

A REVIEW OF THE *PHTHITIA* OF THE JUAN FERNANDEZ ISLANDS, WITH DESCRIPTIONS OF 4 NEW FLIGHTLESS SPECIES FROM ROBINSON CRUSOE ISLAND. (DIPTERA: SPHAEROCERIDAE)

UNA REVISIÓN DEL GÉNERO *PHTHITIA* DE LAS ISLAS JUAN FERNÁNDEZ, CON DESCRIPCIÓN DE CUATRO NUEVAS ESPECIES DE LA ISLA ROBINSON CRUSOE. (DIPTERA: SPHAEROCERIDAE)

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RESUMEN

Se revisan las especies de *Phthitia* Enderlein endémicas de las Islas Juan Fernández, incluyendo la descripción de cuatro nuevas especies: *P. gonzalezi*, *P. charpentieri*, *P. miradorensis*, y *P. cortesi*. Se ofrece además una clave para las nueve especies de Sphaeroceridae braquipteros conocidos de las Islas Juan Fernández. Las relaciones filogenéticas entre las especies del grupo *Phthitia venosa* son discutidas.

ABSTRACT

The seven strap-winged species of *Phthitia* Enderlein endemic to the Juan Fernandez Islands are reviewed, with the description of four new species: *P. gonzalezi*, *P. charpentieri*, *P. miradorensis*, and *P. cortesi*. A key is provided to all species of brachypterous Sphaeroceridae known from the Juan Fernandez Islands. The phylogenetic relationships between the species of the *Phthitia venosa* group are discussed.

KEY WORDS: Sphaeroceridae, *Phthitia*, Juan Fernández islands.

INTRODUCTION

The Juan Fernandez Archipelago comprises three small islands, situated about 600 km west of Valparaiso, Chile, which support a remarkable flora and fauna. Endemism is high, estimated at 67% for the vascular plant species (Stuessy and Crawford, 1990) and 81% for the Coleoptera (Kuschel, 1963), and the endemic taxa include a number of monophyletic species swarms. The family Sphaeroceridae is represented by 18 species on the islands, 10 of which are endemic and 9 of which have narrow, reduced, strap-like wings.

Of the strap-winged species, 7 belong in a species group defined by Marshall and Smith (1992) as the *Phthitia venosa* group. This group, which also includes one poorly known species from Saint Helena, is reviewed here with the description of 4 new species from Robinson Crusoe Island. Robinson Crusoe Island, with an area of 78 km², is the largest and best known of the three Juan Fernandez Islands. All 18 sphaerocerid species occur there, whereas only 3 species (none endemic) are known from the small (3km²), dry Santa Clara Island. The third island, Alexander Selkirk Island with an area of 59 km², is relatively poorly known entomologically. No sphaerocerids endemic to the Juan Fernandez Islands have been recorded from Alexander Selkirk Island, but that probably reflects lack of sampling effort.

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MATERIALS AND METHODS

Collecting was carried out on Robinson Crusoe Island during January, February and December, 1992 and January, 1993 (See Appendix 1). Although a variety of techniques were applied, most *Phthitia* specimens were taken either by using an aspirator or by using unbaited yellow pan traps. Specimens were initially stored in alcohol, then dried in a critical point drier. Genitalic characters were examined using abdomens cleared in potassium hydroxide and rinsed with distilled water. Morphological characters synapomorphic for 2 or more included species (Table 1) were used for a manual cladistic analysis (Fig. 1) which was then checked using Hennig86, a PC-DOS program developed by J.S. Farris. Character optimisation was checked using CLADOS (Nixon, 1992). Morphological terminology follows Marshall and Smith (1992).

PHYLOGENETIC RELATIONSHIPS

The *Phthitia venosa* group forms a strongly supported monophyletic group of uncertain relationship to other species groups in the genus *Phthitia*. Marshall and Smith (1992) pointed out that both other south temperate *Phthitia* clades, the *chilenica* group and the austral *longisetosa*-group species, are more closely related to north temperate groups than to the *venosa* group.

The *Phthitia venosa* group is divided into two distinct clades (Fig. 1), each of which is supported by some distinctive characters. The *selkirki* clade is characterised by a greatly elongated basiphallus and long, narrow wings with R₄₊₅ extending along the hind wing margin near the apex. The *venosa* clade includes smaller species, with different wing venation and a mid tibia which lacks the distal posterior bristle characteristic of most other *Phthitia* species.



Figure 1. Phylogeny of the *Phthitia venosa* species group. Characters marked with a grey bar and an asterisk are homoplasies.

The characters defining the *venosa* clade are relatively weak, because they are of equivocal polarity, uncertain homology, or are subject to frequent homoplasy. We thus have less confidence in the monophyly of this clade than in the monophyly of the *selkirki* clade.

The inclusion of the Atlantic species *sanctae-helenae* in the *venosa* clade is especially problematic, since it renders the *Phthitia* of the Juan Fernández Islands a paraphyletic group. The characters supporting the placement of *sanctae-helenae* are weak, and the available material of *sanctae-helenae* was very poor, so this placement is tentative. It seems more likely that *sanctae-helenae* is the sister taxon to the rest of the *venosa* group, but more specimens of *sanctae-helenae* are required to test these hypotheses. Valdebenito *et al.* (1990) identify a similar apparent relationship between one species of *Peperomia* (Piperaceae) on the Atlantic island of Tristan de Cunha and one of a group of *Peperomia* species on the Juan Fernández Islands. They suggest that long distance dispersal assisted by migrant birds is the most likely explanation for this plant distribution, but that seems implausible for *Phthitia*.

ZOOGEOGRAPHY OF THE JUAN FERNÁNDEZ *PHTHITIA*

The Juan Fernández Islands are volcanic in origin, and Robinson Crusoe Island is approximately 4 million years old. Alexander Selkirk Island is younger, at 1-2.4 million years (Stuessy *et al.* 1984). Robinson Crusoe Island and the nearby Santa Clara Island were once part of a much larger landmass, and Stuessy *et al.* (1984) have pointed out that the distributions of plant species on the island today do not necessarily reflect modes of speciation or places of origin. It is to be expected that the fauna and the flora have been compacted with the shrinkage of the island, and current distributions will be confounded with complex patterns of secondary sympatry. Although the island has been strictly protected as a National Park since 1935 and has been a Biosphere Reserve since 1977, accessible areas had been heavily cut over by the 1700's and altered by introduced animals since the 1600's. The current areas of native forest can be seen as shrunken islands of habitat upon a shrunken island, with

species distributions at least partly representing extreme compaction into remaining refuges.

Phthitia species, along with other strap-winged sphaerocerids and ephydriids, appear to be restricted to rich, moist litter in the relatively pristine native forests in the 300m - 600m elevation range (see map). There is little native forest below 300m, and habitat between 600m and the maximum elevation of 916m has not been sampled for Sphaeroceridae. Within the areas of native forest sampled, *Phthitia* species are mostly restricted to higher elevations where the forest is more open and supports a luxurious growth of ferns. Five species, *alexandri*, *cortesi*, *charpentieri*, *gonzalezi*, and *venosa* were found to be sympatric in one intensively sampled area northeast of the highest point on the island (El Yunque). Two of these species were found in similar habitat near Mirador de Selkirk, a 550m gap through the mountainous backbone of the island north of El Yunque. Another species, *P. miradorensis*, is known only from the immediate area of Mirador de Selkirk. Only one species, *P. selkirki*, is characteristic of the dark, closed forests of the lower slopes, where it appears to be common.

Superimposing the above known distributions on a cladogram (Fig. 1) suggests some possible explanations for the existence of this species swarm in such a small area. *Phthitia miradorensis* and *P. venosa* appear to be allopatric, reflecting a disjunction between appropriate patches of forest on the northeast side of El Yunque and the northeast side of Mirador de Selkirk. The closely related *P. gonzalezi* was found both on the southeast side of Mirador de Selkirk and the northeast slopes of El Yunque, and was found in virtually the same localities in both 1992 and 1993.

Phthitia alexandri, one of the most common species in the *selkirki* clade, was collected at almost every upper elevation site sampled during this study, including the same localities on the northeast slope of El Yunque where the closely related *P. charpentieri* was collected. *Phthitia selkirki* and its sister species *P. cortesi* are both known only from the northeast slopes of El Yunque, but *P. selkirki* is abundant in the lower elevation forests and *P. cortesi* is known only from a single specimen taken among tree ferns at higher elevations.

It is likely this species swarm is the result of

allopatric or microallopatric speciation resulting from the ease with which populations of such flightless, habitat-restricted species can be fragmented on such a topographically diverse island. Collections from some poorly known parts of Robinson Crusoe Island, especially the difficult to reach 600-900m sites, and collections from Alexander Selkirk Island are still necessary for a more balanced picture of the zoogeographic history of the *venosa* group. It would also be informative to identify the macropterous sister group to the *venosa* group. More complete collections from Saint Helena and Tristan da Cunha are needed to compare to those from the Juan Fernandez Islands in order to corroborate the apparent biogeographic connection between these Pacific and Atlantic islands. Such a biogeographic connection might indicate that some of the clades on these remote islands form fragmented relicts of formerly more widespread taxa.

