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Heather-feeding psyllids of the genus *Strophingia* (Homoptera)

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ABSTRACT. Multivariate analysis of morphological characters suggests that the genus *Strophingia* comprises eight distinct species, namely *ericae* (Curtis) [the type-species], *australis* sp.n., *fallax* Log., *cinereae* Hod., *proxima* sp.n., *hispanica* Hod. & Hollis, *harteni* sp.n., and *arborea* Log. Each species is fully characterized and an identification key is provided. A tentative phylogeny of the group is proposed. Among the newly described species, *australis* (host plant: *Erica australis*) occurs in Portugal, *proxima* (host plant: *Erica arborea* and possibly *Calluna vulgaris*) is found throughout the Iberian peninsula, while *harteni* (host plant: *Erica azorica*) is found on the Azores.

Introduction

The genus *Strophingia* was erected by Enderlein (1914) to include a single representative, *Psylla ericae* Curtis, a species previously assigned to the genus *Rhinocola* by Förster (1848). Enderlein (1915) later dubiously referred a fossil insect, *Strophingia oligocenica,* to the genus. Subsequently several authors, including Ossiannilsson (1963) and Klimaszewski (1973, 1975), have regarded *Strophingia* as a synonym of *Aphalaroida* Crawford (1914), a genus otherwise restricted to fabaceous shrubs in the southern U.S.A. Other authors have stressed, correctly in my opinion, that *Strophingia* is a distinct palaearctic genus (Heslop-Harrison, 1952; Vondracek, 1957; Dobreanu & Manolache, 1962; Loginova, 1976).

Strophingia ericae remained the sole extant representative of the genus until Hodkinson (1971) described a further species, *cinereae,* from Britain and later recorded the same species from France (Hodkinson & White, 1979b). Recently Loginova (1976) described *arborea* and *fallax* from the Canary Islands and Madeira, and Hodkinson & Hollis (1980) described *S.hispanica* from Mallorca. I have now examined an abundance of additional material from the Azores, Portugal, Spain and France and a revision of the genus is now clearly required.

All the described *Strophingia* species are associated with host-plants within the genera *Erica* or *Calluna* (Ericaceae). The distribution of the genus appears to centre on the west Mediterranean region (Hodkinson, 1980) although *S.ericae* is known to occur throughout Europe and the European U.S.S.R., the range of its host plant *Calluna vulgaris* (Hodkinson, 1971).

Strophingia species are small, relatively immobile pysllids which seldom fly and it appears that within the genus there is a tendency to form isolated populations. For example, Hodkinson (1973a, b) demonstrated that in northern England *ericae* completed its life cycle in 1 year at low elevations whereas at high elevations it took 2 years. Subsequently Parkinson & Whittaker (1975) showed that the change-over from a 1 to a 2 year life cycle occurred abruptly along an altitudinal transect with continuous host plant cover. The upland 'race' had an inherently slower development rate than the lowland

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'race' and the two populations could be separated statistically using critical measurements of the Cu veins of the forewing. This tendency to form morphologically distinct populations is apparent in the material to hand. When set against the background that several of the described species are island forms, the taxonomy of the group becomes a fascinating dilemma in species interpretation. Multivariate statistical techniques have therefore been employed to identify major disjunctions and thereby help delineate species.

Material examined

My initial philosophy was to ignore existing species groupings and conduct detailed objective analyses to test whether such groupings were justified. The names applied to material listed below result from these analyses. Material examined included all *Strophingia* specimens in the British Museum (Natural History) and my own personal collection together with type material of *arborea* and *fallax* deposited in the Zoological Museum, University of Helsinki. However, in *ericae*, a common species, specimens were selected to display maximum geographical and altitudinal variability. Full locality data for the new species are given in the later descriptions. The following abbreviated list gives the names of the countries/islands from which material was examined followed by the number of localities in parentheses: full locality data are available in mimeograph form from the author.

S.ericae: England (3), Scotland (1), France (1), Denmark (1), Norway (1), Portugal (3), Spain (1)
S.cinereae: England (1) (types), France (1), Corsica (1), Spain (1), Portugal (4)
S.hispanica: Spain, Mallorca (4) (types)
S.fallax: Madeira (2) (types)
S.arborea: Madeira (2), Tenerife (1) (types)
S.australis sp.nov.: Portugal (1)
S.harteni sp.nov.: Azores (2)
S.proxima sp. nov.: Spain (5), Portugal (1)

Strophingia Enderlein

Strophingia Enderlein, 1914: 233. Type-species: *Psylla ericae* Curtis, by monotypy.

Description. The following account complements Enderlein's meagre initial definition and serves to preclude repetitive description from the succeeding species diagnoses:

Small insects less than 2.5 mm in length. Head as broad as thorax, in lateral view globose, moderately deflexed; in dorsal view as Figs. 18 and 19; vertex flat or weakly convex, divided by median suture, rounded downwards anteriorly, with a smooth transition into the genae, the latter smoothly rounded and not markedly expanded; frons, which bears median ocellus apically, pyriform and borne on the underside of the head, barely visible in dorsal view; lateral ocelli very small, situated at outer posterior angles of vertex; clypeus globose, inconspicuous; labium relatively short, eyes hemispherical, pre-occipital lobes well developed. Antennae 10-segmented, at most three-quarters the width of head: basal 2 segments quadrate, remainder filiform, segment 3 the longest; single rhinaria placed at apices of segments 4, 6, 8 and 9; segment 10 with two apical setae. The shape of the head is relatively constant between species: Figs. 18 and 19 represent the extremes. Pronotum narrow, ribbon like, curved downwards anteriorly, transversely arched; propleurites long and narrow, divided by a curved vertical suture arising at mid-point of pronotum; parypterae and tegulae tubercular. Forewings short, at most 3 times head width, oval or rhomboidal, somewhat convex; membrane thick, translucent yellow with a transverse rugosity, venation as in Figs. 2–9; costal break present or absent; pterostigma present. Hindwings normally developed, thin membranous. Fore and mid legs simple; hind legs saltatorial, meracanthi well developed, apex of metatibia with a crown of six to eight (variable) thick black spines, basal metatarsus with two similar apical spines. Male proctiger simple, sometimes slightly lobed but without posterior processes (Figs. 10–17). Female terminalia (Figs. 38–50) normally developed, without characters of generic significance; circumanal pore ring with two complete rows of pores. All described species feed on *Erica* or *Calluna* (Ericaceae).

