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The last instar larva of *Bactericera silvarnis* (Hemiptera, Psylloidea) and the taxonomic value of some setal characters

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The morphology of the fifth instar larva of *Bactericera silvarnis* is redescribed. The number of dorsal sectasetae, a character generally assumed to be stable, is shown to be very variable (setae sometimes even absent). Diagnostic characters differentiating *B. silvarnis* from *B. curvatinervis* and *B. substriola* are discussed. *B.* cf. *silvarnis* from Sicily is probably a distinct species.

Keywords: *Bactericera silvarnis*, Psylloidea, Triozidae, *Salix*, taxonomy, identification.

INTRODUCTION

Jumping plant-lice or psylloids are generally highly host specific. In Central Europe over 10 % (24 species) of the known psylloid species develop on *Salix* spp. (Salicaceae). The psylloids associated with *Salix* belong to the two large, predominantly holarctic genera *Cacopsylla* (Psyllidae) and *Bactericera* (Triozidae) which both include also species developing on other plant families. Both, *Salix* and associated psylloids are difficult to identify (Lautenschlager-Fleury 1994; Burckhardt & Lauterer 1997; Lauterer & Burckhardt 1997). This is particularly true for the larvae whose taxonomy is only incompletely known.

Bactericera silvarnis was originally described as subspecies of the widely distributed "*Trioza*" *curvatinervis* Flor based on British and questionably Czechoslovak material (Hodkinson 1974; see also Hodkinson & White 1979). Later Ossiannilsson & Hodkinson (1987) raised the taxon to species level and stated that the number of marginal sectasetae in *B. silvarnis* is higher than in *B. curvatinervis*. Burckhardt (1989) reported the species from each a locality in Algeria and Southern France respectively, and Burckhardt (2003) listed several localities from Brittany (France). Rapisarda (1994) described material from Sicily which he provisionally referred to *B. silvarnis* for the generally lower number of marginal sectasetae in the last larval instar compared to Ossiannilsson & Hodkinson's (1987) counts (table 1). Burckhardt & Lauterer (1997) summarised the known information on the species and added a record from Greece. In their key *B. silvarnis* larvae are keyed out with the species lacking dorsal sectasetae, and *B.* cf. *silvarnis* from Sicily with species bearing dorsal sectasetae. This is in contrast to White & Hodkinson (1982) who stated that the larva of "*curvatinervis*" (= *B. silvarnis*) bears sometimes dorsal sectasetae.

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The present paper examines the morphological variability of the last instar larva of *B. silvarnis* and compares it to that of the closely related *B. curvatinervis* and *B. substriola*.

MATERIAL AND METHODS

Following larval material was examined: – *Bactericera silvarnis* from the UK, England (Isle of Man, Hantshire, Berkshire), South Wales (Gwent) and from France (dép. Finistère) collected between 1973 and 1999; – *Bactericera curvatinervis* from Switzerland (cantons FR, GR, JU, SZ, TI, VS) collected between 1972 and 1997; – *Bactericera substriola* from Switzerland (cantons VS, GE) and Germany (Baden-Württemberg) collected between 1987 and 2001. The material is deposited in the Naturhistorisches Museum Basel, the Natural History Museum London (BMNH) and the Muséum d'histoire naturelle Geneva. The measurements, drawings and setal counts are from slide mounted material using a compound microscope.

The morphological terminology follows White & Hodkinson (1982) and Ossiannilsson (1992).

RESULTS

Description of the last instar larva of *Bactericera silvarnis*

Colour pale yellow to yellow-brown. Body broadly elliptical (fig. 1), similar to that of *B. curvatinervis* (fig. 2). Humeral lobe almost reaching anterior eye margin. Dorsal surface without (specimens from England: Hants Alice Holt Forest, 8. X. 1995, J.H. Martin 6623, BMNH) or with highly variable number of truncate sectasetae. Tarsal arolium similar to that of *B. curvatinervis*. Counts of lateral truncate sectasetae as in table 1.

Table 1. Mean of marginal sectasetae on one head side (HSS), one forewing pad (FWSS), one hindwing pad (HWSS) and the whole abdomen (ASS). SD = standard deviation. The sample size for *B. silvarnis* is n = 15, for *B. curvatinervis* n = 19 and for *B. substriola* n = 4. The data for *B.* cf. *silvarnis* from Sicily are taken from Rapisarda (1994).

Species	HSS	SD	range	FWSS	SD	range	HWSS	SD	range	ASS	SD	range
B. silvarnis	26.0	2.3	22-32	73.2	5.3	63-82	11.2	2.2	5-16	130.5	7.9	120-146
***B.* cf. *silvarnis* from Sicily**	-	-	18-24	-	-	43-56	-	-	5-8	-	-	90-104
B. curvatinervis	18.6	2.0	14-23	46.6	4.3	37-56	6.2	1.4	3-8	93.8	4.8	85-101
B. substriola	29.0	1.5	27-32	63.0	2.5	59-66	10.8	1.2	9-12	130.5	8.1	122-141

Measurements (in mm) and ratios (n = 2) as in table 2. Body length (BL) 1.93–1.98; body breadth (BB) 1.41–1.43.

