao, from cultivated collection at Trinity College Dublin Botanic Garden, 5 Aug 1914, *Unknown* s.n. (holotype K). (Fig. 6, 17).

Brachistemon macrocalyx Hand.-Mazz., Sinensia 5: 10 (1934). TYPE: China, Kwangsi, Pu-hi, 730m., 27 July 1928, *Ching 6565* (lectotype W, designated by Burtt (1958); isolectotypes A, NY).

Herb; stem 30–150 cm tall, to 2.5–5.3(–8.9) mm diameter, red glandular pilose throughout, leaf internodes 3–10.2 cm. **Leaves** opposite; petiole 2–11.5 cm long; blade herbaceous, ovate to narrowly ovate, 4–21(–25) × 4–11.8 cm, apex acuminate to narrowly acute, base slightly unequal, oblique to narrowly cordate, margin weakly to strongly crenate to dentate, rarely bicrenate to duplicato-dentate, the teeth 0.8–3 mm; 8–10 pairs of secondary veins, tertiary venation reticulate, ciliate; glandular puberulous throughout with hairs of various lengths. **Inflorescence** axillary, 3–15(–25) cm long, red glandular pilose throughout; peduncle 1.1–3.1(–5.2) cm long; bracts



Fig. 15. *Ornithoboea puglisiae* S.M.Scott. Photograph of *Middleton et al.* 5617 by Preecha Karaket.

linear to lanceolate, 6.5–18.3 × 0.8–1.6 mm; pedicels (6.7–)11.1–20.3 mm long. **Sepals** ovate to narrowly ovate, purple/pink to purple/green, 3-veined, 8–14.6 × 1.5–3.2 mm, spreading, apices narrowly attenuate, glandular puberulous above, more densely so beneath, ciliate. **Corolla** bilabiate, c. 17 mm long, blue/purple throughout, glabrous outside; tube (6.5–)7.8–9 mm long; upper lip slightly 2-lobed, erect, each lobe 0.5–0.7 mm long, apices emarginate, glabrous except for a ring of short hairs on the ridge of tissue at the base of the lip which runs down to the sinus with the lower lip; lower lip 3-lobed, slightly reflexed, c. 8 mm long, glabrous except for pale palatal beard at base of lobes, each lobe 3–4(–5) × 2.3–3 mm, slightly obovate, apices rounded, central lobe overlapping lateral lobes. **Stamens** with a pronounced sterile projection, projection 1.5–1.6 mm long, yellow to light blue; filaments 0.7–1 mm long; anthers (0.5–)1–1.5 × 2–2.8 mm, sparsely bearded, lightly fused at the tips; staminodes 3, two of which c. 1.5–2(–2.5) mm long, the third 0.3 mm long. **Ovary** 1.3–2.4(–3) × 0.9–1.5 mm, glandular puberulent throughout; style (6.1–)9–12.4 mm long; stigma globose/rounded. **Fruit** 9.8–17.4 × 1.8–3.2 mm, twisted, pilose.

Distribution. China, Thailand, Laos, (Vietnam?).

Ecology. On karst limestone at 150–2100 m altitude.

Provisional IUCN Conservation Assessment. Least Concern (LC). This species is widespread (even allowing the doubt over the distribution in Vietnam) and locally fairly common.

