

REVIEW OF AUSTRALIAN *PHYLLODES IMPERIALIS* DRUCE (LEPIDOPTERA: EREBIDAE) WITH DESCRIPTION OF A NEW SUBSPECIES FROM SUBTROPICAL AUSTRALIA

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Abstract

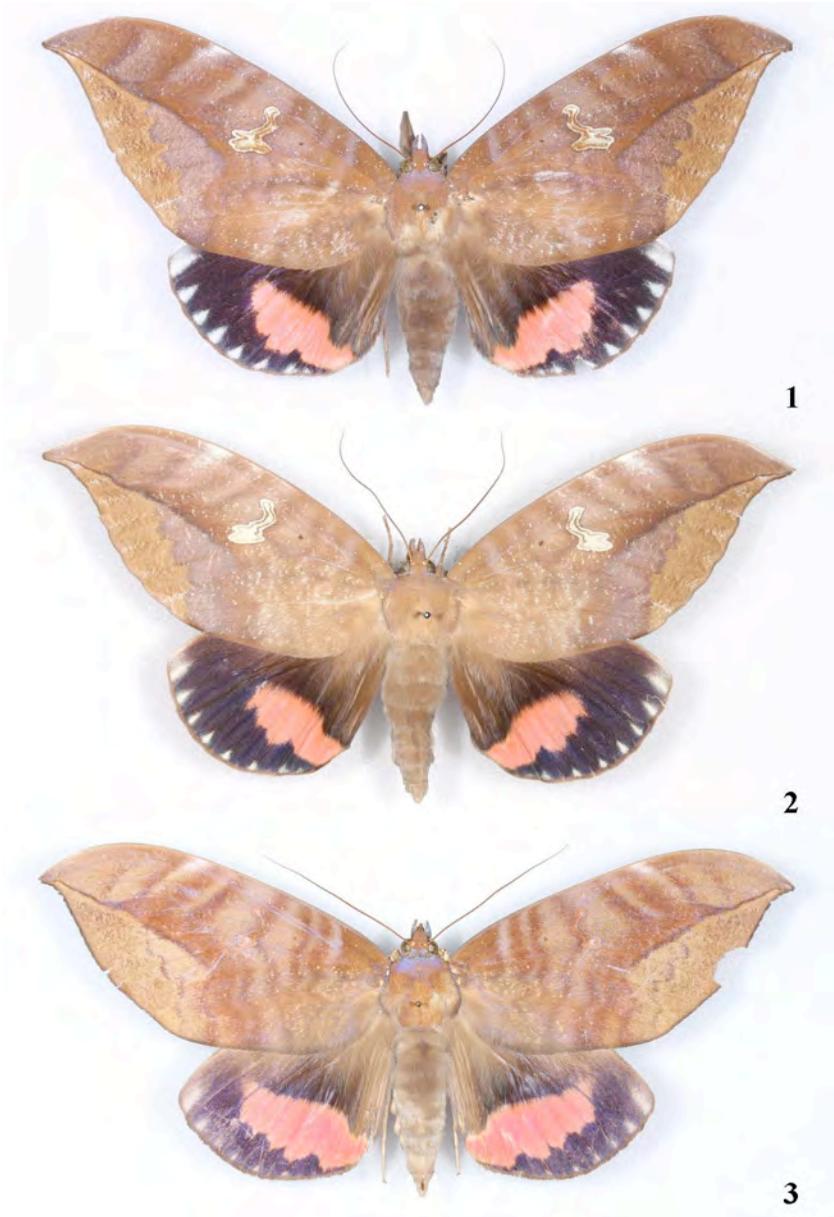
The subspecies of *Phyllodes imperialis* Druce are reviewed: *P. i. meyricki* Olliff from tropical northeastern Australia and New Guinea is validated and compared with the nominotypical *P. i. imperialis* from the Solomon Islands and *P. i. dealbata* Holloway from New Caledonia. *P. imperialis smithersi* subsp. n., from subtropical southeastern Queensland and northeastern New South Wales, is described and figured.