Comments. *B. silvarnis* (fig. 1) and *B. curvatinervis* (fig. 2), which are similar in the body shape, differ in the numbers of marginal sectasetae (table 1) as was pointed out by Ossiannilsson & Hodkinson (1987). The closely related *B. substriola* has approximately the same number of marginal sectasetae as *B. silvarnis*. The

Table 2. Mesurements of body breadth/length ratio (BBBL), Caudal plate breadth/length ratio (CPR), forewing pad length (WL), antennal length (AL) and circumanal ring breadth (ARB) in mm. SD = the standard deviation. The sample size for *B. silvarnis* is n = 2, for *B. curvatinervis* n = 19 and for *B. substriola* n = 4.

Species	BBBL	SD	range	CPR	SD	range	WL	SD	range	AL	SD	range	ARB	SD	range
B. silvarnis	0.73	0.01	0.72-0.73	1.37	0.01	1.36-1.39	1.12	0.01	1.11-1.13	0.35	0.01	0.34-0.35	0.22	-	0.22-0.22
B. curvativernis	0.73	0.05	0.68-0.77	1.28	0.03	1.17-1.38	1.11	0.05	1.01-1.19	0.35	0.03	0.30-0.40	0.21	0.02	0.18-0.24
B. substriola	0.56	0.10	0.52-0.59	1.16	0.07	1.05-1.28	1.02	0.04	0.97-1.07	0.30	0.03	0.27-0.34	0.21	0.03	0.16-0.22

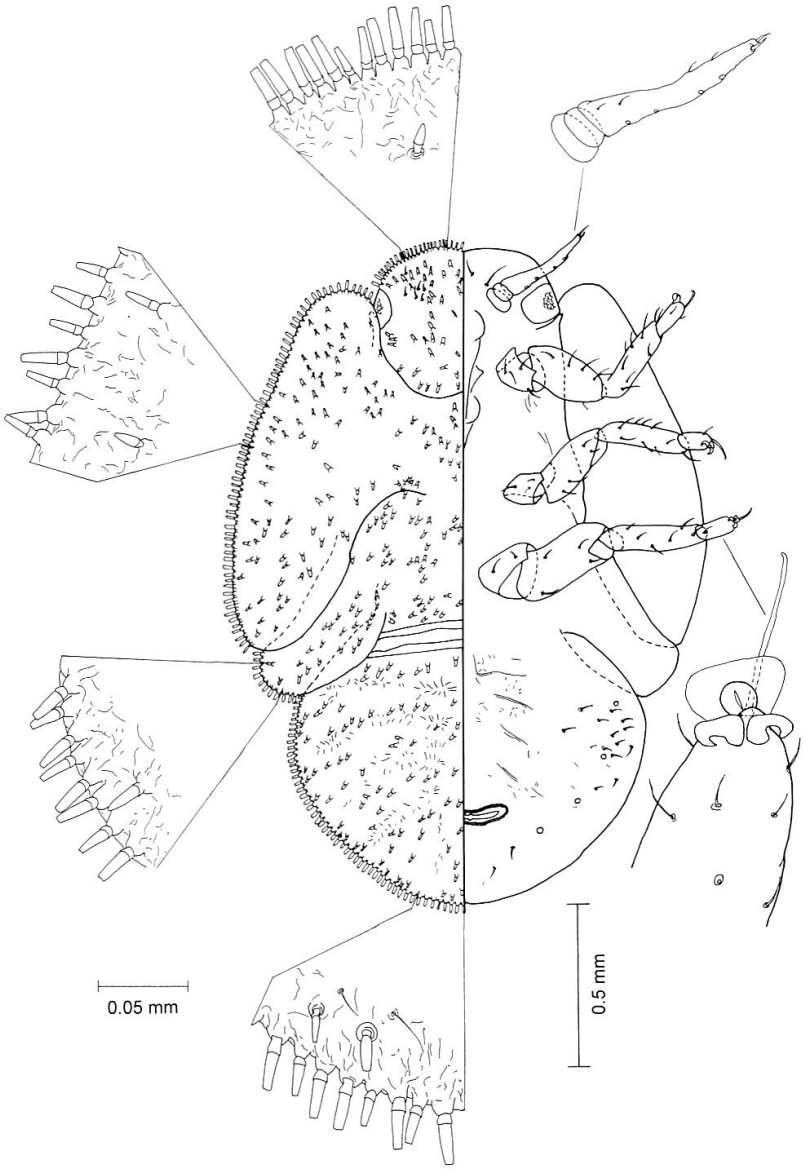

Fig 1. Fifth instar larva of *Bactericera silvarnis* (Hodkinson). Left dorsal side, right ventral side with details of sectasetae, antenna and tarsal apex.