Diagnosis. Heslop-Harrison (1952) discusses in detail the separation of adult *Strophingia* from related genera including *Aphala-*

TABLE 1. Characters selected for principal components analysis. Measurements follow Hodkinson & White (1979a). Characters 35–39 are qualitative characters for use in later cladistic analysis and are derived from the quantitative data.

QUANTITATIVE CHARACTERS

Size measurement

1. Head width

Ratio characters comparing relative size of major body parts

2. Antennal length : head width
3. Length of apical two segments of labium : head width
4. Forewing length : head width
5. Proctiger length (♂ or ♀) : head width

Ratio characters expressing wing shape and relative length of different veins

6. Forewing length : forewing breadth
7. Length of vein R_s : forewing length
8. Length of vein Cu_2 : forewing length
9. Distance from base of C + Sc to base of R_s : forewing length
10. Length of vein $M + M_{1+2}$: forewing length
11. Length of vein M_{1+2} : M
12. Length of vein Cu_{1a} : Cu_{1b}
13. Distance from base of C + Sc to base of R_s : R_s
14. Length of vein Cu : Cu + M
15. Length of vein M_{1+2} : M_{3+4}

Ratio characters expressing relative size and shape of terminalia

16. Length of ♂ penis : proctiger
17. Length of ♂ paramere : proctiger
18. Height of ♂ sub-genital plate : proctiger
19. Length of ♀ circumanal pore ring : proctiger
20. Length of ♀ ovipositor : proctiger

QUALITATIVE CHARACTERS

21. Forewing rhomboidal (0), oval (1)
22. Costal break present (0), absent (1)
23. Forewing without maculation (0), with (1)
24. Vein Cu_{1a} weakly arched (0), strongly arched (1)
25. Vein C + Sc not markedly bulged outwards (0), bulged (1)
26. Vein R_s straight or curved away from costal margin (0), curved distally towards costal margin (1)
27. ♂ paramere without posterior lobe (0), with (1)
28. ♂ paramere with one apical denticle (0), with two apical denticles (1)
29. Apex of penis hooked (0), not hooked (1)
30. Apex of paramere broadly rounded (0), narrowly rounded (1)
31. ♀ proctiger with shallow notch on dorsal margin (0), without notch (1)
32. ♀ proctiger densely hairy, bearing long hairs (0), sparsely hairy (1)
33. ♀ valvulae ventralis recurved apically (0), straight (1)
34. Apex of ♀ sub-genital plate sharp (0), blunt (1)

QUALITATIVE CHARACTERS DERIVED FROM NUMERICAL DATA FOR USE IN SUBSEQUENT CLADISTIC ANALYSIS

35. Forewing relatively narrow (0), broad (1)
36. Cell m_{1+2} approximately equal to cell cu_1 (0), twice size (1)
37. Cell c + sc short (0), long (1)
38. Valvulae ventralis not curved away from ovipositor (0), curved away (1)
39. ♂ paramere not bulged at basal anterior margin (0), bulged (1)

roida. While there is some convergence in adult characters between *Strophingia* and *Aphalaroida*, the respective nymphs are highly distinctive (I. M. White, personal communication).

Character selection and principal components analysis

Characters selected for principal component analysis are given in Table 1. Qualitative characters which involved the use of subtle but apparent differences in the male genitalia were omitted at this stage as were certain quantitative characters, such as vertex length, which could not be reliably measured in slide-mounted material. As *Strophingia* species are sexually dimorphic it was necessary to conduct separate analyses on males and females using the appropriate characters. All data sets were standardized to a mean of zero. In two specimens (*australis*) the antennae were missing and the antennal length:head width ratio was adjusted to the mean of all specimens measured (i.e. to give it zero weighting). Principal component analysis was carried out on the character correlation matrices using an ICL statistical package implemented on the Liverpool Polytechnic computer.

Initial analyses were conducted using quantitative characters alone (characters 1–20). These were subsequently compared with analyses incorporating both quantitative and qualitative characters (1–34). The results from the different analyses were broadly similar but the effect of adding qualitative characters was to tighten the clusters and increase the percentage variance extracted. Therefore the following interpretations are based on analyses employing both character sets.

Results of principal component anlyses

Fig. 1 illustrates the ordination of male and female specimens along principal component

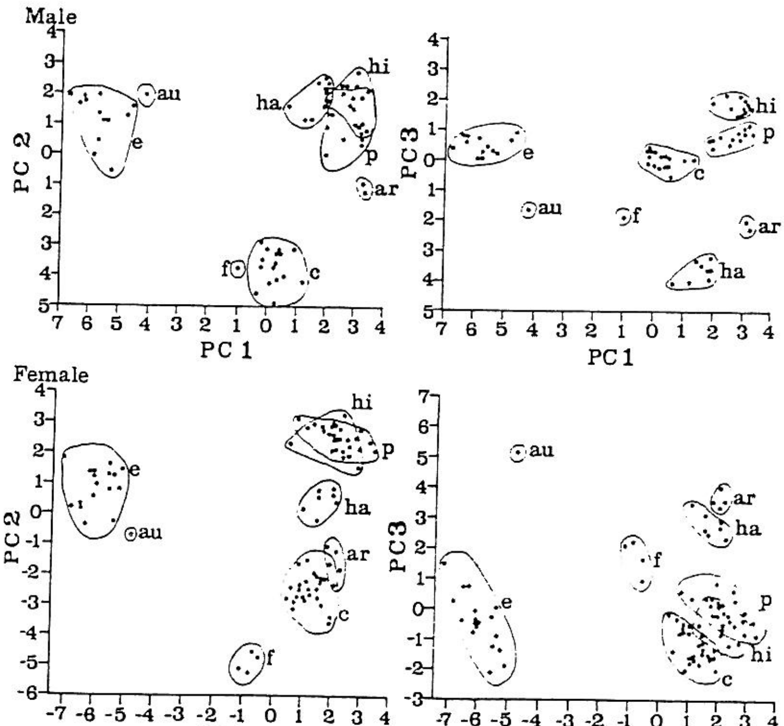


FIG. 1. Ordination of male and female *Strophingia* species along principal component axes 1–3. Each circle represents a specimen measured. Key: ar = *arborea*, au = *australis*, c = *cinereae*, e = *ericae*, f = *fallax*, ha = *harteni*, hi = *hispanica*, p = *proxima*.