Introduction

Several genera of large moths previously referred to the subfamily Catocalinae (Noctuidae), including *Phyllodes* Boisduval (1832), were elevated to the family Erebidae (Calpinae: tribe Phylloдини) by Zahir *et al.* (2011), Holloway (2011) and Zahir *et al.* (2012). Many species in this group belonging to endemic Australian genera (Common 1990) have remained unplaced (Edwards 1996) since the review of Noctuidae by Kitching (1984). Taxa then included in the family Noctuidae have since been rearranged by Zahir *et al.* (2011), with Phylloдини now including *Phyllodes*, *Xylophylla* Hampson, *Oporophylla* Hampson, *Lobophyllodes* Hampson, *Minoides* Guenee and *Minophyllodes* Joannis. Of these genera, *Phyllodes* is the only genus occurring in Australia.

Poole (1989) listed 11 species (with synonyms) of *Phyllodes* and regarded *P. imperialis* Druce, 1888, *P. meyricki* Olliff, 1889 and *P. papuana* Hampson, 1913 as separate species. Earlier authors, *e.g.* Olliff (1889) listed 12 species of *Phyllodes*, Seitz (1923) listed 13 and Hampson (1913) provided a key to 11 species. *Phyllodes i. imperialis* was described from the Solomon Islands (Druce 1888) and this subspecies is also known from Bougainville, Papua New Guinea (ANIC unpublished). Several other populations of *P. imperialis* include the distinctive subspecies *P. i. dealbata* Holloway from New Caledonia (Holloway 1979), while other island populations from Vanuatu (Viette 1950), New Britain and New Ireland (Sands unpublished) may also be distinct. *Phyllodes i. meyricki* Olliff, from northern Queensland and New Guinea, is recognised here as a subspecies differing morphologically from *P. i. imperialis* and *P. i. dealbata*. The population previously referred to as a southern subspecies of *P. imperialis* by Sands (1999) is listed both federally (EPBC 2002, Clark and Spier-Ashcroft 2003) and in New South Wales (TSCA 1995) as an endangered subspecies. The habitat for this subspecies, subtropical lowland rainforest, is listed federally as a critically endangered ecosystem (EPBC 2002; endorsed November 2011).

This southern population of *P. imperialis* from eastern Australia is described here as new; it, *P. i. meyricki* and *P. i. imperialis* are illustrated in Figs 1-12.



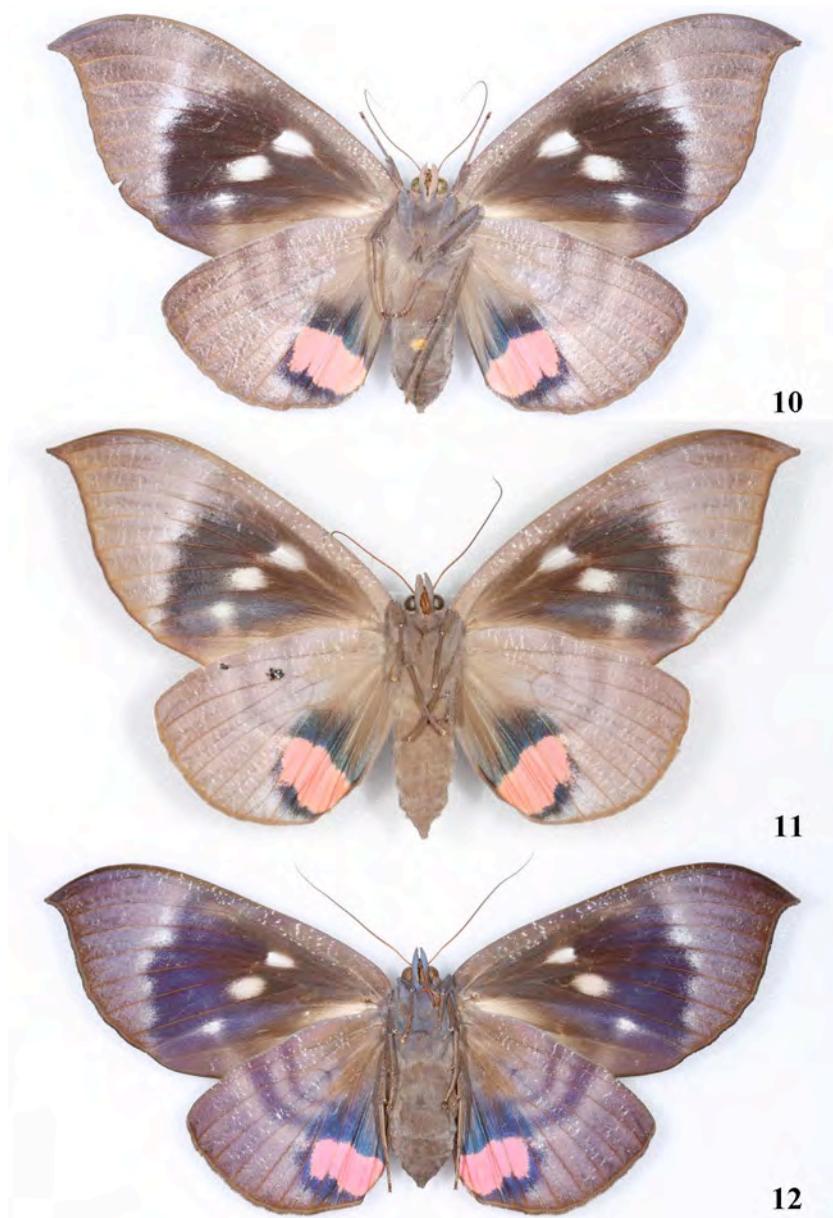
Figs 1-3. *Phyllodes imperialis*, male uppersides: (1) *P. i. meyricki*; (2) *P. i. smithersi* subsp. n.; (3) *P. i. imperialis*.