DESCRIPTION OF THE *PHTHITIA VENOSA* GROUP

Body length *ca.* 1.5 - 3.0mm. General color yellow to dark brown, heavily pruinose; anepimeron black except along edges, usually contrasting with otherwise pale pleuron. Middle interfrontal bristles cruciate, others usually reduced or absent. Eye large, *ca.* 5X genal height, 1 large genal bristle. Aristal hairs short, maximum length equal to aristal width at base. Thorax with 3-4 dorsocentral bristles, 1 presutural and 2 postsutural, usually with a slightly enlarged pair of setulae anterior to presutural bristles. Katepisternum with a large posterodorsal bristle and 1 or more minute anterodorsal setulae. Mid tibia with 1 or 2 pairs of anterodorsal and posterodorsal bristles proximally and single such pair distally; most species with distal posterior bristle on mid tibia (absent in *venosa* clade). Mid tibia of male with long apicoventral and row of weakly developed ventral bristles distally; one or more rows of stout ventral bristles present on basal part of male mid femur. Hind femur dilated, flattened. Wing greatly reduced, narrow, 5-20 times as long as width. Halter absent.

Male abdomen: Each tergite with row of long posterior bristles. Sternite 5 simple, usually with long posterior setae and a membranous posteromedial area. Epandrium narrow dorsally, broad ventrally, with small, equal, sparse bristles; hypandrial arms fused with epandrium. Surstylus broadly fused with epandrium; anterior part of surstylus simple, sessile to lobate; posterior part of surstylus relatively narrow, with inner and outer lobes, inner lobe usually with 2 unequal bristles. Cerci setulose, sometimes with characteristic ventral processes, subanal plate broad. Sternite 10 simple, usually visible as an elongate carina or darkening at middle of subanal plate. Small, separate sclerites (free sclerites) present at posterior apex of aedeagal apodeme, each interposed between base of paramere and basiphallus. Basiphallus short, somewhat frame-like, usually extending posteriorly well beyond junction with distiphallus. Distiphallus simple, mostly membranous, broad distally, sclerotised parts including broad basal part connected to short ventrolateral parts and a long, undivided dorsal part (Fig. 24).

Female abdomen: Epiproct short, weakly sclerotised, fused with cerci at least laterally. Cerci short, with weak bristles. Sternite 8 reduced, usually represented only by bases of 4 small bristles. Hypoproct short, wide. Spermathecae oval to spherical, ducts unsclerotised except for short, broad base.

Comments: The above description applies to the Juan Fernandez Island species considered here, but differs in some details from the Atlantic species *P. sanctaehelenae* (Richards), also included in this species group. In the inadequate material of *P. sanctaehelenae* we have been able to examine, the cerci do not appear to be fused and the hypandrium appears to be free from the epandrium. Wing characters could not be considered since this species is apterous. All other characters seem to agree with the above description of the *venosa* group, and we still consider the isolated Atlantic species *P. sanctaehelenae* as the closest known relative to the Pacific clade considered here. More specimens from Saint Helena are required to test this hypothesis.

Key to the *Phthitia* and other brachypterous Sphaeroceridae of the Juan Fernández Islands

- 1 Scutellum with 8 marginal bristles. Mid tibia with preapical ventral bristle but without apical ventral bristle. *Leptocera* 2
- Scutellum with 4 marginal bristles. Mid tibia with apical ventral bristle *Phthitia* 3
- 2 Wing club-shaped, with complete venation. Sternite 5 with 4 long posteromedial spines. *Leptocera ellipsipennis* Richards
- Wing narrow, strap-shaped (like *Phthitia*). Sternite 5 without long posteromedial bristles or spines *Leptocera cultellipennis* (Enderlein)
- 3 Mid tibia with a posterior bristle in distal half. Wing vestige with R₄₊₅ running to hind margin of wing near wing apex but extending to costa along hind margin (Fig. 19). More than 8 rows of acrostichal bristles. Basiphallus large, dorsoventrally flattened, projecting scoop-like behind base of basiphallus (Fig. 23). *selkirki* clade 4
- Mid tibia with uniformly small setulae posteriorly. Wing vestige with R₄₊₅ either running to costa in anterior wing margin (Fig. 29), not reaching wing margin (Fig. 38), or very faint and ending in middle of hind margin (Fig. 47). Less than 8 rows of acrostichal bristles. Basiphallus frame-like, not forming a prominent scoop-like process behind distiphallus (Fig. 51). *venosa* clade 7
- 4 Mid femur of male with anteroventral and posteroventral rows of stout bristles at base. Male sternite 5 very short, long posterior bristles twice as long as sternite (Fig. 20). Hypoproct large, entirely shining and uniformly pale *selkirki* (Enderlein)
- Mid femur of male with only a posteroventral row of basal bristles. Male sternite 5 at least a third as long as sternite 4, posterior bristles less than twice as long as sternite. Hypoproct short, wide, posterior part setulose or darkened 5
- 5 Wing relatively broad, less than 8 times as long as wide (Fig. 10). Male sternite 5 simple, without long posterior bristles or prominent posteromedial bulge (Fig. 11). Spermathecal surface strongly tuberculate (Fig. 18). *charpentieri* new species
- Wing long and narrow, at least 10 times as long as wide. Male sternite 5 with long posteromedial bristles or a prominent posteromedial bulge. Spermathecae of known females with non-tuberculate surface 6
- 6 Notum primarily dark brown. Acrostichal setulae forming 13 or more rows between anterior dorsocentral bristles. Male sternite 5 with a prominent, setose bulge posteromedially (Fig. 3). *alexandri* Richards
- Notum with a prominent striped pattern, a middle dark brown stripe flanked by yellowish strips. Acrostichal setulae in 10-12 rows between anterior dorsocentral bristles. Male sternite 5 with a broad, densely long-setose posteromedial area (Fig. 6) *cortesi* new species
- 7 Wing narrow, more than 10 times as long as wide, with R₄₊₅ ending in costa along anterior margin of wing (Fig. 29). Cerci of male with long, narrow posteroventral lobes (Fig. 31) *gonzalezi* new species
- Wing relatively short, less than 7 times as long as wide, with R₄₊₅ not extending to costa. Cerci of male with broad ventral parts. 8
- 8 Notum dark brown. Mid tibia of female with only minute anteroventral setulae. R₄₊₅ indistinct, but reaching hind margin of wing (Fig. 47). Male sternite 5 simple, posterior margin unmodified except for small inner process on right side Fig. 52). Anterior lobe of surstylus broad, blunt (Fig. 50). *miradorensis* new species
- Notum with broad longitudinal stripes, dark brown middle part flanked by yellow-brown strips. Mid tibia of female with anteroventral bristle below middle. R₄₊₅ ending in middle of wing (Fig. 38). Male sternite 5 long, with a prominent convex posteromedial part (Fig. 39). Anterior lobe of surstylus tapered, acute (Fig. 41). *venosa* Enderlein

Species descriptions follow in phylogenetic order (Fig. 1).

Phthitia alexandri Richards

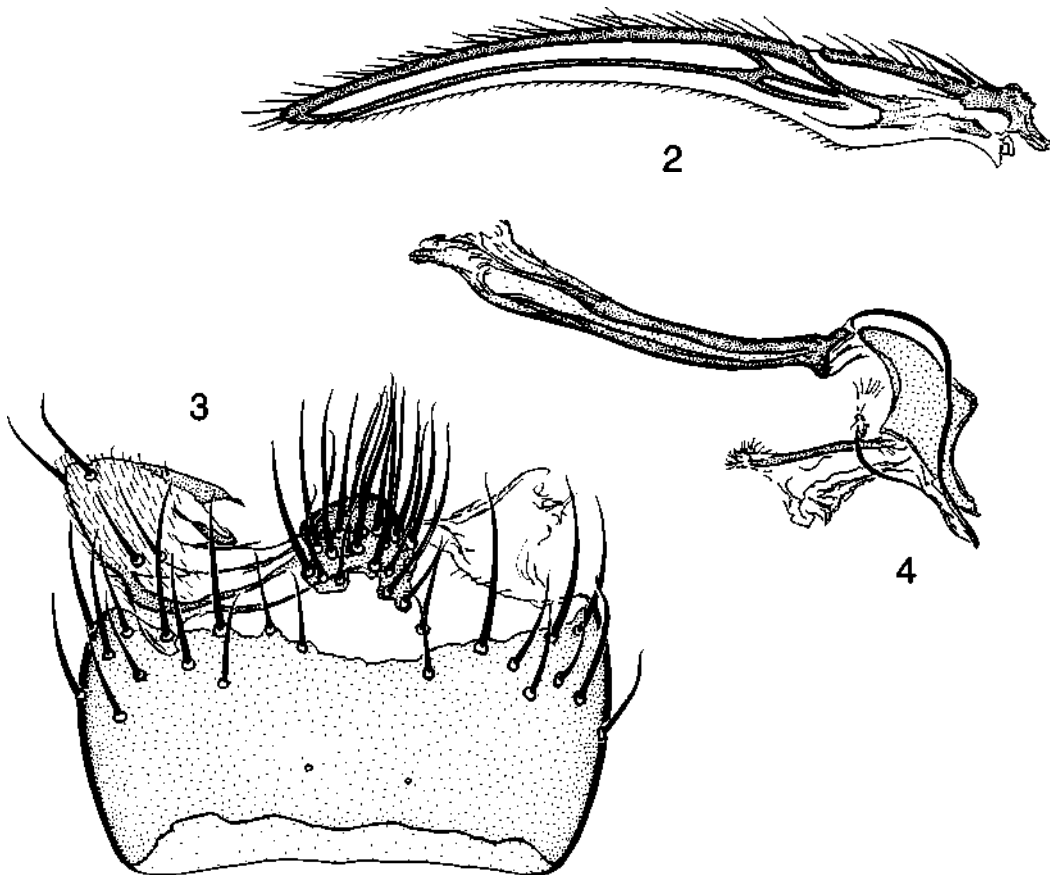
Figs. 2-4

Phthitia alexandri Richards, 1955: 85; Marshall and Smith, 1992: 14 (description and figures of male and female genitalia).