TABLE 2. Summary of variance extracted by principal component analysis and characters having highest weighting along components 1–5

Variance extracted (%)

PC	1	2	3	4	5
♂	39	59	69	76	81
♀	38	59	70	74	78

Characters with highest loadings

PC rank order	1		2		3		4		5	
	♂	♀	♂	♀	♂	♀	♂	♀	♂	♀
1	21	21	5	20	25	25	26	26	8	8
2	29	23	18	33	30	4	14	25	3	3
3	23	24	16	1	2	11	4	8	11	10
4	24	31	17	34	28	22	3	7	5	19
5	13	32	11	22	4	33	8	13	12	2
6	9	5	27	11	1	26	6	6	25	1
7	1	13	22	6	9	15	12	2	13	14
8	22	19	15	2	8	20	25	3	9	20

axes 1–3. The variance extracted for each analysis and the characters having the highest loading along each axis are summarized in Table 2. In the males, eight groups separated out along these three axes and are considered to represent species. The two closest species, *hispanica* and *proxima*, separated further on axis 5. In the females the same groupings recurred except that *hispanica* and *proxima* overlapped on the first three axes but separated out on the fourth axis. Along this same axis *arborea* separated from *proxima*, *hispanica* and *cinereae*, and *harteni* was further distinguished from *proxima*.

The previously recognized species, *ericae*, *cinereae*, *fallax*, *arborea* and *hispanica*, were all demonstrated to be distinct and three new species, *australis*, *proxima* and *harteni*, were discriminated.

Recognition of the species

Table 3 summarizes size measurements and the more important ratio characters of taxonomic significance for each species. This table should be used to confirm identifications made using the following key. In *cinereae* there is some geographic variation in the shape of the penis: this is illustrated in Figs. 30–33. The penis of the unique male of *fallax* is damaged and is therefore not illustrated.

Key to *Strophingia* species

1 Costal break present in fore-margin of wing adjacent to base of pterostigma (Figs. 2–5). Male paramere (Figs. 20–23) usually with distinct subapical posterior lobe [exception *australis*]. Female proctiger (Figs. 28, 40 and 42) usually longer than head width [exception *cinereae*]. Male proctiger (Figs. 10, 12 and 13) usually without posterior bulge [exception *australis*]. Smaller species: head width ♂ 0.46–0.55 mm, ♀ 0.47–0.66 mm. 2

– Costal break absent (Figs. 6–9). Male paramere (Figs. 24–27) without posterior lobe. Female proctiger (Figs. 46, 48, 50 and 52) shorter than head width. Male proctiger (Figs. 14–17) with slight posterior bulge. Larger species: head width ♂ 0.50–0.67 mm, ♀ 0.60–0.76 mm. 5

2 Forewing (Fig. 2) broadly oval; round maculae present on membrane; vein Cu_{1a} strongly arched. Female proctiger (Fig. 38) sparsely hairy, without shallow notch in dorsal margin. Male paramere as Figs. 10 and 20, penis as Fig. 28. *ericae* (Curtis)

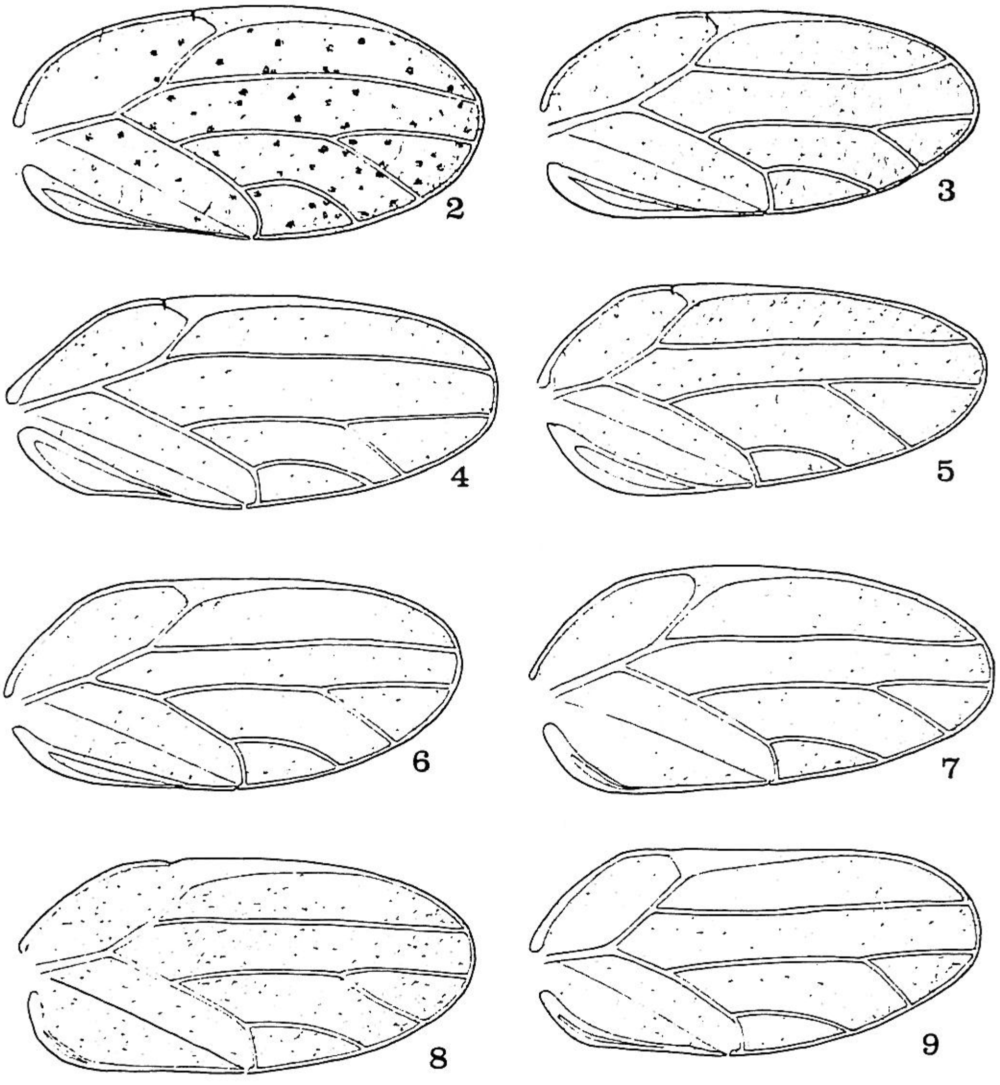
– Forewing narrowly oval (Fig. 3) or rhomboidal (Fig. 5); maculae absent; vein Cu_{1a} weakly arched. Female proctiger (Figs. 40, 42 and 44) more densely hairy, with shallow notch in dorsal margin. 3

