REVIEW OF THE SUBGENUS TRIFURCULA (LEVARCHAMA),
WITH TWO NEW SPECIES (LEPIDOPTERA: NEPTICULIDAE)

NIEUKERKEN, E. J. VAN

National Museum of Natural History Naturalis
PO Box 9517, 2300 RA Leiden, The Netherlands; e-mail: nieukerken@naturalis.nl

The subgenus Trifurcula (Levarchama) is reviewed. It comprises seven species, two of which are described as new: Trifurcula (Levarchama) peloponnesica VAN NIEUKERKEN sp. n., found in Greece: Peloponnesus and feeding on Anthyllis hermanniae, and Trifurcula (Levarchama) manygoza VAN NIEUKERKEN, A. LAŠTŮVKA et Z. LAŠTŮVKA sp. n., from Croatia and northern Greece, feeding on Lotus corniculatus. The subgenus occurs throughout Europe and the Mediterranean, and all species make leafmines on Fabaceae: Loteae. All species are diagnosed and biology and distribution are discussed, including new hostplant and distributional records. The phylogeny is discussed on the basis of morphological characters and hostplant relationships are discussed. The Macaronesian T. ridiculosa WALSINGHAM is sister to a clade comprising the remaining species. Lotus is most likely the plesiomorphic hostplant choice, with two host shifts to respectively Anthyllis and Coronilla.

Key words: Nepticulidae, new species, leafminers, biology, distribution, hostplants, Fabaceae, Loteae, Anthyllis, Coronilla

INTRODUCTION

The nepticulid subgenus Levarchama BEIRNE, 1945 is the smallest of the three subgenera of the genus Trifurcula ZELLER, 1848, with five known species (VAN NIEUKERKEN 1986a, b). This contrasts with the larger subgenera Trifurcula s. str. and Glaucolepis BRAUN which have 28 and 27 named species respectively and to which belong many unnamed species that are known in collections (VAN NIEUKERKEN 1990, VAN NIEUKERKEN & PUPLESIS 1991, Z. & A. LAŠTŮVKA 1994, A. & Z. LAŠTŮVKA 2000, 2005, DIŠKUS & PUPLESIS 2003). For Levarchama only two unnamed species were known to us, which are here described as new; for comparison the southern European and Macaronesian species T. anthyllidella KLIMESCH, 1975 and T. ridiculosa (WALSINGHAM, 1908) are redescribed. The other three, widespread, European species have been amply described (VAN NIEUKERKEN & JOHANSSON 1990, A. & Z. LAŠTŮVKA 1997) and are only diagnosed here with notes on biology and distribution. Host plant relationships and phylogeny are discussed.
MATERIAL AND METHODS

Material – For the collections I use the abbreviations from EVENHUIS and SAMUELSON (2004) with the following additions: AL – Collection – A. LAŠTŮVKA (Prostejov, Czech Republic); GB Collection Giorgio Baldizzone (Asti, Italy). Material from Spain, Portugal, France and Corsica listed recently (VAN NIEUKERKEN et al., 2004a, 2006), is not repeated here.

Methods – Distribution maps were prepared with DMAP 7.0 (Morton 2000). For these maps I have used the examined material supplemented with the data from the original descriptions and reliable literature records. UTM coordinates (here given in the material lists) or longitude/latitude when not given on labels or in references, were mainly derived from a few major internet gazetteers and one atlas (IGN 1997–2003, Times 2000, NIMA 2004).

Genitalia preparations were embedded in Euparal, following the methods described in VAN NIEUKERKEN et al. (1990). Slide numbers, when given without letters, refer to EvN numbers, from which RMNH numbers (if relevant) can be calculated by adding 20,000 (slide EvN 3717 = RMNH INS 23717).

Morphological terms follow VAN NIEUKERKEN et al. (1990). Hostplant nomenclature follows ILDIS (2005) (Table 1).

Photographs of moths, leafmines and genitalia slides were taken with a Zeiss AxioCam digital camera attached to respectively a Zeiss Stemi SV11 stereo-microscope or a Zeiss Axioskop H, using Carl Zeiss AxioVision software. Drawings of genitalia were made with a drawing tube attached to the Zeiss Axioskop. The SEM micrographs were made in 1980–1984 in the Free University, Amsterdam, with an ISI-40 scanning electron microscope, with a beam current of 5 or 10 kV on gold coated, air dried specimens.