Diagnosis: Body length *ca.* 2.0mm. General color light brown, heavily pruinose, notum with faint striping anteriorly, otherwise uniformly dark brown. Acrostichal bristles short, in *ca.* 12 rows between dorsocentral bristles, prescutellar pair enlarged. Mid tibia of male with long apicoventral and row of weakly developed ventral bristles distally; a single row of *ca.* 12 stout posteroventral bristles present on basal part of femur. Mid tibia of female with a long anteroventral bristle below

middle. Mid tibia with 2 long anterodorsal and 2 long posterodorsal bristles proximally, a long anterodorsal, and a long posterodorsal bristle distally. Wing (Fig. 2) pale basally and dark distally; R₄₊₅ running to hind margin of wing near apex; length *ca.* 10 times width, extending to hind margin of abdominal tergite 3.

Male terminalia: Sternite 5 (Fig. 3) half as long as sternite 4, broadly convex posteriorly, posteromedially with prominent, long-setose, darkly pigmented patch surrounded by unpigmented, marginally setulose area. Upper part of cercus with long bristle; lower part of cercus with outer, narrow lobe and setose, pale mediobasal part. Basiphallus (Fig. 4) large, with a long, tapered



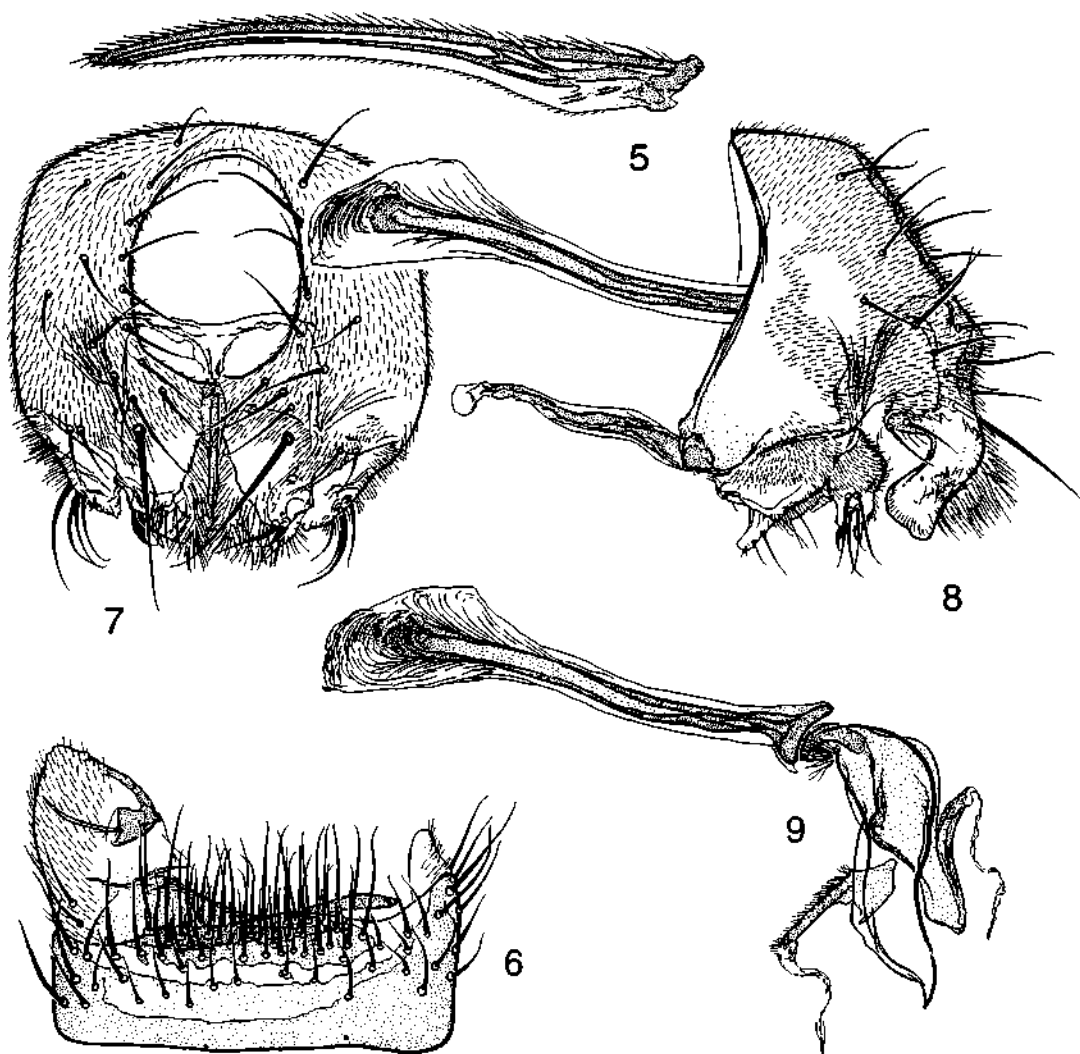
Figures 2-4. *Phthitia alexandri* Richards: 2, left wing, dorsal; 3, male sternite 5 and sternite 6; 4, aedeagus and associated structures.

posterior extension. Paramere (Fig. 4) broad basally, abruptly tapered to a narrow apical third.

Female terminalia: Epiproct entirely setulose, pale medially. Cerci with only weak, dorsal bristles. Hypoproct bare, dark and shining posteriorly. Spermathecae spherical, smooth.

Material examined: CHILE: Juan Fernández Is-

lands. Robinson Crusoe Island. Base of El Yunque, ca. 500m, in moss, 23-30.I.1992, S.A. Marshall (2♂,3♀,GUE,MNHNS); Upper part of Plazoleta-El Yunque trail, pan traps among tree ferns, steep slope, ca. 575m., 23-28.I.1992, S.A. Marshall (3♂,4♀,GUE); same as previous, aspirated (1♂,1♀); South side of Mirador de Selkirk, ca. 450m, litter, Berlese funnel, 4.I.1993, S.A. Marshall (1♂, GUE); south side of Mirador de



Figures 5-9. *Phthitia cortesi* Marshall & Smith, sp. nov.: 5, left wing, dorsal; 6, male sternite 5 and sternite 6; 7, male terminalia, posterior; 8, male terminalia, left lateral; 9, aedeagus and associated structures.

Selkirk, pan traps in rich litter, 3-10.I.1993, S.A. Marshall (1♀, GUE); Damajuana, 400m, 6.I.1993, S.A. Marshall (1♂, GUE); "Masatierra" (♀ and ♂ paratypes, BMNH, abdomen of ♂ removed and cleared); Alto Ingles, 600m, 28/2/55 (1 ♂, BMNH); Alto Pangal, 650m., 6/3/55" (1 ♀, BMNH).

Comments: Marshall and Smith (1992) were not able to describe the aedeagus and associated structures due to limited material. These structures are illustrated and described here.

Phthitia cortesi Marshall and Smith,
new species
(Figs. 5-9)

Description: Body length ca. 3.0mm. General color light brown, heavily pruinose; head dark brown dorsally, yellow-brown ventrally; notum with a broad median longitudinal dark brown stripe, a dark patch medial to notopleuron, and slightly darkened along dorsocentral row. Interfrontal bristles in 2 large pairs, upper pair cruciate and slightly larger than lower pair, small setulae above and below interfrontals. Eye large, height 5.0 times genal height; gena yellowish, without shining areas; 1 large genal bristle. Acrostichal bristles short, in ca. 11 rows between dorsocentral bristles, prescutellar pair enlarged. Katepisternum with a large posterodorsal bristle and minute anterodorsal setula. Mid tibia with 2 pairs of anterodorsal and posterodorsal bristles proximally and single such pair distally, a small anterodorsal bristle proximal to distal anterodorsal bristle, and a small posterior bristle slightly distal to distal posterodorsal bristle; distal paired bristles equal in size to each other and to second proximal paired bristles. Mid tibia of male with long apicoventral and row of weakly developed ventral bristles distally; single row of ca. 9 stout posteroventral bristles present on basal part of mid femur; single row of ca. 16 small anterodorsal bristles on mid femur. Hind femur dilated, flattened. Wing (Fig. 5) ca. 20 times as long as width at middle, extending to hind margin of abdominal tergite 3; pale basally, dark distally; R₄₊₅ running to posterior wing margin near apex of wing.

Abdominal syntergite 1+2 dark brown to black, tergite 1 slightly paler than tergite 2; preabdomi-

nal tergites black along posterior and anterior margin, dark brown at middle.

Male terminalia: Sternite 5 (Fig. 6) half as long as sternite 4, posterior half mostly desclerotised, densely long-setose posteromedially. Sternite 6 simple. Epandrium dark brown dorsally, becoming paler ventrally, cerci and surstyli pale brown (Fig. 7). Posterior part of surstylus (Fig. 8) with two lobes; outer lobe broad, blade-like, with one short broad spur and several other bristles; inner part narrow with 2 large, unequal, apical bristles. Lower part of cercus broad, flattened; medial part densely setulose. Basiphallus (Fig. 9) large, tapered posteriorly and projecting posteriorly beyond junction with distiphallus. Paramere (Fig. 9) relatively narrow, abruptly tapered near apex.