3 Cell c + sc of forewing (Fig. 3) relatively long; vein R_s curved apically towards costal margin;

TABLE 3. Size measurements (in mm), ranges for those ratio characters having a high weighting in principal components analysis, and known host plants of *Strophingia* spp.

	ericae	*australis*	*fallax*	*cinereae*	*proxima*	*hispanica*	*harteni*	*arborea*
Male								
Head width (HW)	0.48–0.55	0.47	0.47	0.50–0.54	0.57–0.63	0.63–0.67	0.55–0.59	0.50–0.60
Antennal length (AL)	0.32–0.41	–	0.36	0.29–0.34	0.32–0.37	0.32–0.34	0.37–0.40	0.30–0.37
Forewing length (FL)	0.99–1.10	1.07	1.19	1.08–1.24	1.28–1.46	1.39–1.50	1.25–1.41	1.30–1.47
Proctiger length (PL)	0.22–0.25	0.22	0.23	0.24–0.27	0.26–0.28	0.26–0.30	0.24–0.27	0.24–0.26
Penis length (P)	0.18–0.20	0.18	0.17	0.19–0.21	0.22–0.25	0.25–0.26	0.22–0.24	0.19–0.21
Paramere length (PA)	0.18–0.21	0.19	0.17	0.16–0.20	0.19–0.22	0.21–0.23	0.19–0.20	0.17–0.18
AL : HW	0.65–0.71	–	0.77	0.57–0.65	0.54–0.60	0.47–0.51	0.64–0.72	0.54–0.56
Ultimate two segs. labium : HW	0.37–0.42	0.46	0.39	0.34–0.38	0.32–0.35	0.37–0.39	0.34–0.39	0.38–0.39
FL : HW	1.94–2.16	2.30	2.57	2.11–2.32	2.13–2.38	2.14–2.31	2.16–2.46	2.36–2.47
FL : forewing breadth	1.89–2.09	2.16	2.27	2.08–2.35	2.13–2.32	2.09–2.21	2.10–2.24	2.22–2.26
Vein M_{1+2} : M	0.41–0.89	0.51	0.87	0.81–1.41	0.60–0.95	0.30–0.72	0.58–0.89	0.59–0.60
Length C + Sc : FL	0.35–0.40	0.37	0.32	0.28–0.32	0.29–0.33	0.28–0.32	0.32–0.37	0.29–0.30
PL : HW	0.44–0.48	0.46	0.49	0.46–0.55	0.41–0.48	0.41–0.46	0.41–0.45	0.43–0.44
P : PL	0.75–0.84	0.83	0.73	0.74–0.80	0.80–0.93	0.85–0.97	0.87–0.96	0.80–0.81
PA : PL	0.79–0.85	0.89	0.74	0.63–0.78	0.69–0.84	0.74–0.82	0.75–0.81	0.69–0.71

Female								
Head width (HW)	0.55–0.67	0.51	0.47–0.54	0.54–0.61	0.63–0.70	0.70–0.76	0.60–0.64	0.62–0.65
Antennal length (AL)	0.35–0.45	–	0.35–0.39	0.32–0.36	0.34–0.39	0.34–0.37	0.37–0.40	0.38–0.42
Forewing length (FL)	1.41–1.75	1.44	1.38–1.47	1.41–1.60	1.55–1.80	1.74–1.89	1.61–1.77	1.75–1.91
Proctiger length (PL)	0.57–0.67	0.59	0.53–0.58	0.47–0.55	0.49–0.54	0.54–0.61	0.55 0.58	0.50 0.56
Circumanal ring length (CL)	0.13–0.17	0.13	0.14–0.15	0.13–0.16	0.13–0.17	0.14–0.16	0.16–0.18	0.16–0.18
Ovipositor length (OL)	0.15–0.17	0.13	0.08–0.09	0.10–0.12	0.13–0.15	0.14–0.16	0.11–0.12	0.09–0.11
AL : HW	0.62–0.72	–	0.72–0.75	0.55–0.64	0.51–0.58	0.46–0.49	0.58–0.67	0.61–0.67
Ultimate two segs. labium : HW	0.37–0.43	0.39	0.39–0.43	0.32–0.39	0.30–0.35	0.36–0.40	0.36–0.38	0.36–0.38
FL : HW	2.44–2.83	2.82	2.75–3.03	2.46–2.78	2.44–2.68	2.49–2.60	2.53–2.85	2.71–3.08
FL : forewing breadth	2.04–2.24	2.27	2.36–2.43	2.19–2.38	2.16–2.32	2.17–2.30	2.17–2.32	2.17–2.27
Vein M_{1+2} : M	0.27–0.92	0.69	0.71–0.84	0.80–1.29	0.58–0.90	0.63–0.80	0.57–0.78	0.76–0.95
Length C + Sc : FL	0.31–0.36	0.35	0.28–0.31	0.26–0.31	0.25–0.32	0.25–0.33	0.28–0.31	0.27–0.30
PL : HW	1.01–1.15	1.16	1.06–1.12	0.83–0.96	0.75–0.82	0.77–0.84	0.86–0.94	0.80–0.89
CA : PL	0.22–0.26	0.22	0.25–0.28	0.26–0.32	0.26–0.31	0.25–0.28	0.30–0.32	0.30–0.32
OL : PL	0.24–0.27	0.22	0.15–0.16	0.20–0.24	0.24–0.28	0.25–0.29	0.20–0.22	0.18–0.20
Host plants	*Calluna vulgaris* *Erica cinerea*?	*Erica australis*	*Erica arborea*	*Erica cinerea* *E. arborea* *E. lucitanica*	*Erica arborea* *Calluna vulgaris*?	*Erica multiflora*	*Erica azorica*	*Erica arborea* *E. zucinulus*