Figs 4-6. *Phyllodes imperialis*, male undersides: (4) *P. i. meyricki*; (5) *P. i. smithersi* subsp. n.; (6) *P. i. imperialis*.



Figs 7-9. *Phyllodes imperialis*, female uppersides: (7) *P. i. meyricki*; (8) *P. i. smithersi* subsp. n.; (9) *P. i. imperialis*.



Figs 10-12. *Phyllodes imperialis*, female undersides: (10) *P. i. meyricki*; (11) *P. i. smithersi* subsp. n.; (12) *P. i. imperialis*.

Abbreviations used are: ANIC - Australian National Insect Collection, CSIRO, Canberra; AM - Australian Museum, Sydney; BMNH - Natural History Museum, London; QM - Queensland Museum, Brisbane; Qld - Queensland; NSW - New South Wales; fwl - forewing length; hwl - hind wing length.

***Phyllodes imperialis meyricki* Olliff, 1889, stat. rev.**

(Figs 1, 4, 7, 10)

Phyllodes meyricki Olliff, 1889: 114; Hampson, 1913: 392; Seitz 1923 (Vol. 11): 470.

Phyllodes papuana Hampson, 1913: 392; syn. by Seitz 1923 (Vol. 11): 470.

Phyllodes imperialis Druce; Common 1990: 454; Edwards 1996: 307-308; Zborowski and Edwards 2007: 15.

Types. *Lectotype* ♀ (here designated), AUSTRALIA (QUEENSLAND): labelled 'Mt Bellenden Ker, Cairns, Q.', '*Phyllodes meyricki* Oll.', 'AM registration number K351914'; 1 *Paralectotype* ♀, labelled 'Daintree Riv N. Queensland, Pres. C. French 89.1', '*Phyllodes meyricki* Oll. Type, AM registration number K183621' (both in AM: photographs examined). Olliff (1889) described this taxon from two specimens in the Australian Museum, which he indicated as from 'Mt Bellenden-Ker, near Cairns, and Daintree River, Queensland', but did not designate a Type. A lectotype is designated here in order to stabilise the nomenclature, the specimen selected being the one first mentioned by Olliff (and in better condition).

Other material examined. PAPUA NEW GUINEA: 2 ♂♂, 4 ♀♀, Kiunga, Lae; 1 labelled 'Kiunga 65/516, AUST. NAT. INS. COLL.' (NEW GUINEA) (ANIC). AUSTRALIA (QUEENSLAND): northern Queensland: 14 ♂♂, 6 ♀♀ (ANIC), 2 ♂♂, 3 ♀♀ (Sands); male genitalia slides: 1 labelled 'NOCT ♂ 18608 *Phyllodes imperialis* 17°18'S, 145°35'E, Lake Eacham Q, 24 May 1989 IFB Common' (ANIC).