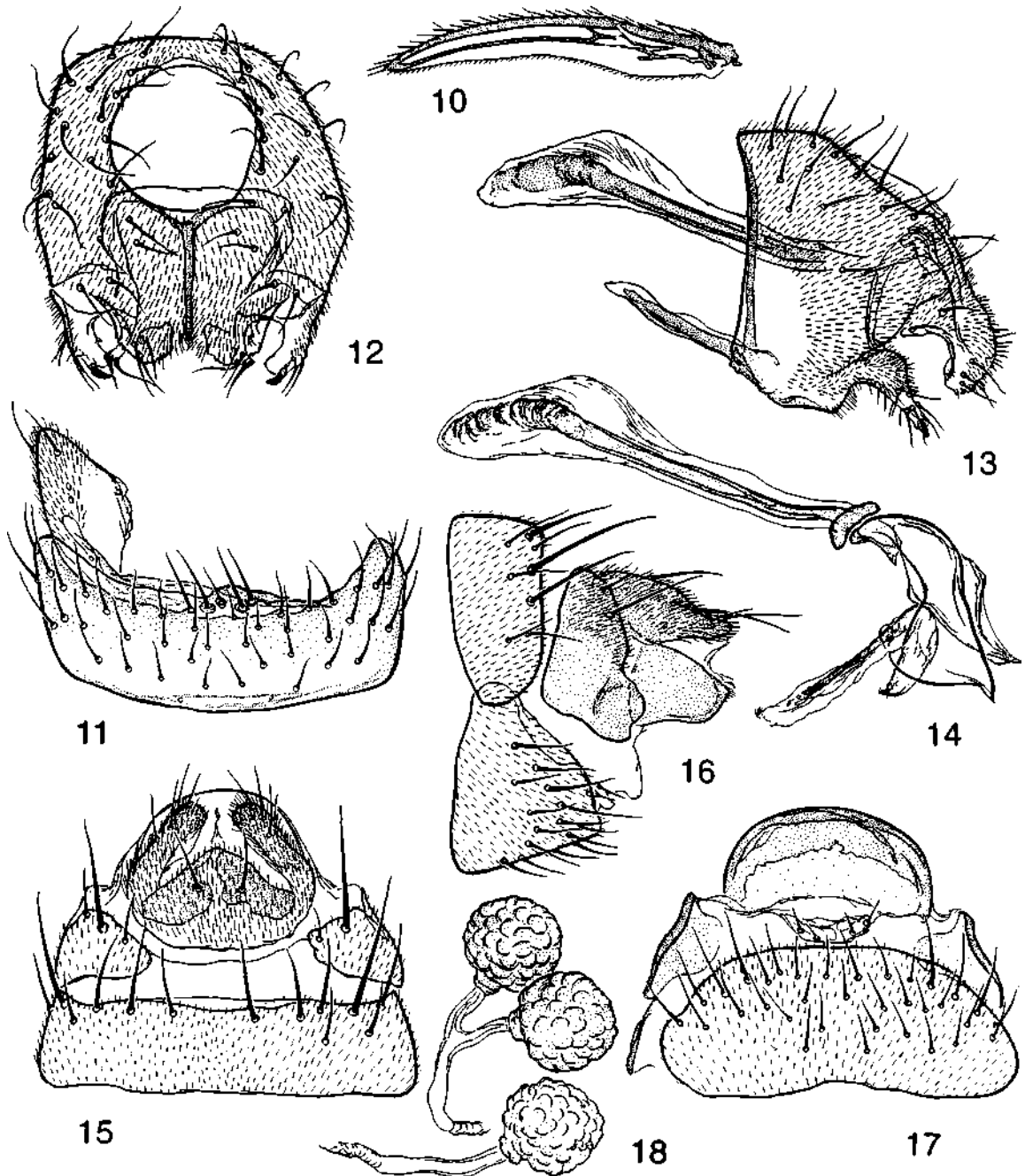
Female unknown.

Holotype ♂ (MNHNS): CHILE. Juan Fernandez Islands, Robinson Crusoe Island, aspirated from among tree ferns along upper part of trail between Plazoleta and El Yunque, 26.I.1992, S.A. Marshall.

Etymology: This species is named after Dr. Raul Cortés, a great dipterist and friend.

Phthitia charpentieri Marshall and Smith,
new species
(Figs. 10-18)

Description: Body length ca. 3.0mm. General color light brown, heavily pruinose; head dark brown dorsally, yellow-brown ventrally; notum with a faint median longitudinal dark brown stripe and a dark patch medial to notopleuron. Interfrontal bristles in 2-3 pairs: upper pair small, middle pair long and cruciate, lower pair small to minute; 1-2 small setulae usually present below lower interfrontals. Eye large, height 5.0 times genal height; gena yellowish, without shining areas; 1 large genal bristle. Acrostichal bristles short, in ca. 10 rows between dorsocentral bristles, prescutellar pair enlarged. Katepisternum with a large posterodorsal bristle and minute anterodorsal setula. Mid tibia with 2 pairs of anterodorsal and posterodorsal bristles proximally and single such pair distally, a small anterodorsal bristle proximal



Figures 10-18. *Phthitia charpentieri* Marshall & Smith, sp. nov.: 10, left wing, dorsal; 11, male sternite 5 and sternite 6; 12, male terminalia, posterior; 13, male terminalia, left lateral; 14, aedeagus and associated structures; 15, female terminalia, dorsal; 16, female terminalia, left lateral; 17, female terminalia, ventral; 18, spermathecae.

to distal anterodorsal bristle, and a small posterior bristle slightly distal to distal posterodorsal bristle; distal paired bristles equal in size to each other and to second proximal paired bristles. Mid tibia of female with a large anteroventral bristle below middle. Mid tibia of male with long apicoventral and row of weakly developed ventral bristles distally; one row of *ca.* 9 stout posteroventral bristles present on basal part of mid femur; single row of *ca.* 16 small anterodorsal bristles on mid femur. Hind femur dilated, flattened. Wing (Fig. 10) *ca.* 7 times as long as width at middle, extending to anterior margin of abdominal tergite 3; pale basally, dark distally; R₄₊₅ running to posterior wing margin near apex of wing.

Abdominal syntergite 1+2 dark brown to black, tergite 1 slightly paler than tergite 2; preabdominal tergites black along posterior and anterior margin, dark brown at middle.

Male terminalia: Sternite 5 (Fig. 11) half as long as sternite 4; broadly concave posteriorly, posteromedially with a small, distally shining, convex part with 4-6 enlarged bristles. Sternite 6 simple. Epandrium (Fig. 12) dark brown dorsally, becoming paler ventrally, cerci and surstyli yellow. Posterior part of surstylus (Fig. 13) with two lobes; outer lobe broad, blade-like, with one short broad spur and several other bristles; inner part narrow with 2 large, unequal, apical bristles. Basiphallus (Fig. 14) large, tapered posteriorly and projecting posteriorly beyond junction with distiphallus. Paramere (Fig. 14) very broad preapically.

Female terminalia: Tergite 7 slightly narrower and less than half as long as tergite 6, darkly pigmented, concave anteromedially. Tergite 8 divided into 2 dark lateral sclerites. Epiproct short, wide, entirely setulose, very pale anteriorly; fused laterally with cerci. Cerci short, almost sessile, with small preapical dorsal bristles only (Fig. 15). Sternite 8 reduced to 4 small tubercle-based setae. Hypoproct bare, dark and shining posteriorly, pale and concave anteriorly (Figs. 16,17). Spermathecae subspherical, surface strongly tuberculate, ducts unsclerotized, inserted on a short, broad base (Fig. 18).

Holotype, ♂ and one paratype ♀ (MNHNS,

GUE). CHILE. Juan Fernández Islands. Robinson Crusoe Island. Pan trap in moss between Plazoleta and El Yunque, *ca.* 500m, 23-30.I.1992, S.A. Marshall.

Paratypes: Juan Fernandez Islands. Robinson Crusoe Island, pan traps among ferns in steep, upper part of Plazoleta-El Yunque trail, *ca.* 575m, 23-28.I.1992, and 2.I.1993, S.A. Marshall (1♂, 1♀, 1992; 2, 1993, GUE); same as previous locality, aspirated (1♀, GUE).

Comments: This species is named after Esteban Charpentier, in recognition of his assistance in getting to good habitat on Robinson Crusoe Island.