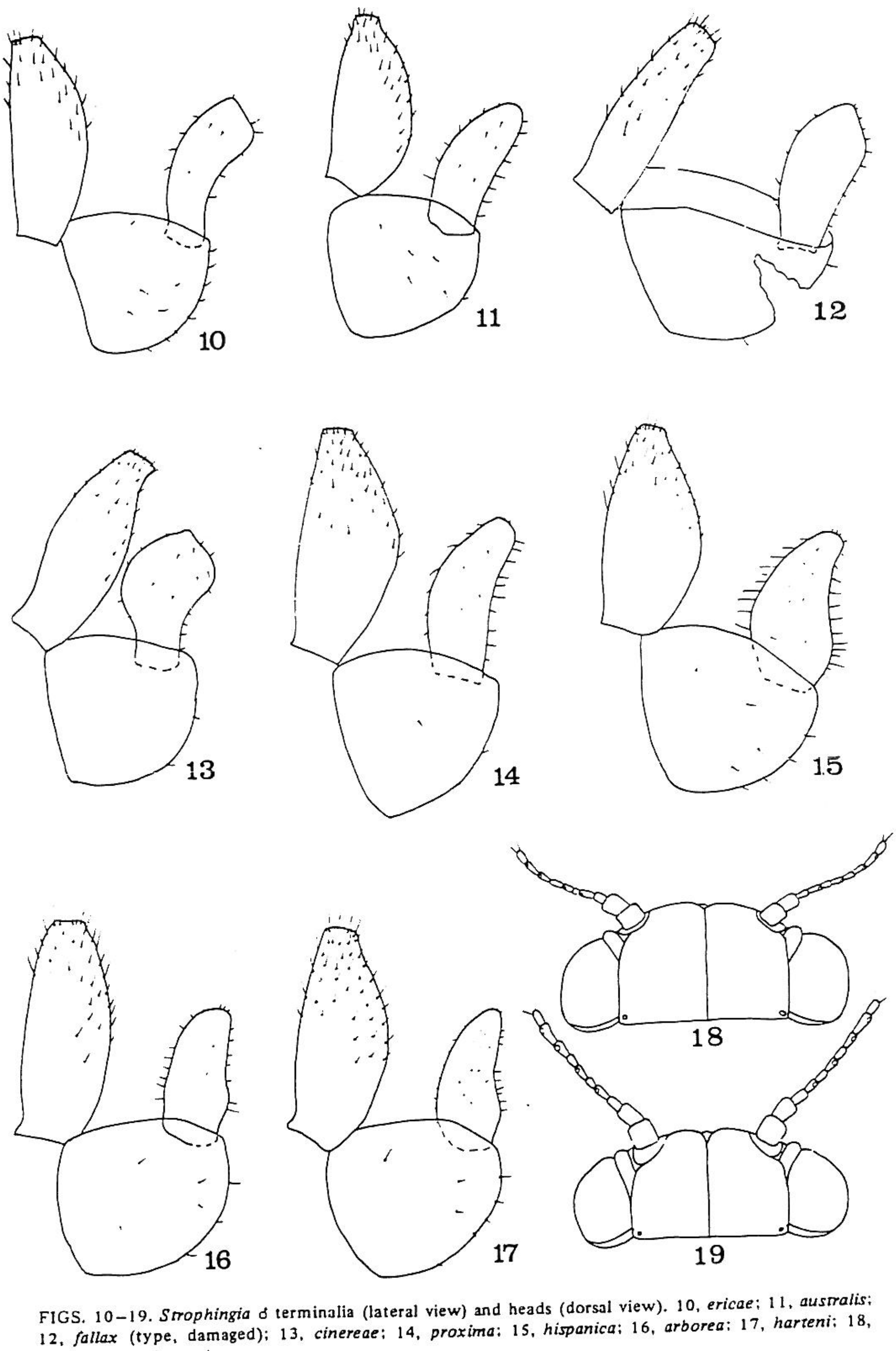
FIGS. 2–9. *Strophingia* ♂ forewings. 2, *ericae*; 3, *australis*; 4, *fallax*; 5, *cinereae*; 6, *proxima*; 7, *hispanica*; 8, *harteni*; 9, *arborea*.

cell m_1 equal in size to cell cu_1. Male paramere (Figs. 11 and 21) without posterior lobe. Female sub-genital plate (Fig. 40) apically blunt; valvulae ventralis (Fig. 41) recurved apically. Penis as Fig. 29. *australis* sp.n.