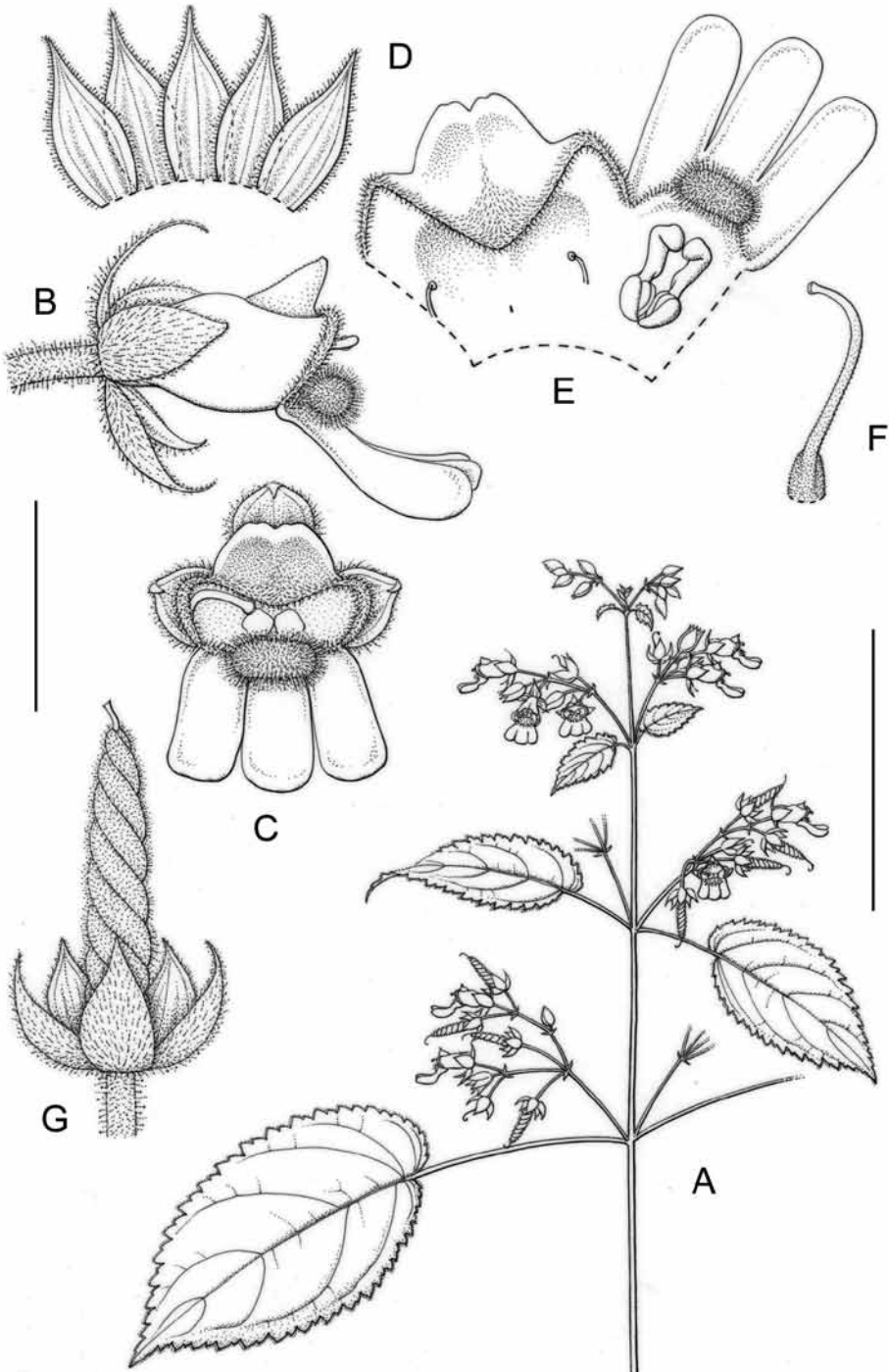


Fig. 16. *Ornithoboea puglisiae* S.M.Scott. **A.** Habit. **B.** Flower, side view. **C.** Flower, front view. **D.** Calyx opened out. **E.** Corolla dissection showing the two small lobes of the upper lip, the three larger lobes of the upper lip, two stamens and three staminodes. **F.** Pistil; **G.** Fruit. From Middleton *et al.* 5617 (E). Scale bars: A = 9 cm; B–G = 1 cm. Drawn by Claire Banks.



Fig. 17. Habit of *Ornithoboea wildeana* Craib. Inset: close up of flower. Photographs of Middleton *et al.* 5000 by David Middleton.

Additional specimens examined: CHINA: **Yunnan**: Mar-li-po, 5 Nov 1943, *Feng, K.M.* 14074 (KUN).