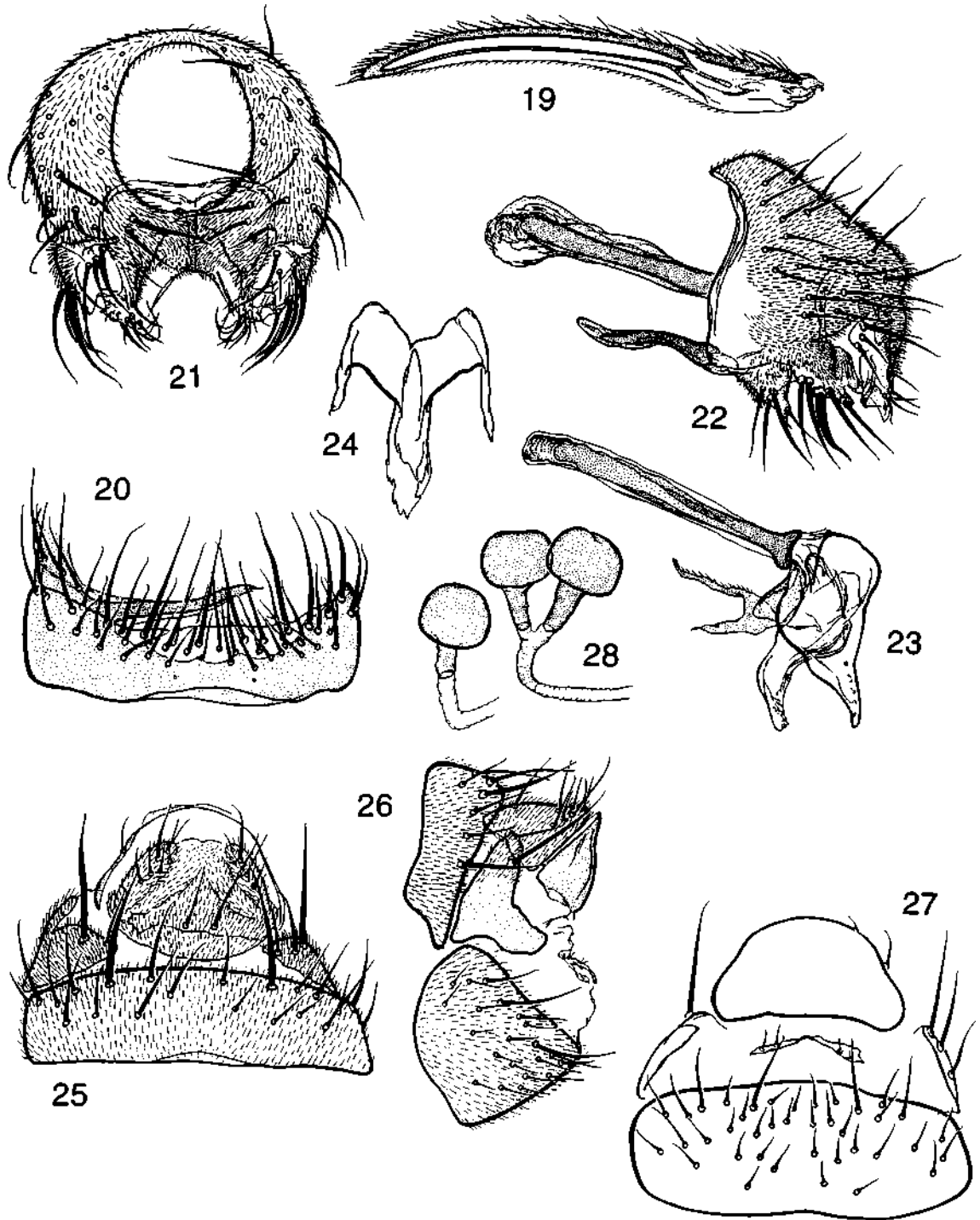
Phthitia selkirki (Enderlein)

Figs. 19-28

Pterodrepana selkirki Enderlein, 1938: 652.

Phthitia selkirki Richards, 1955: 83 (in part); Marshall and Smith, 1992: 71 (in part).

Description: Body length *ca.* 3.0mm. General color light brown, heavily pruinose; head dark brown dorsally, yellow-brown ventrally; notum with a broad median longitudinal dark brown stripe, a dark patch medial to notopleuron, and slightly darkened along dorsocentral row. Interfrontal bristles in 2-3 pairs: upper pair small, middle pair long and cruciate, lower pair small to minute; 1-2 small setulae usually present below lower interfrontals. Eye large, height 5.0 times genal height; gena yellowish, without shining areas; 1 large genal bristle. Acrostichal bristles short, in *ca.* 11 rows between dorsocentral bristles, prescutellar pair enlarged. Katepisternum with a large posterodorsal bristle and minute anterodorsal setula. Mid tibia with 2 pairs of anterodorsal and posterodorsal bristles proximally and single such pair distally, a small anterodorsal bristle proximal to distal anterodorsal bristle, and a small posterior bristle slightly distal to distal posterodorsal bristle; distal paired bristles equal in size to each other and to second proximal paired bristles. Mid tibia of female with a large anteroventral bristle below middle. Mid tibia of male with long apicoventral and row of weakly developed ventral bristles distally; two rows of *ca.*



Figures 19-28. *Phthitia selkirki* Enderlein: 19, left wing, dorsal; 20, male sternite 5 and sternite 6; 21, male terminalia, posterior; 22, male terminalia, left lateral; 23, acedeagus and associated structures; 24, distiphallus, dorsal; 25, female terminalia, dorsal; 26, female terminalia, left lateral; 27, female terminalia, ventral; 28, spermathecae.

11 stout posteroventral bristles present on basal part of mid femur. Mid tibia of female with anteroventral bristle near middle.

Wing (Fig. 19) *ca.* 10 times as long as width at middle, extending to anterior margin of abdominal tergite 3; pale basally, dark distally; R₄₊₅ running to posterior wing margin near apex of wing. Abdominal syntergite 1+2 dark brown to black, tergite 1 slightly paler than tergite 2; preabdominal tergites black along posterior and anterior margin, dark brown at middle.

Male terminalia: Sternite 5 (Fig. 20) very narrow medially, 0.2 times as long as sternite 4; broadly concave posteriorly, posteromedially with a pale area with a transverse row of enlarged bristles. Sternite 6 simple. Epandrium pale brown dorsally, becoming paler ventrally, cerci and surstyli pale brown (Fig. 21). Anterior part of surstylus (Fig. 22) with a sessile outer part and a narrow, apically setose, inner lobe. Posterior part of surstylus with two lobes; outer lobe broad, blade-like, with one large, curved, flattened, bristle and several other bristles, inner ventral corner of outer posterior surstylar lobe with a dark, quadrate process; inner lobe of posterior part of surstylus narrow with 2 small, unequal, apical bristles. Lower part of cercus narrow, tapered to a long inner ventral lobe. Paramere (Fig. 23) broad basally, strongly tapered apically. Basiphallus (Fig. 23) large, tapered posteriorly and projecting posteriorly beyond junction with distiphallus, posterior part prominent and curved.

Female terminalia: Tergite 7 slightly narrower and less than half as long as tergite 6, darkly pigmented, anterior margin straight. Tergite 8 divided into 2 dark lateral sclerites, ventral two thirds bare, with large posteroventral extension. Epiproct short, wide, entirely setulose, dark brown posteriorly, paler anteriorly; broadly fused with cerci. Cerci short, almost sessile, with several small and one large preapical dorsal bristles (Fig. 25). Sternite 8 (Fig. 27) reduced to 2 pale sclerites, each with 2 small setae. Hypoproct bare, pale and concave anteriorly (Figs. 26,27). Spermathecae dark, subspherical with a narrow base subequal to diameter of round part, entire surface bare and smooth; ducts unsclerotised beyond spermathecal bases (Fig. 28).

Holotype: "Masatierra", K. Skottsberg (♂, NRS, wing and leg only).

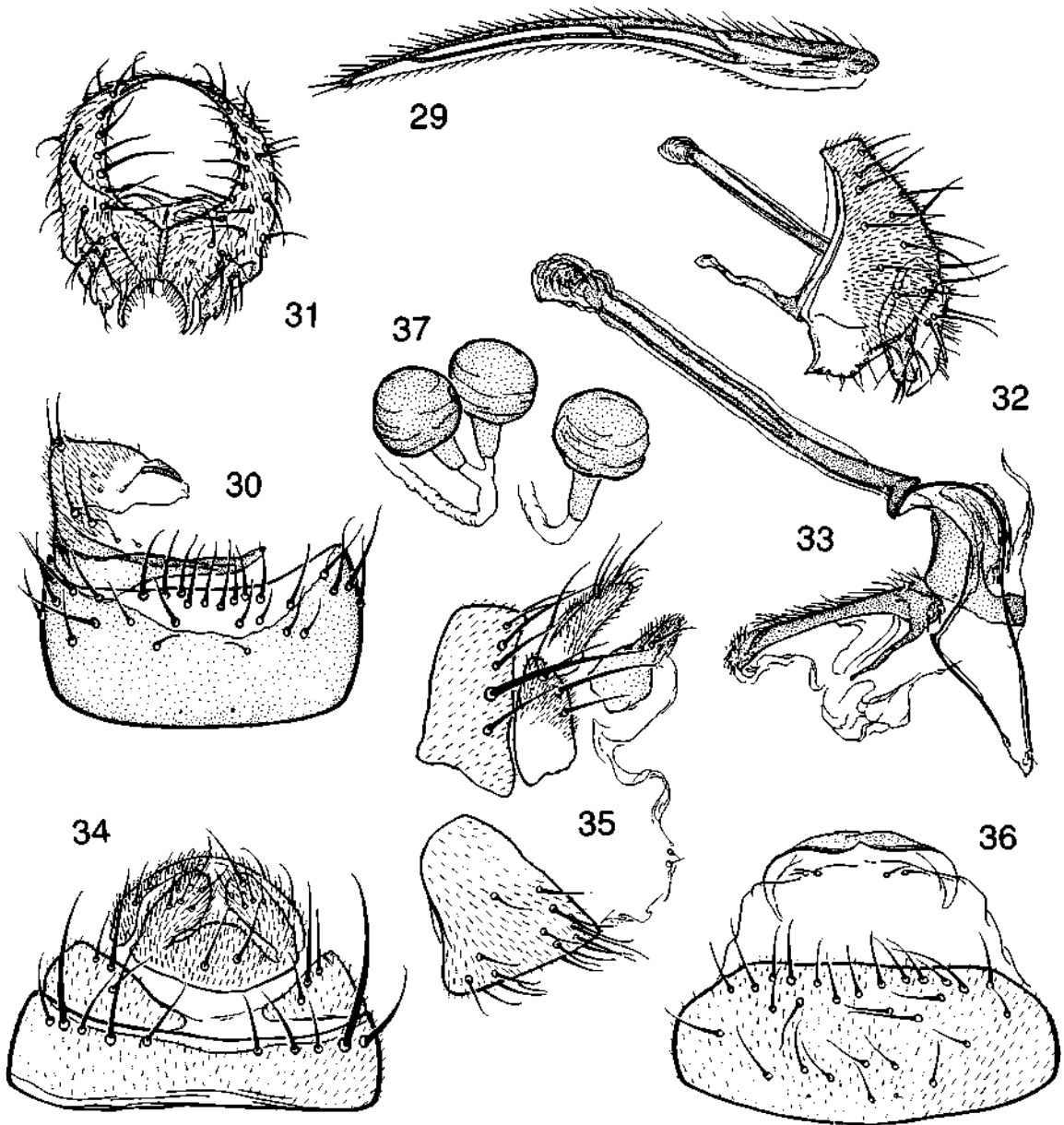
Material examined: Robinson Crusoe Island. Open forest immediately above Plazoleta, pan traps, 1-9.I.1993, S.A. Marshall, (30♂,16♀, GUE,MNHNS); same locality, 23-28.I.1992, pan traps, S.A. Marshall (7♂, 5♀,GUE); same area and adjacent lower part of El Yunque trail, aspirated, 31.XII.1992, and 2.I.1993, S.A. Marshall and C. Gonzalez (4♂, 6♀,GUE); same area, pans in intermittent streambed and along streambed margin, S.A. Marshall (2♂, 3♀,GUE); same area, beating and sweeping ferns at night, 9.I.1993, S.A. Marshall (1♂, 2♀,GUE).