Measurements of genitalia (presented in Table 2) were recently obtained from digital images, using AxioVision, 20× objective for male genitalia and 10× or 20× for females. Some older measurements were taken with an eyepiece reticule, with a precision of about 5 μm. Capsule length was measured from vinculum to middle of pseuduncus, excluding the uncus; valva length from tip of posterior process to ventral edge, excluding the sublateral process; aedeagus length was measured from the sclerotized tube, from tip of ventral process/carina, excluding any protruding vesica parts; length of cornuti was measured as the longest distance in ventral view, including any sclerotised basal pieces. Bursa length is measured from cloaca to anterior tip. Forewing length (see Table 2) was measured from tip of cilia to attachment on thorax, usually at magnification of 20×. Antennal segment counts (see Table 2) include scape and pedicel. Because measurements were obtained by different methods, with different accuracies, I refrain from giving mean and standard deviation; moreover, the sample size for genitalia measurements is usually very low, with exception for males of T. eurema (15 measured).

<table>
<thead>
<tr>
<th>Species</th>
<th>Host</th>
<th>Sources</th>
</tr>
</thead>
<tbody>
<tr>
<td>T. ridiculosa</td>
<td>Lotus sessilifolius</td>
<td>WALSINGHAM 1908, KLIMESCH 1977</td>
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<tr>
<td></td>
<td>Lotus campylocladus</td>
<td>KLIMESCH 1977</td>
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<td></td>
<td>Lotus glaucus</td>
<td>KLIMESCH 1977</td>
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<td></td>
<td>Lotus glinoides (as</td>
<td>KLIMESCH 1977</td>
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<tr>
<td>Arabicus L.)</td>
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<td></td>
<td>Lotus pedunculatus (=uliginosus)</td>
<td>this study</td>
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Acta zool. hung. 53 (Suppl. 1), 2007
<table>
<thead>
<tr>
<th>Species</th>
<th>Host</th>
<th>Sources</th>
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<tbody>
<tr>
<td><em>T. anthyllidella</em></td>
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<td>KLIMESCH 1975, NIEUKERKEN <em>et al.</em> 2004a</td>
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<td><em>Anthyllis terriflora</em></td>
<td>NIEUKERKEN <em>et al.</em> 2004a</td>
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<tr>
<td><em>T. peloponnesica</em></td>
<td><em>Anthyllis hermanniae</em></td>
<td>this study</td>
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<tr>
<td><em>T. cryptella</em></td>
<td><em>Lotus corniculatus</em></td>
<td>TUTT 1899, NIEUKERKEN &amp; JOHANSSON 1990</td>
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<tr>
<td></td>
<td><em>Lotus pedunculatus</em></td>
<td>NIEUKERKEN &amp; JOHANSSON 1990, NIEUKERKEN <em>et al.</em> 2004a</td>
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<tr>
<td></td>
<td>(=uliginosus)</td>
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<tr>
<td></td>
<td><em>Lotus hispidus</em></td>
<td>L'HOMME [1963]</td>
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<tr>
<td><em>Hippocrepis comosa</em></td>
<td></td>
<td>KLIMESCH 1951b, NIEUKERKEN &amp; JOHANSSON 1990, NIEUKERKEN <em>et al.</em> 2006</td>
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<td><em>Hippocrepis emerus</em></td>
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<td><em>Anthyllis montana</em></td>
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<td>NIEUKERKEN &amp; JOHANSSON 1990, NIEUKERKEN <em>et al.</em> 2006</td>
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<tr>
<td><em>T. eurema</em></td>
<td><em>Lotus corniculatus</em></td>
<td>TUTT 1899, NIEUKERKEN &amp; JOHANSSON 1990</td>
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<td><em>Lotus cytisoides</em></td>
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<td><em>Lotus maritimus</em></td>
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<td><em>Dorycnium pentaphyllum</em></td>
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<td>SUIRE 1928, NIEUKERKEN &amp; JOHANSSON 1990, NIEUKERKEN <em>et al.</em> 2006</td>
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<td><em>Dorycnium hirsutum</em></td>
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<td></td>
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<td>this study</td>
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<tr>
<td><em>T. manygoza</em></td>
<td><em>Lotus corniculatus</em></td>
<td>this study</td>
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<tr>
<td><em>T. ortneri</em></td>
<td><em>Coronilla coronata</em></td>
<td>KLIMESCH 1951b, NIEUKERKEN &amp; JOHANSSON 1990</td>
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<td><em>Coronilla vaginalis</em></td>
<td>KLIMESCH 1961, NIEUKERKEN &amp; JOHANSSON 1990</td>
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<td><em>Coronilla minima</em></td>
<td>NIEUKERKEN <em>et al.</em> 2004a, 2006</td>
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<td><em>Coronilla valentina</em></td>
<td>NIEUKERKEN <em>et al.</em> 2006, this study</td>
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<tr>
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<td>ssp. valentina</td>
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<td></td>
<td>ssp. glauca</td>
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<td></td>
<td>this study</td>
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</tr>
<tr>
<td><em>Coronilla viminalis</em></td>
<td></td>
<td>this study (mines only)</td>
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</table>