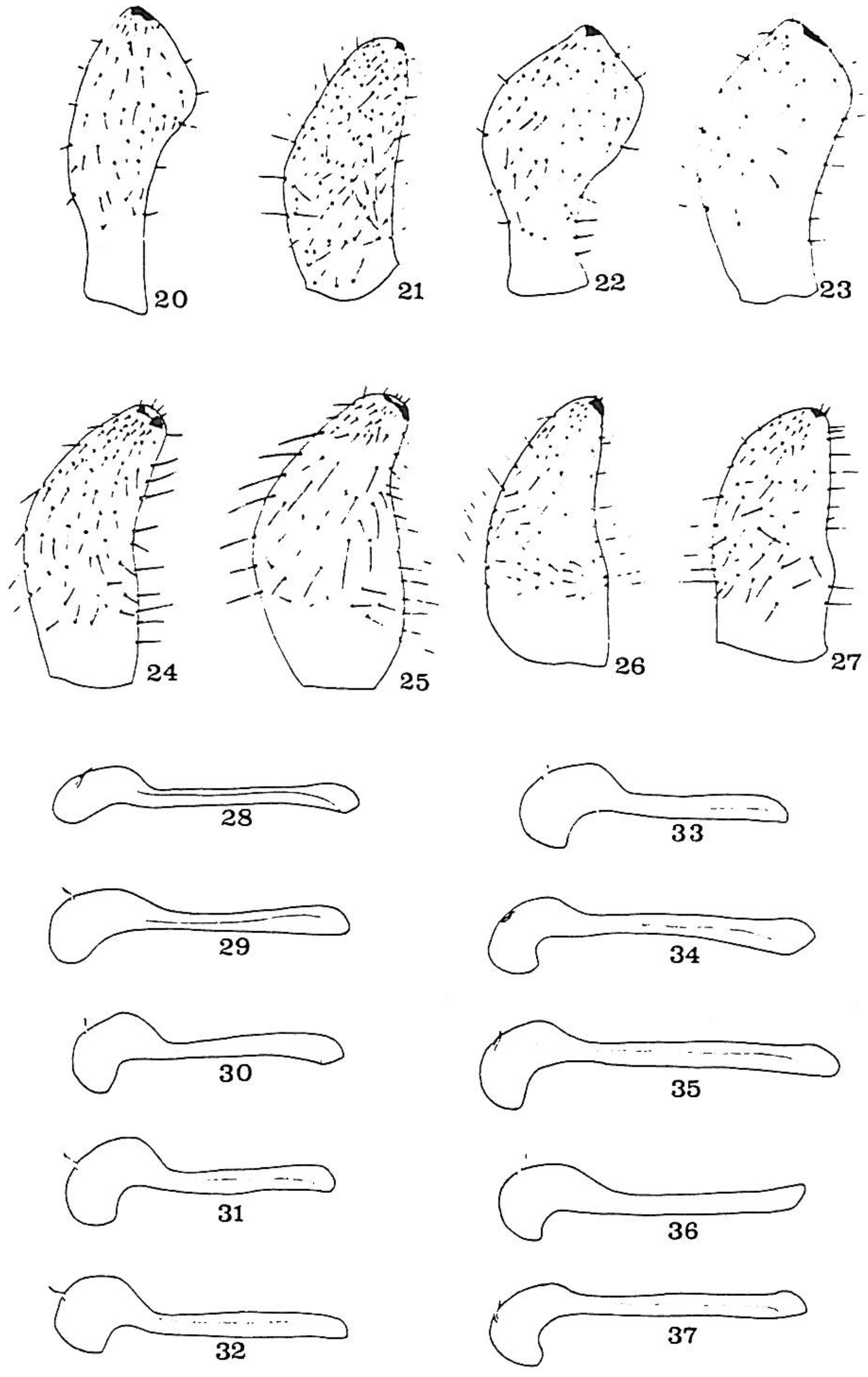
– Cell c + sc shorter (Figs. 4 and 5); vein R_s straight or curved away from costal margin: cell m_1 about twice size of cell cu_1. Male paramere (Figs. 22 and 23) with posterior lobe. Female sub-genital plate (Figs. 42 and 44) drawn out into sharp apex; valvulae ventralis (Figs. 43 and 45) straight apically. 4

4 Forewing (Fig. 5) strongly rhomboidal, cell c + sc relatively broad in middle. Antennae shorter, at most 0.65 times head width. Female terminalia (Fig. 44) shorter, proctiger less than 0.96 times head width; ovipositor (Fig. 45) at least 0.19 times proctiger length. Male paramere (Figs. 13 and 22) with large posterior lobe. Head width greater than 0.50 mm in ♂, 0.54 mm in ♀. Penis as Figs. 30–33. . . . . *cinereae* Hodkinson