Comments: Although the holotype was supposed to be a female, the mid tibial chaetotaxy leaves no doubt that it is a male. Richards (1955) and Marshall and Smith (1992) treated the new species here described as *P. gonzalezi* as *P. selkirki*. The extensive new material included here shows that R₄₊₅ consistently runs to the hind margin of the wing in *P. selkirki*, as illustrated by Enderlein, and those specimens in which R₄₊₅ ends in the costa represent a new species.

Phthitia gonzalezi Marshall and Smith,
new species
Figs. 29-37

Phthitia selkirki Richards, 1955: 83 (in part);
Marshall and Smith, 1992: 71 (in part).

Description: Body length *ca.* 2.2mm. General color yellow-brown, lightly pruinose; notum faintly striped, almost uniformly pale brown. Acrostichal bristles short, in about 9 rows between anterior dorsocentral bristles, prescutellar pair enlarged. Katepisternum with a large postero-dorsal bristle and 3 minute anterodorsal bristles. Mid tibia with 2 pairs of anterodorsal-posterodorsal bristles proximally, upper pair small; distally with a large anterodorsal-posterodorsal bristle pair, a small anterodorsal proximal to distal anterodorsal and a very small anterodorsal proximal to and between distal pair. Mid tibia of female with anteroventral bristle below middle. Mid tibia of male with a single anteroventral row of about 14 short, very stout bristles on distal half, only



Figures 29-37. *Phthitia gonzalezi* Marshall & Smith, sp. nov.: 29, left wing, dorsal; 30, male sternite 5 and sternite 6; 31, male terminalia, posterior; 32, male terminalia, left lateral; 33, aedeagus and associated structures; 34, female terminalia, dorsal; 35, female terminalia, left lateral; 36, female terminalia, ventral; 37, spermathecae.

minute setulae on posterior surface of tibia. Mid femur of male with two groups of bristles near base, anteroventral row of about 8 stout bristles and a posteroventral row of about 12, one of which is twice as long as the others (Fig. 9, Richards 1955). Wing (Fig. 29) strongly reduced, about 7 times as long as wide, extending beyond third abdominal segment (Fig. 7, Richards 1955), R₄₊₅ ending in costa well before wing tip. Abdominal tergites mottled with pale areas.

Male terminalia: Sternite 5 (Fig. 30) half as long as sternite 4, posteromedially pale, setose. Sternite 6 simple. Lower part of cercus long, tapered to a dark point (Fig. 31). Surstylus with broad, sessile anterior part; posterior part with a small outer lobe and an inner lobe with 2 apical bristles (Fig. 32). Basiphallus (Fig. 33) short, frame-like, posterior part beyond junction with distiphallus narrow. Paramere (Fig. 33) narrow, tapered towards apex.

Female terminalia: Tergite 7 slightly narrower and less than one third as long as tergite 6, darkly pigmented, concave anteromedially and posteromedially. Tergite 8 divided into 2 dark lateral sclerites, ventral half bare but without posteroventral extension. Epiproct short, wide, uniformly pale brown posteriorly, very pale anteriorly; fused laterally with cerci (Fig. 34). Cerci short, almost sessile, with small preapical dorsal bristles only. Sternite 8 reduced to 4 small tubercle-based setae (Fig. 36). Hypoproct setose posteriorly and posterolaterally (Figs. 35, 36). Spermathecae subspherical, surface smooth or with weak transverse wrinkles, ducts unsclerotized, inserted on a short, cone-shaped base (Fig. 37).

Holotype (♂, MNHNS): Robinson Crusoe Island, pan traps among ferns in steep, upper part of Plazoleta-El Yunque trail, ca. 575m, 23-28.I.1992, S.A. Marshall.

Paratypes: Robinson Crusoe Island, pan traps among ferns in steep, upper part of Plazoleta-El Yunque trail, ca. 575m, 23-28.I.1992, and 1-9.I.1993, S.A. Marshall (2♂, 1♀, 1992; 1♀, 1993, GUE); pan traps in quebrada between Mirador and Villagra, 450m, 1-10,1993, S.A. Marshall (1♀, MNHNS); mule dung on trail near Mirador,

27.I.1992. 475m, S. Marshall (1♀, GUE); "Masa-tierra" (♀ and ♂, BMNH, abdomen of ♂ removed and cleared);

Comments: Marshall and Smith (1992) used 2 specimens of this species for their redescription of *P. selkirki*. These specimens had been compared to the type of *selkirki* by Hennig, and were also used by Richards in his redescription of *P. selkirki*. These specimens, and the new material used in the above description of the new species *P. gonzalezi*, differ from what remains of the type of *P. selkirki* (a leg and wing) in the number of rows of bristles at the base of the male mid femur, the absence of a distal posterior tibial bristle, and in the wing venation. *Phthitia gonzalezi* also differs markedly from *P. selkirki* in its very narrow male sternite 5 and its internal genitalia. Characters of the internal genitalia suggest that *P. gonzalezi* belongs in the *venosa* clade rather than the *selkirki* clade, species of which have a characteristic posteroventral extension on the basiphallus. Several characters, including the lack of the distal posterior mid tibial bristle found in other *Phthitia*, suggest a close relationship between *gonzalezi* and *venosa* plus *miradorensis* (the *venosa* clade).

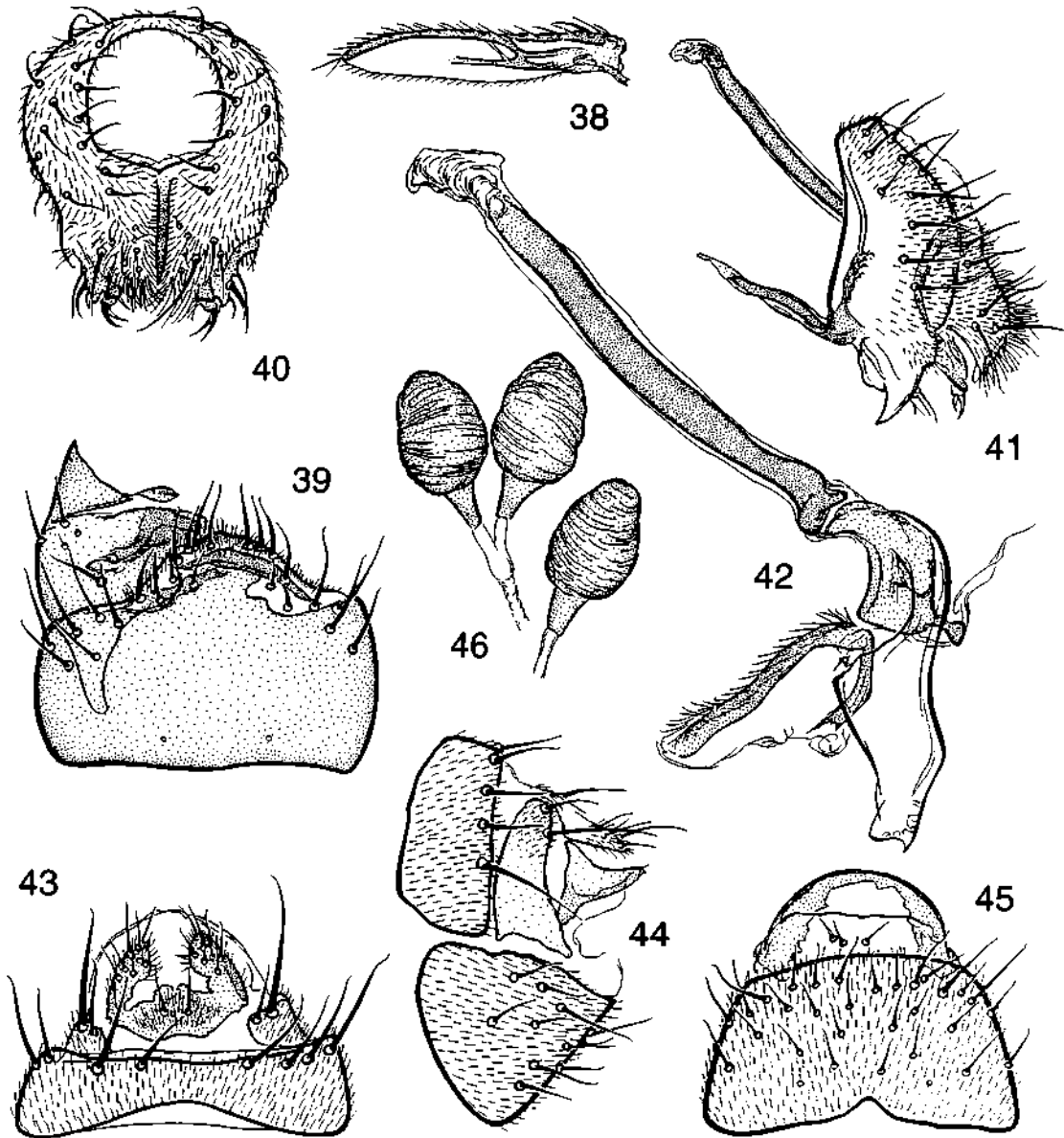
Etymology: This species is named after Christian Gonzalez in recognition of his invaluable assistance with this study.