Diagnosis. *Phyllodes i. meyricki* (Figs 1, 4, 7, 10) can be distinguished from *P. i. imperialis* (Figs 3, 6, 9, 12) by its narrower forewings with its margins not so strongly bowed as in the nominotypical subspecies. *P. i. meyricki* is overall larger and the forewings longer (♂♂ fwl: 74-78 mm, n = 5; ♀♀ fwl: 75-85 mm, n = 5) than in *P. i. smithersi* (♂♂ fwl: 58-69 mm, n = 5; ♀♀ fwl: 59-69 mm, n = 6) and the pink hind wing band of *P. i. meyricki*, although variable, is not as wide as in *P. i. imperialis* and extends further towards the apex than in *P. i. smithersi*. *Phyllodes i. meyricki* can be distinguished from *P. i. dealbata* from New Caledonia by the presence of white sub-triangular spots at the vein ends of the hind wing termen, absent in *P. i. dealbata*.

Distribution. The island of New Guinea (Indonesian West Papua and mainland Papua New Guinea) and northern Queensland, Australia (Hunter 1939). In Papua New Guinea recorded from Aroa River (Poole 1989) and Kiunga (ANIC). In Queensland subspecies *P. i. meyricki* is recorded from Mount Bellenden-Ker, Daintree River (Olliff 1889), Atherton, Mutarnee (ANIC), Paluma, Ingham, Tully, Innisfail (L. Ring), Dunk Island, Kuranda, Cooktown, Claudie River and Bamaga (unpublished data and ANIC records).

One specimen from near Proserpine, labelled 'Airlie Beach, N.Q, Sept. 1976, A.W. Smith, CGL Gooding Coll.' (in ANIC) is probably this subspecies but more specimens are required to confirm its status; none of the food plants of *P. imperialis* are known to occur in this region of Queensland.

Larval food plant. The life history and the immature stages of *P. i. meyricki* were described by Hunter (1939). The moth breeds in the heavily-shaded understorey of rainforest, where females oviposit on low, young growth of the vines *Pycnarrhena novoguineensis* Miq. (= *P. australiana*) (Hunter 1939, Fay 1996) and *P. ozantha* Diels (Menispermaceae). Eggs are parasitised by an unidentified *Ooencyrtus* sp. (Hymenoptera: Encyrtidae).

Phyllodes imperialis smithersi subsp. n.

(Figs 2, 5, 8, 11, 13-15, 16-21)

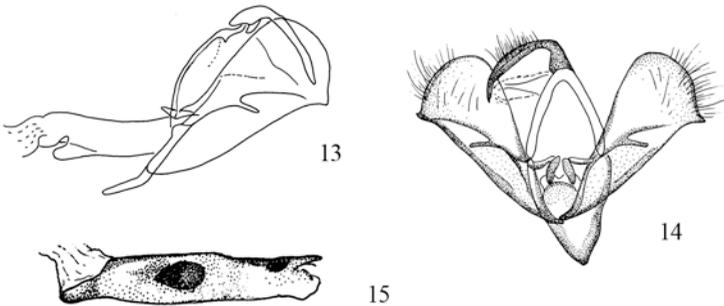
Phyllodes imperialis 'southern subspecies': TSCA 1995; Sands 1999: 386; EPBC 2002 (ANIC Ref. No. 3333), Clark and Spier-Ashcroft 2003: 99; Sands 2012: 38-39.