*pdf shows differences from printed version: corrections added, see last page*
**Table 2.** Numerical characters for *Trifucrula* (*Levarchama*) species. The ratio cornutus/aedeagus length refers to the largest cornutus.

<table>
<thead>
<tr>
<th></th>
<th>ridiculosa</th>
<th>anthyllidella</th>
<th>peloponnesica</th>
<th>cryptella</th>
<th>eurema</th>
<th>manygoza</th>
<th>ortneri</th>
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<tbody>
<tr>
<td><strong>Male</strong></td>
<td></td>
<td></td>
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<tr>
<td>Forewing length</td>
<td>1.85–2.1 mm</td>
<td>2.9–3.65 mm</td>
<td>2.15–2.8 mm</td>
<td>2.4–3.0 mm</td>
<td>2.0–3.2 mm</td>
<td>2.1–2.7 mm</td>
<td>2.5–2.92 mm</td>
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<tr>
<td><strong>Female</strong></td>
<td></td>
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<tr>
<td>Forewing length</td>
<td>1.55–1.8 mm</td>
<td>2.8–3.3 mm</td>
<td>2.25–2.6 mm</td>
<td>2.1–2.7 mm</td>
<td>2.1–2.65 mm</td>
<td>2.55 mm</td>
<td>2.3–2.7 mm</td>
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<tr>
<td><strong>Male genitalia</strong></td>
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<tr>
<td>Aedeagus length</td>
<td>259–284 µm</td>
<td>371–399 µm</td>
<td>308–327 µm</td>
<td>279–304 µm</td>
<td>256–300 µm</td>
<td>253–290 µm</td>
<td>295–325 µm</td>
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<tr>
<td>Longest cornutus</td>
<td>121 µm</td>
<td>132 µm</td>
<td>110–116 µm</td>
<td>86–116 µm</td>
<td>49–75 µm</td>
<td>50–82 µm</td>
<td>97–133 µm</td>
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<tr>
<td>2nd cornutus</td>
<td>95 µm</td>
<td>104 µm</td>
<td>74–94 µm</td>
<td>79–94 µm</td>
<td>43–64 µm</td>
<td>29–68 µm</td>
<td>70–95 µm</td>
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<tr>
<td>Ratio cornutus/aedeagus</td>
<td>0.46</td>
<td>0.33</td>
<td>0.34–0.38</td>
<td>0.29–0.39</td>
<td>0.18–0.27</td>
<td>0.18–0.28</td>
<td>0.32–0.45</td>
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<tr>
<td><strong>Female genitalia</strong></td>
<td></td>
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</tr>
<tr>
<td>Longest signum</td>
<td>351 µm</td>
<td>439 µm</td>
<td>380–442 µm</td>
<td>394–459 µm</td>
<td>347–420 µm</td>
<td>441 µm</td>
<td>399–505 µm</td>
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<tr>
<td>Shortest signum</td>
<td>273 µm</td>
<td>421 µm</td>
<td>380–404 µm</td>
<td>381–429 µm</td>
<td>334–399 µm</td>
<td>386 µm</td>
<td>296–475 µm</td>
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<tr>
<td>Setae on T8 (half)</td>
<td>12</td>
<td>11–12</td>
<td>11–12</td>
<td>12–14</td>
<td>13–14</td>
<td>21</td>
<td>8–16</td>
</tr>
<tr>
<td>Setae on T9 (half)</td>
<td>14</td>
<td>–</td>
<td>–</td>
<td>11–14</td>
<td>10–18</td>
<td>15–17</td>
<td>13–22</td>
</tr>
<tr>
<td>Convolution ductus spermathecae</td>
<td>3</td>
<td>10</td>
<td>7.5</td>
<td>9</td>
<td>7–8</td>
<td>9.5</td>
<td>6–7.5</td>
</tr>
</tbody>
</table>
Phylogeny – Species were used as terminal taxa. As outgroup I included exemplar species from the other subgenera and species groups: *Trifurcula (Glaucolepis) headleyella* (STANTON, 1854), *T. (T.) subnitidella* (DUPONCHEL, 1843) and *T. (T.) immundella* (ZELLER, 1839). The 24 characters scored are listed in the Appendix, the data matrix is given in Table 3. Parsimony analysis was executed with Paup 4.0b10 for Windows (SWOFFORD 2001).