Phthitia venosa Enderlein

Figs. 38-46

Phthitia venosa Enderlein, 1938: 650, figs. 7-9 (♀ only); Richards, 1955: 82 (♀ only, not *venosa sensu* Enderlein); Marshall and Smith, 1992: 77 (in part).

Description: Body length ca. 1.5mm. General color yellow to light brown, heavily pruinose; notum luteous with median brown stripe, brown patches inside humeri and above wing, and weak brown stripe along dorsocentral areas. Interfrontal bristles in 2-3 pairs: upper pair small, middle pair long and cruciate, lower pair small to minute. Eye large, height 5.0 times genal height; gena yellow, without shining areas; 1 large genal bristle. Acrostichal bristles long, in ca. 7 rows between dorsocentral bristles, prescutellar pair slightly en-



Figures 38-46. *Phthitia venosa* Enderlein: 38, left wing, dorsal; 39, male sternite 5 and sternite 6; 40, male terminalia, posterior; 41, male terminalia, left lateral; 42, aedeagus and associated structures; 43, female terminalia, dorsal; 44, female terminalia, left lateral; 45, female terminalia, ventral; 46, spermathecae.

larged. Katepisternum with a large posterodorsal bristle and a minute anterodorsal bristle. Mid tibia with paired of anterodorsal and posterodorsal bristles proximally and distally; distal anteroventral bristle subequal to distal posterodorsal; posterior surface with only uniformly small setulae. Mid tibia of female with a strong anteroventral bristle below middle. Mid tibia of male with a row of 7 small stout ventral bristles distally; cluster of ca. 12 stout posteroventral bristles and row of ca. 5 stout anteroventral bristles present on basal part of mid femur. Hind femur dilated, flattened. Wing (Fig. 38) ca. 6 times as long as width at middle, extending to anterior edge of tergite 3; uniformly darkly infuscated, R₄₊₅ ending in middle of wing, not reaching costa or hind wing margin.

Abdominal syntergite 1+2 dark brown to black, tergite 1 slightly paler than tergite 2; preabdominal tergites uniformly brown.

Male terminalia: Sternite 5 (Fig. 39) 0.8X long as sternite 4, strongly convex posteriorly, with a pale posteromedial lobe with 8 marginal bristles. Sternite 6 simple. Epandrium (Fig. 40) uniformly pale brown. Lower part of cercus broadly rounded and setose medially, with a prominent, black, quadrate lobe posterolaterally. Anterior section of surstylus pale and bare laterally, anteroventrally with a long, tapered lobe. Posterior part of surstylus with a dark outer ventral lobe and a paler inner ventral lobe with an unequal pair of large inner ventral bristles (Fig. 41). Paramere broad and weakly bifid at apex; basiphallus short, frame-like, posterior part beyond junction with distiphallus narrow (Fig. 42).

Female terminalia: Tergite 7 slightly narrower and less than one half as long as tergite 6, darkly pigmented. Tergite 8 divided into 2 dark lateral sclerites, ventral half bare with narrow posteroventral extension. Epiproct and cerci brown, broadly fused; epiproct with two closely spaced bristles, middle part of epiproct setulose. Cerci short, setulose, with ca. 8 dorsal bristles (Fig. 43). Sternite 8 reduced to 4 small tubercle-based setae (Fig. 45). Hypoproct short, pale, bare (Figs. 44,45). Spermathecae elongate-oval, surface tuberculate, ducts unsclerotized, inserted on a short, cone-shaped base (Fig. 46).

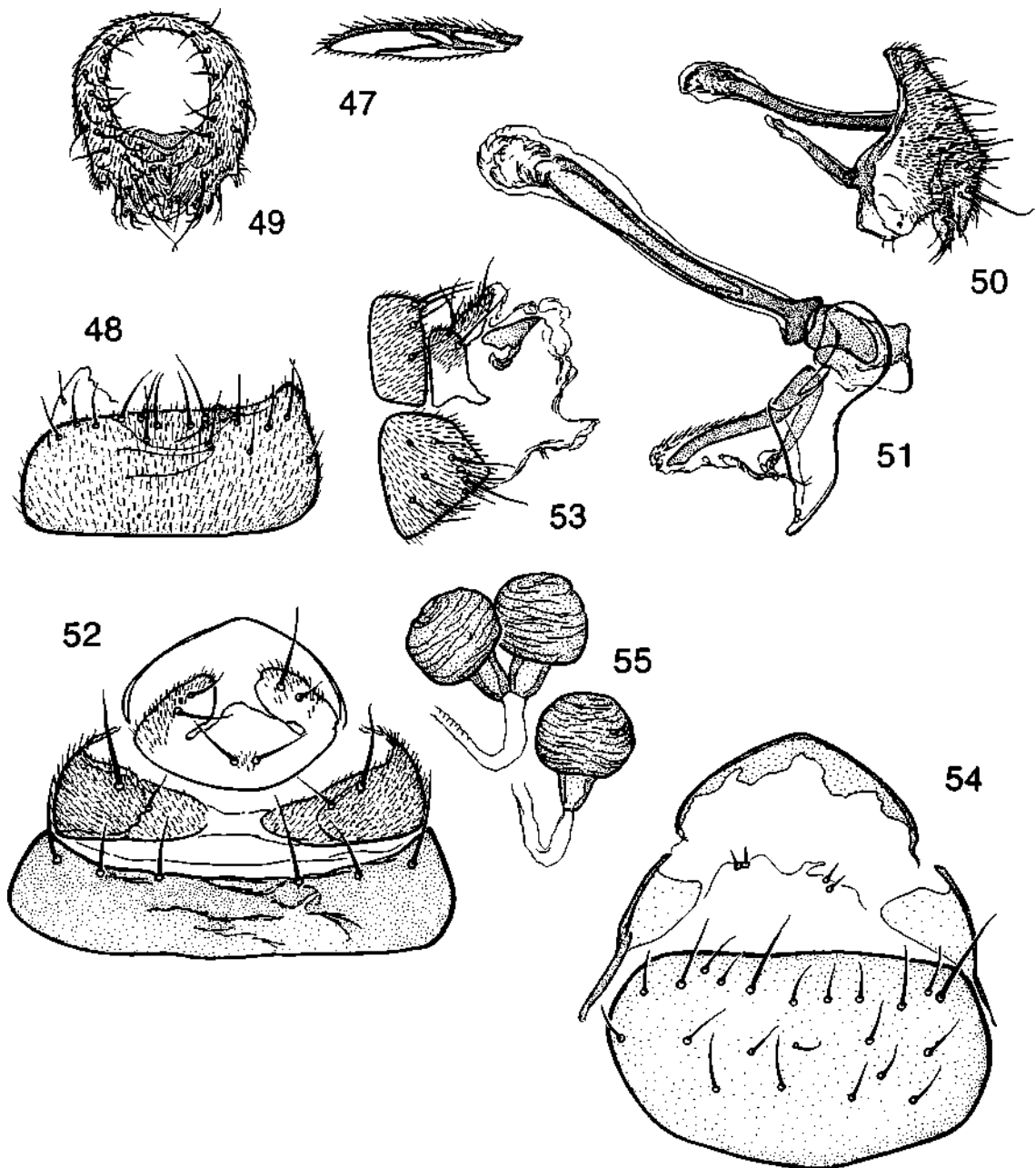
Material examined: Robinson Crusoe Island, aspirated from upper part of Plazoleta - El Yunque trail, ca. 550m, 26.I.1992, S.A. Marshall (2♂, GUE); same locality, aspirated from moss (1♀, GUE); El Yunque, 300-500m, 13.II.1968, leg. Prof. Franz, "SA196" (1♂, Vienna).

Comments: This species was previously known only from the single type female, collected in 1917, and two additional females in 1952, all from Robinson Crusoe Island but with no further locality data. The latter specimens were described by Richards (1955), however the wing figured by Richards differs from the specimens considered here, and the holotype, in that R₄₊₅ seems to reach the tip of the wing. The relatively broad wing with a long apical bristle serves to distinguish *venosa* from the other brachypterous *Phthitia* of the Juan Fernández Islands.

Phthitia miradorensis Marshall and Smith,
new species
Figs. 47-55

Description: Body length ca. 1.5mm. General color dark brown, heavily pruinose; head mostly dark brown, face yellow-brown. Thorax reduced, narrower than head or abdomen (unlike all known congeners); notum uniformly dark brown. Interfrontal bristles in 2-3 pairs: upper pair small, middle pair long and cruciate, lower pair small to minute. Eye large, height 5.0 times genal height; gena dark, without shining areas; 1 large genal bristle. Acrostichal bristles long, in ca. 4 rows between dorsocentral bristles, prescutellar pair slightly enlarged. Katepisternum with a large posterodorsal bristle only. Mid tibia with paired anterodorsal and posterodorsal bristles proximally and distally; distal anteroventral bristle smaller than distal posterodorsal; posterior and anteroventral surfaces with only uniformly small setulae. Mid tibia of male with a row of 7 small stout ventral bristles distally; cluster of ca. 8 stout posteroventral bristles present on basal part of mid femur. Hind femur dilated, flattened. Wing (Fig. 47) ca. 6 times as long as width at middle, extending to anterior edge of tergite 3; uniformly darkly infuscated, R₄₊₅ very weak, ending in posterior wing margin near middle of wing.