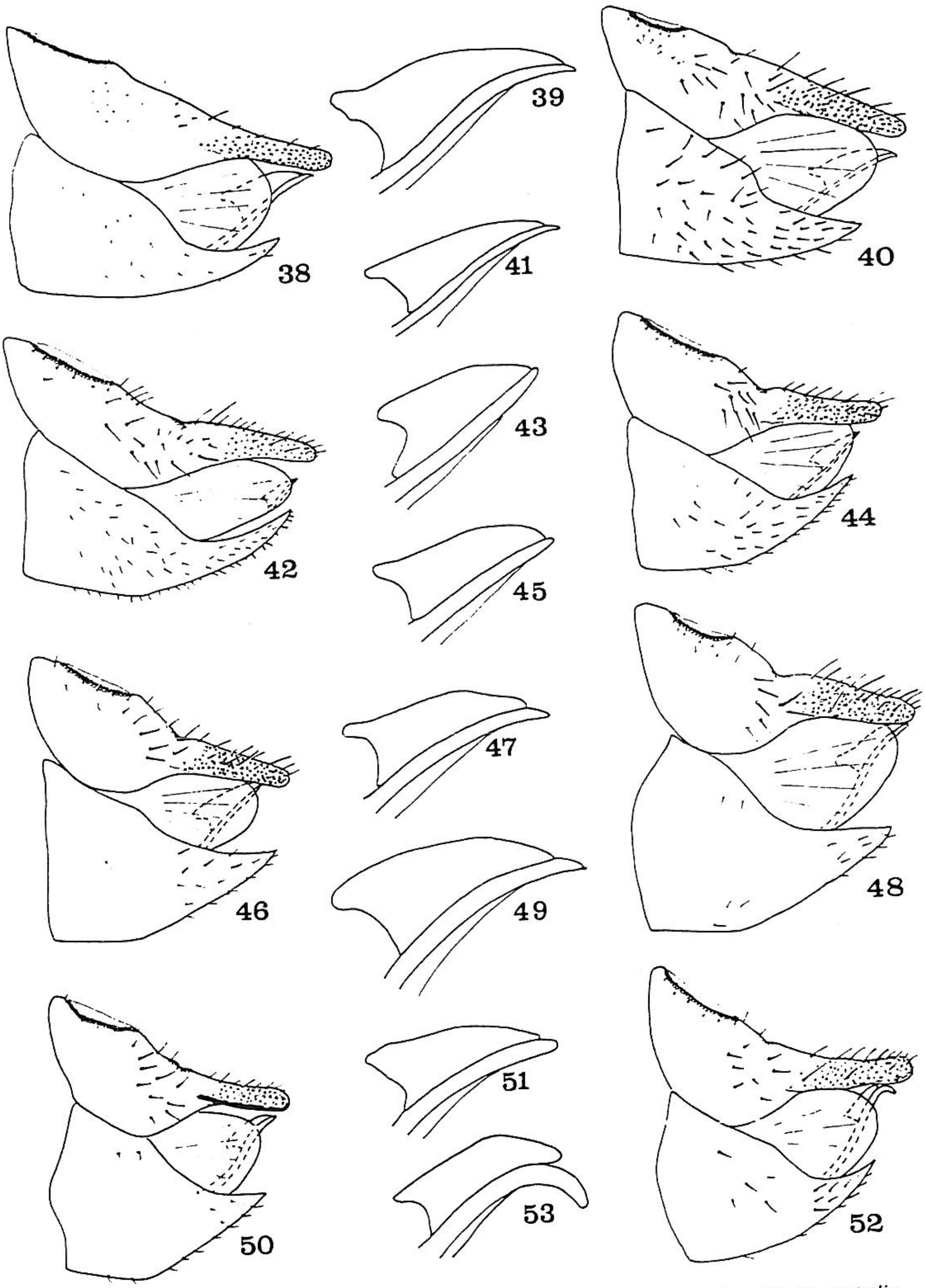
– Forewing (Fig. 4) less rhomboidal, tending to narrowly oval, cell c + sc narrower. Antennae longer, at least 0.71 times head width. Female terminalia (Fig. 42) longer, proctiger at least 1.06 times head width; ovipositor (Fig. 43) at most 0.16 times proctiger length. Male paramere (Figs. 12 and 23) with smaller posterior



FIGS. 10–19. *Strophingia* ♂ terminalia (lateral view) and heads (dorsal view). 10, *ericae*; 11, *australis*; 12, *fallax* (type, damaged); 13, *cinereae*; 14, *proxima*; 15, *hispanica*; 16, *arborea*; 17, *harteni*; 18, *hispanica*; 19, *harteni*.



FIGS. 20–37. *Strophingia* ♂ parameres (inner view) and apical portions of penis. 20, *ericae*; 21, *australis*; 22, *cinereae*; 23, *fallax*; 24, *proxima*; 25, *hispanica*; 26, *harteni*; 27, *arborea*; 28, *ericae*; 29, *australis*; 30, *cinereae* (England:type); 31, *cinereae* (Corsica); 32, *cinereae* (Portugal); 33, *cinereae* (France); 34, *proxima*; 35, *hispanica*; 36, *harteni*; 37, *arborea*.



FIGS. 38–50. *Strophingia* ♀ terminalia (lateral view) and ovipositor. 38, 39, *ericae*; 40, 41, *australis*; 42, 43, *fallax*; 44, 45, *cinereae*; 46, 47, *proxima*; 48, 49, *hispanica*; 50, 51, *harteni*; 52, 53, *arborea*.

lobe. Head width less than 0.50 mm in ♂, 0.54 mm in ♀. . . . . *fallax* Loginova

5 Male paramere (Figs. 14, 15, 24 and 25) drawn out into posteriorly curved, broad sub-parallel truncate apex which bears two denticles. Female ovipositor (Figs. 47 and 49) at least 0.24 times length of proctiger. Cell c + sc of forewing (Figs. 6 and 7) not markedly bulged outwards. 6

– Male paramere (Figs. 16, 17, 26 and 27) with acute apex which bears a single denticle. Female ovipositor (Figs. 51 and 53) at most 0.22 times length of proctiger. Cell c + sc (Figs. 8 and 9) bulged outwards. 7

6 Male paramere (Fig. 25) with basal anterior margin bulged; penis as Fig. 35. Antennae less than 0.51 times head width. Distal two segments of labium greater than 0.36 times head width. Ratio of length of vein Cu_2: forewing length less than 0.50 in ♂, 0.49 in ♀. Larger species: head width ♂ 0.63–0.67 mm, ♀ 0.70–0.76 mm. Mallorca . . . . . . *hispanica* Hodkinson & Hollis

– Male paramere (Fig. 24) approximately parallel sided; penis as Fig. 34. Antennae more than 0.51 times head width. Distal two segments of labium less than 0.36 times head width. Cu_2:forewing length greater than 0.50 in ♂, 0.49 in ♀. Smaller species: head width ♂ 0.57–0.63 mm, ♀ 0.63–0.70 mm. Iberian peninsula . . . . *proxima* sp.n.