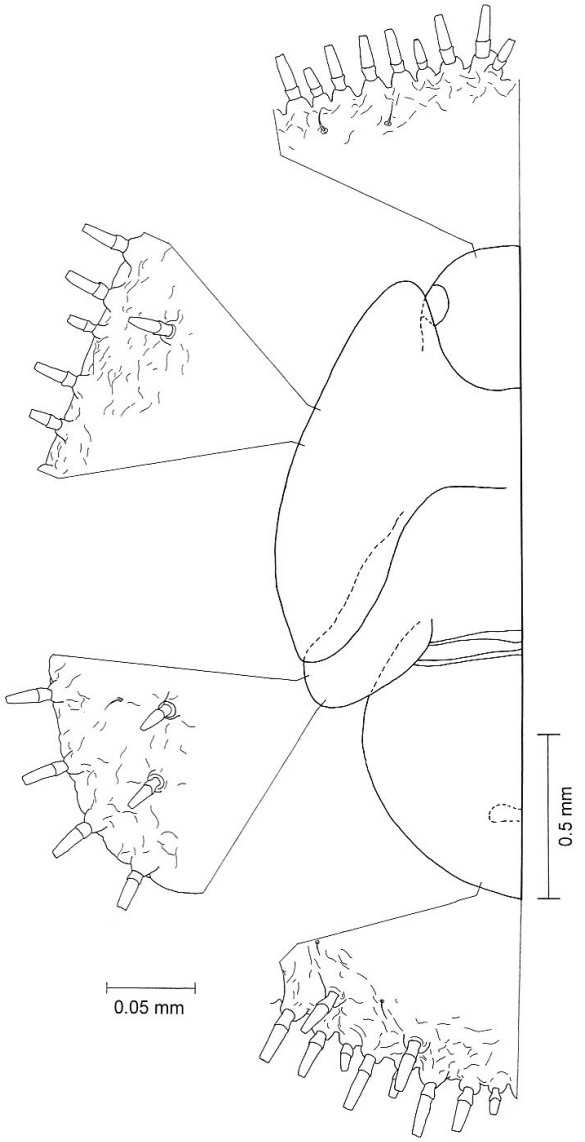

Fig 2. Outline of left side of fifth instar larva of *Bactericera curvatinervis* (Förster) with details of sectasetae.

last two species differ significantly in the body shape (table 2). The body of *B. substriola* (fig. 3) is much more elliptical than that of *B. silvarnis* and *B. curvatinervis*. The humeral lobe of *B. substriola* is short and does not reach the anterior eye margin as that of the other two species.

Presence or absence of sectasetae on the dorsal body surface cannot be used to identify *B. silvarnis* larvae contrary to the key of Burckhardt & Lauterer (1997). *B. silvarnis* larvae were treated there as lacking dorsal sectasetae. Specimens bearing dorsal sectasetae run in this key to *B. curvatinervis* and *B.* cf. *silvarnis* from Sicily from which they can be differentiated by the number of marginal sectasetae on the forewing pads and on the abdomen (table 1). A revised key is provided here for the known fifth instar larvae of the European *Bactericera* spp.

1 Dorsal body surface with sectasetae 2
– Dorsal body surface without sectasetae 5

2 Sectasetae on head and thorax subacute apically. Body breadth/length ratio (BBBL) larger than 1.6 (table 2) ..... ***B. substriola***
– Sectasetae on head and thorax truncate apically. Body breadth/length ratio (BBBL) smaller than 1.6 (table 2) 3

3 More than 60 marginal sectasetae on each forewing pad and more than 110 marginal sectasetae on the whole abdomen ..... ***B. silvarnis***
– Less than 60 marginal sectasetae on each forewing pad and less than 110 marginal sectasetae on the whole abdomen 4