**RESULTS**

*Trifurcula* (Levarchama)

Diagnosis – All species of *Levarchama* share the three most important apomorphies of the genus *Trifurcula*: the trifurculate condition of R+M in hindwing, the male abdomen with paired tufts on T6, T7 and T8 and the velvet patch of special scales on male hindwing underside (Fig. 10). Further in the forewing the connection between R2+3 and R4+5 is lost, shared with *Trifurcula s. str.* The only synapomorphy for *Levarchama* of the two listed by VAN NIEUKERKEN (1986b), that is present in all species is the longitudinally split uncus. The character: bursa being suddenly narrowed anteriorly may well be another apomorphy for *Levarchama*. The European species (thus excluding the Macaronesian *T. ridiculosa*) also share the hairpencil on the underside of the male hindwing (Fig. 9, the only external character), the globule group of strongly sclerotized cornuti at left side of the aedeagus, the pectinations in the female vestibulum, and the ductus spermathecae with more than six convolutions. Only the last character is also known within the other subgenera: in several *T. (Glaucolepis)* species, but in these the ductus starts with a long straight part before the coiled part.

Characters – Most species of *Levarchama* can be identified by a combination of colour pattern and geographic distribution, but *T. ortneri* and *T. manygoza* may be sympatric, at least in Croatia, and thus genitalia dissection is necessary for sepa-

<table>
<thead>
<tr>
<th>Table 3. Data matrix (for explanation of numbers in the header see the Appendix)</th>
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<tbody>
<tr>
<td>1</td>
</tr>
<tr>
<td>headleyella</td>
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<tr>
<td>subnitidella</td>
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<tr>
<td>immundella</td>
</tr>
<tr>
<td>ridiculosa</td>
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<tr>
<td>anthylidella</td>
</tr>
<tr>
<td>peloponnesica</td>
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<tr>
<td>eureka</td>
</tr>
<tr>
<td>cryptella</td>
</tr>
<tr>
<td>ortneri</td>
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<tr>
<td>manygoza</td>
</tr>
</tbody>
</table>

Acta zool. hung. 53 (Suppl. 1), 2007
rating this pair when not reared. In general dissection is providing better identifications, especially worn examples can easily be confused with species from other subgenera.

The hair-pencil (Fig. 9), separating the species from other Trifurcula subgenera, may be difficult to observe, especially in the pale species where there is very little contrast with the wings. Carefully moving the forewing upwards may sometimes be helpful to show the hair-pencil better, because it then appears from underneath the costal fold of the forewing.

The male genitalia are very uniform within this group, with best characters being the shape of the valva and inner processes, the shape of the uncus and size and shape of cornuti (Figs 34–40). The aedeagus of T. ridiculosa is rather different from the remaining species: the globose group of cornuti is missing, and two processes resemble the large cornuti, resulting in four long cornuti-like structures. One of these is the very narrow, needle-like ventral process (carina) or juxta, which is more triangular and bifurcate in the other species, another one is the narrow sclerotized part of the dorsal process of the aedeagus proper (Fig. 41). This dorsal process is also very characteristic in T. anthyllidella, where it has a serrate margin (very similar to some species in the Trifurcula (T.) subnitidella group, see VAN NIEUKERKEN 1990) and in T. peloponnesica, where it is spatulate (Figs 42, 43). In the remaining four species, the dorsal lobe is a conspicuous asymmetric extension at the right side (Figs 27, 44, 45), most strongly developed in T. ortneri. Measurement of cornuti is not always unequivocal, the sclerotization of the basic structure is variable, resulting sometimes in uncertainty about the starting point for measurement. However, the large size of the cornuti in cryptella is diagnostic, and also the difference between manygoza and ortneri is usually easy (see Table 2).

The female genitalia are rather similar to those of other Trifurcula subgenera, but the pectinations in the vestibulum in all species except ridiculosa, are unique (Figs 53, 58). In T. peloponnesica these are more elaborate and include spinelike structures (Fig. 59). This species and T. anthyllidella also share indistinct sclerotizations in the vestibulum and a distinct pointed ovipositor (S7 and T8), resulting in loss of the setose anal papillae (Figs 54–57).