Types. *Holotype* ♂, AUSTRALIA: labelled 'QUEENSLAND. Mary Cairncross Pk nr Maleny, 26°44'S, 152°52'E, e.p. 27.vi.1988, DPA Sands & R. Broe, larva on *Carronia multisepealea* col. 16.iii.1988' (in ANIC). *Paratypes*: (QUEENSLAND): 4 ♂♂, as above but e.p. 13.v.1988, col. 9.iii.1988; e.p. 24.iii.1988, col. 16.iii.1988; e.p. 6.vi.1988, col. 16.iii.1988, ANIC genitalia slide No. 20391 (all ANIC); 5 ♀♀, as above but e.p. 4.vi.1988, col. 9.iii.1988, e.p. 7.vi.1988, col. 9. iii. 1988, e.p. 6.vi.1988, col. 13.iii.1988, e.p. 14.v.1988, col. 9. iii. 1988 and e.p. 8.vi.1988, col. 5. iv. 1988 (all ANIC); 1 ♂, Mary Cairncross Pk nr Maleny, e.p. 22.i.2004, DPA Sands, larva on *Carronia multisepealea*, col. 22.xii.2003 (QM); 1 ♀, Maleny, 26°44'S, 152°52' E, nr Mary Cairncross Park, to light, 3.xi.2001, A.M. Stabler & A.G. Orr (QM); 1 ♂, labelled '*Phyllodes imperialis* Lamington PN, 16.iii.07 Antoine Levegne leg' (QM); 1 ♀, Upper Currumbin, 4.vi.32, L. Franzen (ANIC). (NEW SOUTH WALES): 1 ♀, Dorrigo National Park, Dorrigo, 18.xi.1990, A.A. Calder (ANIC); 1 ♂, Dorrigo, 27.iii.73, D.S.P 1. ARCH. (ANIC); 1 ♀, ANIC Uni. of New England Coll. donated 1983 (ANIC); 1 ♂, Bellingen Island Reserve, 30°26'55"S, 102°53'47"E, egg coll. 13.xi.2006, D. Britton & P Richards, ex pupa 25.i.2007, Australian Museum K243319 (AM); 1 ♂, same except ex pupa 26.i.2007, Australian Museum K243460 (AM).

Description. *Male* (Figs 2, 5). Head, palpus, antenna and thorax light brown; eyes grey-brown, large, rounded, setae obscure; antenna less than half forewing length, slender with short fine setae; palpi upturned, segment 2 very broad, flattened, apically squared, segment 3 short, pencil-like, arising from proximal edge of segment 2; proboscis long, setae very fine, short, without serrations. Forewing length (*holotype*) 66 mm, more than twice width (x 2.1-2.2), ovate (leaf-like appearance), apex produced, costa convex, sub-apically convex; termen obliquely curved, inner margin convex basally; above grey-brown, white area at two thirds length from base at costa, obscure widely-spaced transverse darker bands reaching costa, from sub-apex to base, a dark brown median line from below apex to base of M₃; termen narrowly dark brown, a broad paler terminal band, inwardly broadly toothed, extending

from median line to tornus; subcentral, post-cell reniform near discocellular vein, shape resembling a leaf miner scar, white edged brown and white, broad basally, angled and narrow towards costa. Hind wing longer than wide, apex obtuse, termen convex; above black, costa and base brown, outer margins with 8 triangular subterminal white spots at vein ends, decreasing in size from apex to tornus; a central pink band less than half hind wing width, indented at vein 1A+2A, from M_3 to inner margin above tornus. Beneath grey-brown, forewing with central subtriangular grey-black area, from sub-base to tornus and sub-costa, submarginally-crenate, area with 3 submedian greyish-white areas between tornus and costa. Hind wing veins M_1 to M_3 dark towards termen, with 2 black median transverse and submedian bands M_3 to costa; broad dark grey-brown area to base and inner margin at tornus; overlain by a broad oval postmedian pink band extending about two thirds length of wing, from the tornus to M_3 and reaching Sc, indented at 1A + 2A and Cu A_1 .

Male genitalia (Figs 13-15). Vinculum and tegumen with prominent median junction, saccus subtriangular in dorsal aspect, tegumen apically subtriangular, tapered at base of gnathos; gnathos heavily sclerotized, curved and hook shaped, with apex between apices of valvae clothed in long setae; valvae broadly subtriangular, dorsal edge straight, apex strongly bowed, tapered ventrally to a triangular point, ventral margin weakly convex, ampulla fold with slender, ventrally-directed and pencil-like apically pointed process; juxta hood shaped with short, apical bifurcate sclerotized flanges; aedeagus broadly tubular, base of subzonal sheath rounded, apex truncated, cornuti with median short group of sclerotized cornuti and short apical group near orifice (vesica retracted); prezonal sheath apically broad, with two, rod-like sclerites.



Figs 13-15. *Phylloides imperialis smithersi*, male genitalia: (13) lateral view; (14) posterior view; (15) aedeagus. (14-15 slide mounted).

Female (Figs 8, 11). Colour similar but often darker than male, wings usually longer and broader than male, forewing costa and inner margin more strongly convex.

Etymology. Named to honour the late Courtenay Smithers.

Variation. The ground colour of both sexes varies from pale grey-brown to dark reddish brown and is usually paler than in ssp. *meyricki*. The reniform mark on the forewing (*sensu* Hampson 1913) is usually white edged dark brown, sometimes brown, or rarely obscure in females.