Abdominal syntergite 1+2 dark brown to black,



Figures 47-55. *Phthitia miradorensis* Marshall & Smith, sp. nov.: 47, left wing, dorsal; 48, male sternite 5 and sternite 6; 49, male terminalia, posterior; 50, male terminalia, left lateral; 51, aedeagus and associated structures; 52, female terminalia, dorsal; 53, female terminalia, left lateral; 54, female terminalia, ventral; 55, spermathecae.

tergite 1 slightly paler than tergite 2; preabdominal tergites black along posterior and anterior margin, dark brown at middle.

Male terminalia: Sternite 5 (Fig. 48) half as long as sternite 4, straight posteriorly, posteromedially pale, setose. Sternite 6 simple; a large, bare, dark medially prominent sclerite of unknown origin immediately behind apex of sternite 6. Mesolobus of sternite 10 long, forming a dark longitudinal area between broadly fused parts of cerci. Lower part of cercus broadly rounded, setose (Fig. 49). Anterior section of surstylus pale and bare laterally, anteroventrally with a long, dark lobe. Posterior part with a dark ventral lobe, unequal pair of large inner ventral bristles and one large outer ventral bristle (Fig. 50). Paramere broadly triangular; basiphallus short, frame-like, posterior part beyond junction with distiphallus narrow (Fig. 51).

Female terminalia: Tergite 7 slightly narrower and less than one half as long as tergite 6, darkly pigmented. Tergite 8 divided into 2 dark lateral sclerites, ventral half bare with narrow posteroventral extension. Epiproct and cerci pale luteous, broadly fused; epiproct with two closely spaced bristles on a small setulose patch, otherwise epiproct and inner margins of cerci bare and shining. Cerci short, almost sessile, with 2 dorsal bristles only (Fig. 52). Sternite 8 reduced to 4 small tubercle-based setae (Fig. 54). Hypoproct short, pale, bare (Figs. 53, 54). Spermathecae subspherical, surface with transverse wrinkles, ducts unsclerotized, inserted on a short, cone-shaped base (Fig. 55).

Holotype: Robinson Crusoe Island, pans in mossy seep on north side of Mirador de Selkirk, 450m, 1-10.I.1993, S.A. Marshall (1♀, GUE).

Paratypes: Robinson Crusoe Island, pan traps above Mirador de Selkirk, 500m, 1-10.I.1993, S.A. Marshall (2♀, GUE, MNHNS).

Comments: This species keys out to *venosa* in Richards (1955) and Marshall and Smith (1992), and is probably the sister species to *venosa*. It differs from *venosa* in its narrow, uniformly brown thorax, the lack of a midventral bristle on the female mid tibia, the lack of a prominent stub of R₄₊₅, the lack of stout anteroventral bristles on the male mid tibia, and several abdominal characters. All known specimens are from the area of Mirador de Selkirk.

Etymology: The specific name refers to the type locality.

Collection abbreviations: MNHNS, Museo Nacional de Historia Natural, Santiago, Chile; BMNH, British Museum (The Natural History Museum), London; GUE, University of Guelph (default deposition); UMCE, Universidad Metropolitana de Ciencias de la Educacion, Santiago, Chile; NRS, Naturhistoriska Riksmuseet, Stockholm, Sweden. BMNH, British Museum Natural History.

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TABLE I
 CHARACTER MATRIX FOR THE PHTHITIA VENOSA GROUP
 (1, PRESENT; 0, ABSENT; 2, SECOND STATE OF MULTISTATE CHARACTERS; ?, UNKNOWN)

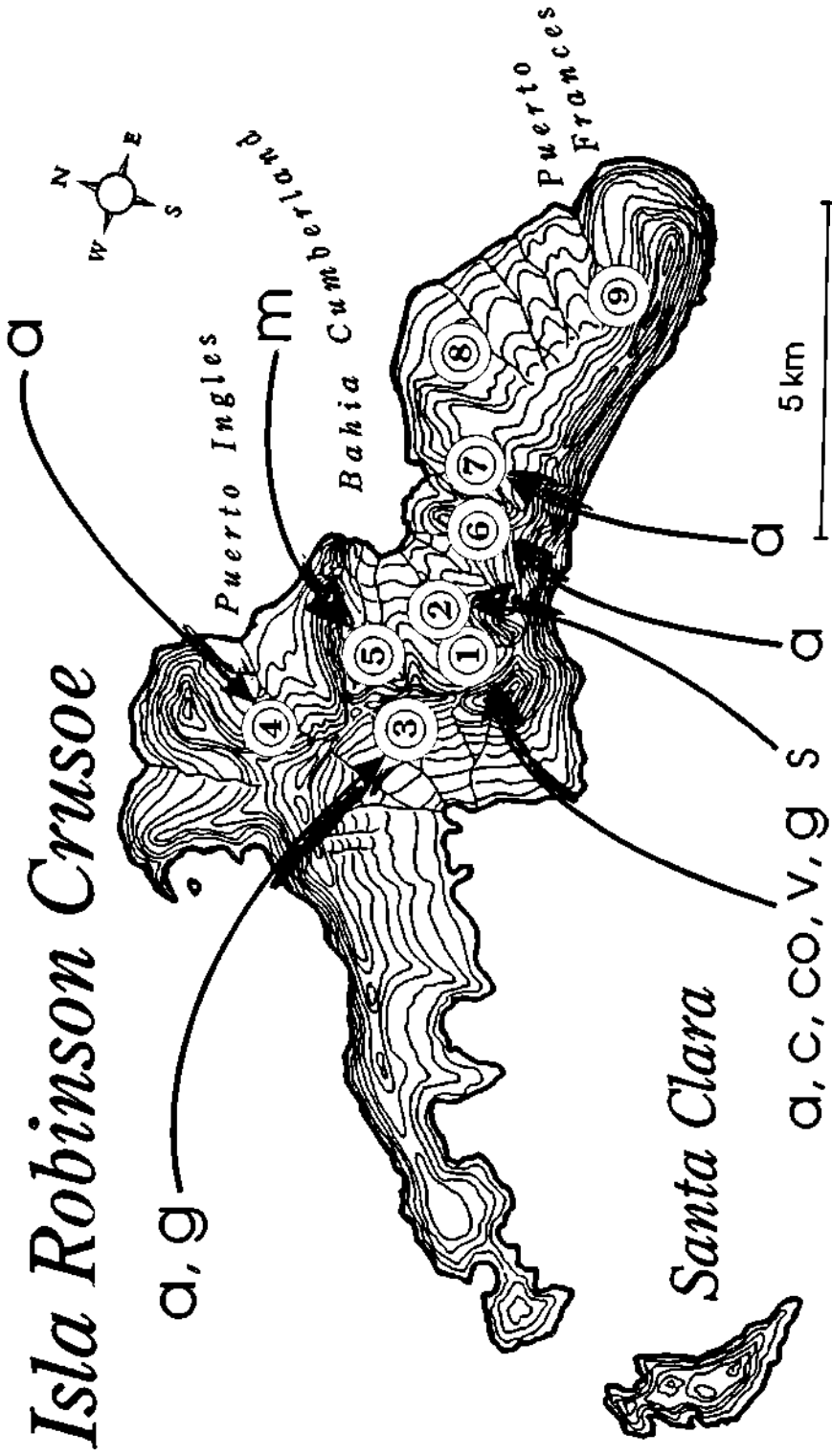
	00000	00001	11111	11112
	12345	67890	12345	67890
<i>alexandri</i>	01011	10101	01001	11111
<i>charpentieri</i>	01010	10101	00001	11111
<i>cortesi</i>	01011	11011	?????	11111
<i>selkirki</i>	01010	01011	10001	11111
<i>venosa</i>	20101	00000	11110	11111
<i>miradorensis</i>	20101	00000	11110	11111
<i>gonzalezi</i>	10100	00000	01100	11111
<i>sanctae-helenae</i>	10101	00000	01011	11110

Character codings: (apomorphic states are given; plus symbols reflect an estimate of character weight, see Marshall, 1987). 1, Body size (1, under 2.5mm; 2, under 2.0mm; +); 2, Acrostichals forming more than 8 rows (+); 3, Distal posterior bristle absent from mid tibia (++) ; 4, R4+5 running to posterior wing margin near wing tip (+++); 5, Male cercus with a long bristle (+); 6, Male mid femur with a single row of ventral bristles (+); 7, Sclerotized part of male sternite 5 very short (++) ; 8, Male sternite 5 with a tab-like structure posteromedially (++) ; 9, Posterior margin of male sternite 5 long setose (++) ; 10, Basiphallus very large, extending posteroventrally (+++); 11, Female tergite 8 with narrow posteroventral lobe (+); 12, Sternite 8 present only as bristle bases (+); 13, Epiproct bare laterally (+); 14, Spermathecae with strong transverse grooves (+); 15, Hypoproct large, shining (++) ; 16, Eye enlarged (++) ; 17, Contrasting black anepimeron (+++); 18, Anterior part of surstylus sessile (++) ; 19, Halter lost (+); 20, Wing narrow, strap-like (+++).

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APPENDIX I



Native forest collecting sites, with *Pithecia* species records

1, Base of El Yunque; 2, Forest above Plazoleta; 3, South side of Mirador; 4, Puerto Ingles; 5, North side of Mirador; 6, Damajuana; 7, Alto Pangal; 8, Rabanal; 9, Puerto Frances.