THAILAND: **Chiang Mai**: Chiang Dao, Doi Chiang Dao Wildlife Sanctuary, 6 Nov 1961, *Bunchuai, K.* 1177 (BKF); *ibid.*, 3 Dec 1922, *Kerr, A.F.G.* 6552 (ABN, BM, K); *ibid.*, 25 Sep 1971, *Murata, G. et al.* T14927 (BKF); *ibid.*, 26 Sep 1971, *Murata, G. et al.* T15257 (AAU, BKF); *ibid.*, 18 Oct 1926, *Put, N.* 394 (BM, K); *ibid.*, 4 Dec 1961, *Smitinand, T. & Anderson, J.A.R.* 7361 (BKF); *ibid.*, 10 Nov 1962, *Smitinand, T. et al.* 7786 (BKF); *ibid.*, 11 Sep 1967, *Tagawa, M. et al.* T9787 (BKF); *ibid.*, 16 Aug 2006, *Triboun, P.* 3632 (E); *ibid.*, acc. no. 3 vouchered as Jan 1962, *Unknown* 9562 (US); Chiang Dao, Doi Chiang Dao Wildlife Sanctuary, Trail to summit of Doi Chiang Dao, 27 Sep 2009, *Middleton, D.J. et al.* 5000 (E); Chiang Dao, Doi Chiang Dao Wildlife Sanctuary, Way to Muang Kong, 20 Sep 2008, *Middleton, D.J. et al.* 4531 (E); San Kamphaeng, Sahagon, Doi Muang Awn, 29 Oct 1992, *Maxwell, J.F.* 92651 (A, L). **Chiang Rai**: 21 Sep 1924, *Garrett, H.B.G.* 200 (ABN, BM, E, K). **Khon Kaen**: 9 Sep 1963, *Smitinand, T. & Sleumer, H.O.* 1126 (BKF, E, L, SING). **Lampang**: Ngao, 28 Aug 1922, *Winit* 755 (ABN, K); Tham Pha Thai, 23 Sep 1967, *Tagawa, M. et al.* T10625 (BKF); Wang Nuea, Chae Son National Park, Bassac, 3 Oct 1996, *Maxwell, J.F.* 96-1283 (B); Wang Nuea, Chae Son National Park, summit above Maw Cave, 3 Oct 1996, *Maxwell, J.F.* 96-1283 (A). **Mae Hong Son**: 10 Sep 1974, *Larsen, K. & Larsen, S.S.* 34335 (AAU, SING); Muang Mae Hong Son, Doi Mae Sakut, 23 Sep 1995, *Nanakorn, W. et al.* 4690 (E); Pang Mapha, Tahm Lawt, 10 Nov 2004, *Palee, P.* 768 (BKF); Pangmapha, Tham Lot Cave, 23 Sep 2009, *Middleton, D.J. et al.* 4975 (BKF, E); Pangmapha, Ban Jah Bo, Mae La Nah Cave, 30 Sep 2003, *Maxwell, J.F.* 03304 (BKF). **Sukhothai**: Khiri Mat, 27 Nov 77, *Phengklai, C. et al.* 3930 (BKF).
LAOS: s.l., 12 Sep 1929, *Poilane, E.* 16931 (P).

VIETNAM: **Bac Kan**: Ba Be District, Nam Mau Municipality, Nam Dai Village, Ba Be National Park, 12 Jul 2004, *Atha, D.E. et al.* 4723 (NY).

Notes. The identification of the collection from Vietnam is not without doubt and further collections are necessary from Vietnam to be sure of its presence there.

Ornithoboea wildeana has one of the widest geographical distributions in the genus and is also one of the most variable, particularly in the flowers, especially in the degree of development of the sterile processes on the stamens. There is also variation in the shape and size of the sepals with some being ovate and short and others being narrowly ovate to over 14 mm long.

It shares similarities to *Ornithoboea lacei* in having a long corolla, short filaments, and the same tall stature. It differs in *Ornithoboea lacei* in having much shorter inflorescences, shorter sepals and fruit with a persistent style.

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