Diagnosis. *P. i. smithersi* is smaller and the forewings (♂♂ fwl: 58-69 mm, n = 5, ♀♀ fwl: 59-69 mm, n = 6) are significantly shorter than in other subspecies of *P. imperialis*, including *P. i. meyricki* (♂♂ fwl: 74-78 mm, n = 5; ♀♀ fwl: 75-85 mm, n = 5). The pink hind wing band (measured apex - inner margin) of *P. i. smithersi* (Figs 2, 8) is less than half the width of the hind wing (0.34-0.47:1 hwl) and smaller than in *P. i. meyricki* (0.55-0.62:1 hwl). The termen of the forewings of *P. i. smithersi* (Figs 2, 5, 8, 11) are narrower and the inner margins not as strongly convex as in *P. i. meyricki* (Figs 1, 4, 7, 10). The male genitalia are smaller than in *P. i. meyricki* and *P. i. dealbata* (Holloway) and the apical cornuti (Fig. 15) are less dense and proportionally smaller than in *P. i. meyricki*. Although both subspecies are variable, differences in the colour, shape and forewing length enable *P. i. smithersi* from subtropical eastern Australia to be easily distinguished from *P. i. meyricki* from northern Queensland and mainland Papua New Guinea.

Distribution. Queensland: *P. i. smithersi* occurs at Kin Kin Creek, southeast from Gympie to the NSW-Qld Border Ranges; it has been observed at Conondale (E. Weir pers. comm.), Conondale Range and Witta (R. Thomas pers comm.), Maleny, Blackall Range (R. Broe, N. Clancy, A. Orr), Bellthorpe, Mount Mee (J. Moss and R. Kendall 2007), Lamington (AM) and Springbrook (R. Bell pers. comm.). New South Wales: *P. i. smithersi* larvae or adults have been photographed or collected at Mount Warning and on the Border Ranges, Richmond Range, Richmond River (unpublished), Billinudgel (K. Vale), Dorrigo (ANIC), Rosewood River (Britton 2006), Bellingen, Huonville (N. Hart) and Bellinger Island (V. Jones, T. Deane pers. comm.).

Larval food plant: *Carronia multiseppalea* F. Muell. (Menispermaceae) (Sands 1999, Britton 2006). *C. multiseppalea* is an endemic subtropical vine, mostly restricted to 'old growth' subtropical rainforests on the coast and ranges (< ca 1,000 m), from Kin Kin Creek, Qld to the Bellinger River, NSW. The vine frequently occurs in association with another vine, *Pararistolochia praevenosa* (Aristolochiaceae), the principal food plant for the Richmond birdwing butterfly, *Ornithoptera richmondia* (Gray).

Life history. Since discovery of the life history of *P. i. smithersi* and its food plant (Sands 1999), images of the early stages (Figs 16-21) on its food plant

C. multiseppalea, including the remarkable larva, have been published on several occasions (e.g. Moss 2002, Moss and Kendall 2007, Britton 2006, Zborowski and Edwards 2007). Adults have been observed feeding on the damaged fruit of *Ficus* spp. and a *Syzygium* sp.



Figs 16-21. *Phyllodes imperialis smithersi*, immature stages: (16) egg deposited beneath leaf of *Carronia multiseppalea*; (17) first instar larva beneath leaf of *Carronia multiseppalea*; (18) third instar larva; (19) fifth instar larva, resting position; (20) fifth instar larva, alarmed position; (21) pupal case.

Comments

Phyllodes i. imperialis from the Solomon Islands and Bougainville are here considered con-subspecific. Similarly, *P. imperialis* from Lae and Kiunga,

Papua New Guinea and from localities from north of Townsville to the tip of Cape York Peninsula, northern Queensland, are indistinguishable, confirming the synonymy of *P. i. papuana* and *P. i. meyricki* as proposed by Seitz (1923). The subtropical subspecies *P. imperialis smithersi* is confined to notophyll vine forest where the food plant, *C. multisepealea*, is an uncommon endemic vine in eastern Australia, growing on rich volcanic slopes and riparian or alluvial soils. The leaf-like forewings of most *Phyllodes* spp. (Seitz 1923) are similar, with the reniform marking resembling leaf miner scars (M. Horak pers. comm.).

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