4 More than 10 dorsal (excluding lateral) sectasetae present on each forewing pad ..... ***B. curvatinervis***

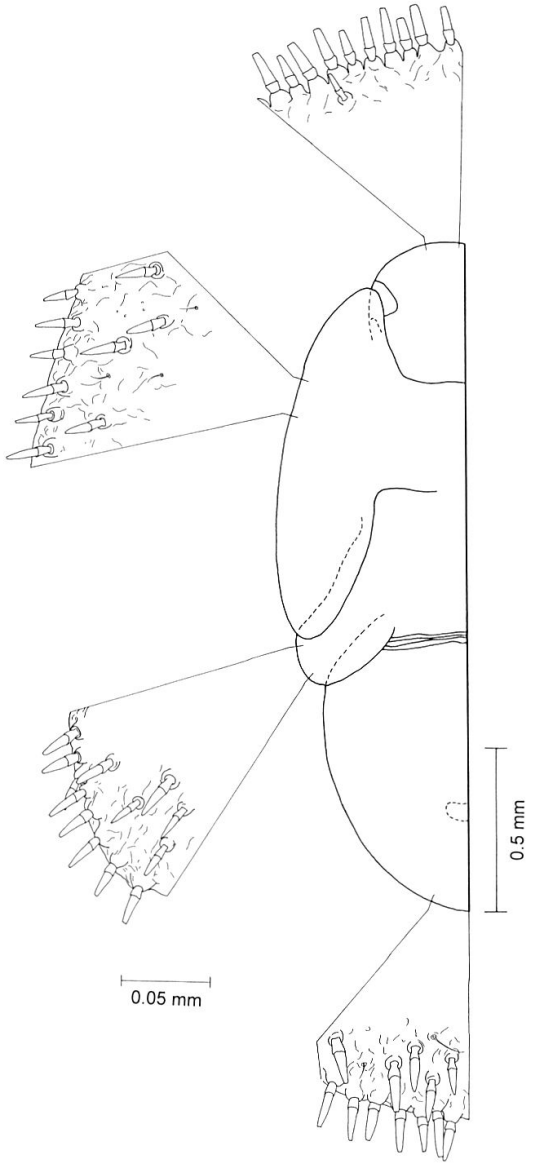

Fig 3. Outline of left side of fifth instar larva of *Bactericera substriola* Ossiannilsson with details of sectasetae.

– Less than 10 dorsal (excluding lateral) sectasetae present on each forewing pad ***B.* cf. *silvarnis*** from Sicily

5 More than 100 marginal sectasetae on each forewing pad 6
– Less than 100 marginal sectasetae on each forewing pad 8

6 More than 130 marginal sectasetae on each forewing pad ..... ***B. maura***
– Less than 130 marginal sectasetae on each forewing pad 7

7 Humeral lobe of forewing pads narrowly rounded. Less than 120+120 and 105+105 marginal sectasetae on forewing pads and abdomen respectively. In higher altitudes ..... ***B. parastriola***
– Humeral lobe of forewing pads widely rounded. More than 120+120 and 105+105 marginal sectasetae on forewing pads and abdomen respectively. In lower altitudes ..... ***B. striola***

8 Abdominal margin with less than 70+70 sectasetae ..... ***B. silvarnis***
– Abdominal margin with more than 70+70 sectasetae 9

9 Width of poles of sectasetae on forewing pads less than interspaces between successive setae ..... ***B. albiventris***
– Width of poles of sectasetae on forewing pads greater than or equal to interspaces between successive setae ..... ***B. salicivora***

DISCUSSION

Our setal counts of the fifth instar larvae of *Bactericera silvarnis* and *B. curvatinervis* are consistent with those of White & Hodkinson (1982) and Ossiannilsson & Hodkinson (1987). We also confirm the findings of White & Hodkinson (1982) regarding the dorsal truncate setae in *B. silvarnis* (dealt under the name *curvatinervis*) which are sometimes present. According to our observations dorsal sectasetae are very variable in number in *B. silvarnis* and can even be completely absent. This is in contradiction to Burckhardt & Lauterer (1997) who suggested dorsal sectasetae are always lacking. The number of sectasetae is generally considered to be reasonably constant constituting an important diagnostic feature within Psylloidea. A similar variation has been described in *Trioza vitreoradiata* (Maskell) by Martin & Malumphy (1995) suggesting to be more cautious in using this character in future. The number of sectasetae is even variable within a single specimen when comparing the left and right body half (table 3).

Table 3. Difference in numbers of marginal sectasetae between the right and the left side of the same individual. FWSSD = forewing pad margin sectasetae difference, HWSSD = hindwing pad margin sectasetae difference, HSSD = head margin sectasetae difference, min. = smallest difference between the numbers of counted sectasetae on the left to the right side, max. = largest difference between the numbers of counted sectasetae on the left to the right side.

Species	FWSSD	min.-max.	HWSSD	min.-max.	HSSD	min.-max.
Bactericera silvarnis	3.5	0-10	1.7	0-6	1.7	0-5
Bactericera curvatinervis	1.9	0-8	0.7	0-2	1.1	0-4
Bactericera substriola	2.0	1-3	0.5	0-1	1.5	1-3

Our observations confirm that *B.* cf. *silvarnis* from Sicily of Rapisarda (1994) has consistently lower numbers of marginal sectasetae compared to *B. silvarnis*. The taxon is probably a distinct species but additional material should be examined as has been suggested by Rapisarda (1994).

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