7. Forewing (Fig. 9) with vein C + Sc strongly curved close to base, leading edge of wing almost straight in centre; cell c + sc shaped as in figure, strongly bulged. Paramere (Fig. 27) broadly acute at apex. Penis as Fig. 37. Ovipositor less than 0.20 times length of proctiger; valvulae ventralis (Fig. 53) strongly recurved at apex: sub-genital plate (Fig. 52) with posterior apical projection sharp. Madeira and Canary Islands. *arborea* Loginova

– Forewing (Fig. 8) with vein C + Sc less strongly curved, leading edge of wing convex, cell c + sc less strongly bulged outwards. Paramere (Fig. 26) narrowly acute at apex. Penis as Fig. 36. Ovipositor greater than 0.20 times length of proctiger; valvulae ventralis (Fig. 51) less strongly recurved at apex: sub-genital plate (Fig. 50) blunt. Azores . . . . *harteni* sp.n.

Description of new species

As each new species conforms to the generic description, is fully illustrated and is separated from existing species both in the key and the later cladogram, there is no further need for discursive description. Type material as designated below is deposited in the British Museum (Natural History) unless otherwise stated.

Strophingia australis sp.n. (Figs. 3, 11, 21, 29, 40 and 41)

Holotype ♂, PORTUGAL: S. Braz, ~ 300 m, 30.iv.1978 from *Erica australis* (*Bink-Moenen*).

Paratype. 1 ♀, data as holotype.

Strophingia proxima sp.n. (Figs. 6, 14, 24, 34, 46 and 47)

Holotype ♂, SPAIN: Gerona, 3–9 km La Bisbal – Calonge Rd, 1.vi.1975 (*Hollis*).

Paratypes. 8 ♂, 6 ♀, data as holotype; 2 ♂, 2 ♀, SPAIN: Gerona, Llafranch, 2.vi.1975 (*Hollis*); 1 ♂, 4 ♀, SPAIN: Huelva, 20 km S. Almante, 13.vi.1977, from *Erica arborea* (*Hollis*). 2 ♀, labelled 'Andalusia, Rambur collection, *ericae* Curt. M. Leth'. 4 ♀, labelled 'Andalusia, Rambur collection, sp.n.'. 4 ♂, 18 ♀, PORTUGAL: nr. Nazare, 17.ix.1979, on *Erica* sp. (*Lienhard*) (in coll. D. Burckhardt).

Strophingia harteni sp.n. (Figs. 8, 17, 19, 26, 36, 50 and 51)

Holotype ♂, AZORES: Flores, 24.ix.1979, from *E.azorica* (*van Harten*).

Paratypes. 8 ♂, 19 ♀, data as holotype. 1 ♀ labelled 'Azores: S. Miguel, Furnas, 23.vii–1.vii. Frey. *Rhinocola*'.

Cladistic relationships with the genus *Strophingia*

Fig. 54 is the most parsimonious cladistic estimate of phylogeny within the genus based on an analysis of the qualitative characters 21–34 and on a further series of qualitative characters (35–39) derived from the initial quantitative character set (Table 1). In each case the (0) state is assumed to be the plesiomorphic state and the (1) state the apomorphic. All characters are used in the cladogram; with the exception of numbers 21, 27 and 34, each is uniquely derived. In consequence, in the most parsimonious solution, characters 21, 27 and 34 must be regarded as being multiply derived. *Strophingia proxima, hispanica, harteni* and *arborea* form

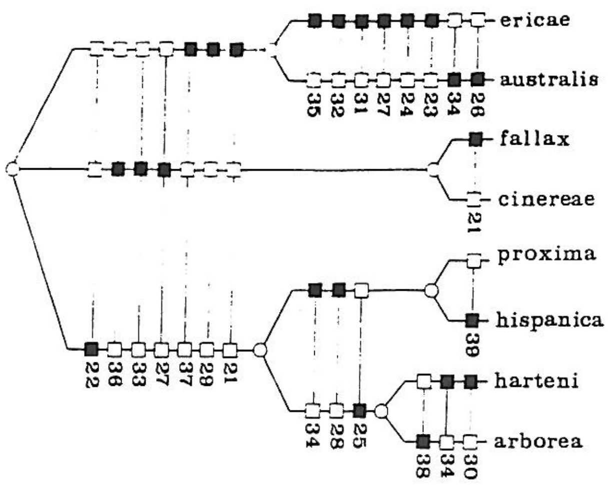


FIG. 54. Cladogram to illustrate proposed phylogeny of *Strophingia* species. Black squares are apomorphic character states, open squares are plesiomorphic character states. Numbers refer to characters listed in Table 1. The ancestral species is assumed to have possessed all characters in the plesiomorphic state. Characters 21, 27 and 34 are shown as being multiply derived.

a single clade defined by the absence of a costal break: *fallax/cinereae* and *ericae/australis* form two further separate clades. There are no derived characters which define the exact branching sequence between these three major clades and they are drawn as arising from a trifurcation. However, the evidence suggests that the *fallax/cinereae* clade is closer to the *ericae/australis* clade than to the *proxima/arborea* clade. For instance, *ericae, fallax* and *cinereae* share the same unique general paramere shape and *ericae, australis* and *fallax* all possess similar elongate female terminalia. Furthermore, all these species have retained the costal break. This suggests that perhaps the *ericae/australis* and the *fallax/cinereae* clades should split subsequent to the separation of the *proxima* group.

The possible isolating mechanisms which led to speciation are apparent in both the *fallax* and *proxima* groups. In the former, *fallax* occurs on Madeira whereas *cinereae* is confined to mainland Europe, Britain and Corsica. In the latter group, *proxima* is found on the Iberian peninsula, while the remainder are found on isolated islands: *hispanica* occurs on Mallorca, *harteni* on the Azores and *arborea* on Madeira and the Canaries. The mechanism leading to the separation of *ericae* and *australis* is less obvious: *ericae* is distributed throughout Europe, whereas *australis* is known only from Portugal.

The extent to which host-plant isolation in both a taxonomic and a geographical sense has contributed to speciation within the genus remains unclear as the host plant ranges of the different species are yet to be fully defined.

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