Immature stages – The final instar larvae of three species were described by GUSTAFSSON & VAN NIEUKERKEN (1990). The larvae are yellow and feed with the ventral side upwards (Figs 65–70).

Biology (Figs 65–74) – All species make leafmines on herbs or small shrubs belonging to Fabaceae: Loteae. The mines are ophio-stigmatonomes: they start with a gallery and end with a blotch. In contrast to many other Nepticulidae, the larval exit-hole is typically on the leaf underside, although this is variable in T.
Figs 9–10. *Trifurcula cryptella*, hindwing structure, SEM micrographs (scales 20 µm): 9 = frenulum and hairpencil on hindwing underside, 10 = raised androconial scales of velvet patch and microtrichia on hindwing underside.
anthyllidella. *T. eurema* pupates usually inside the mine, the other species outside, on the soil or on debris.

Distribution – The subgenus occurs throughout Europe, from southern Scandinavia to the Mediterranean borders and also occurs in northern Africa, Macaronesia and Asia Minor.

CHECKLIST

*Trifurcula* ZELLER, 1848  
Subgenus *Levarchama* BEIRNE, 1945  
Type-species: *Nepticula cryptella* STAINTON, 1856 (original designation)  
*ridiculosa* (WALSINGHAM, 1908)  
*anthyllidella* KLIMESCH, 1975  
*peloponnesica* VAN NIEUKERKEN sp. n.  
*cryptella* (STAINTON, 1856)  
*? trifolii* (SORHAGEN, 1885)  
*eurema* (TUTT, 1899)  
*doryeniella* (SUIRE, 1928)  
*gozmanyi* (SZŐCS, 1959)  
*manygoza* VAN NIEUKERKEN, A. LAŠTŮVKA et Z. LAŠTŮVKA sp. n.  
*ortneri* (KLIMESCH, 1951)

*Trifurcula (Levarchama) ridiculosa* WALSINGHAM  
(Figs 1, 11–14, 28, 33, 34, 41, 46, 60, 71, 75)

*Stigmella ridiculosa* WALSINGHAM, 1908: 1011. LECTOTYPE ♂ (here designated): CANARY ISLANDS: Tenerife, Santa Cruz, Guimar, 8–14.II.1907, larva on *Lotus sessilifolius*, e.l. 6–8.IV. 1907, Wlsm. No 99255 [labelled as female], Genitalia slide BM30259 (BMNH) [examined].  
*Trifurcula ridiculosa*: KLIMESCH 1975: 15, 18 [genitalia and leafmines illustrated].  
*Trifurcula (Levarchama) ridiculosa*: KLIMESCH 1977: 199 [redescription]; AGUIAR & KARSHOLT 2006: 17 [recorded from Madeira].

Diagnosis – *Trifurcula ridiculosa* is a pale species, smaller than the next two species, which are also pale. It differs from the remaining *Levarchama* species by the absence of a hairpencil on hindwing. The only other *Trifurcula* with which it may be confused on the Canary islands is *T. (Glaucolepis) sanctaeerucris* (WALSINGHAM, 1908); it is the only known *Trifurcula* on Madeira. Male genitalia are very characteristic by the medial lobe of the valva, the absence of the globose group of cornuti and the presence of a long spiny juxta and dorsal lobe of aedeagus,
both resembling cornuti. Female genitalia differ from other *Levarchama* by few coils in ductus spermathecae and absence of group of pectinations in vestibulum.

Description – Male (Fig. 1). Forewing length 1.95–2.1 mm, wingspan ca. 4.1–4.5 mm. Head: frontal tuft mixed white and grey-brown, collar white, comprising piliform scales; scape white, mixed with grey-brown tipped scales. Antennae grey-brown, with 33–35 segments. Thorax and forewings cream white, irrorate with grey-brown tipped scales, cilia line distinct; underside grey-brown. Hindwings white to grey-white, underside with velvet patch of raised scales, without hairpencil. Abdomen grey-brown, anal tufts white.

Female. Forewing length 1.55–1.8 mm, wingspan ca. 3.8–4.1 mm. Antennae with 25–28 segments. Hindwing without velvet patch, abdomen without tufts; otherwise as male.

Male genitalia (Figs 11–14, 28, 33–34, 41). Capsule slightly longer than wide. Vinculum rounded anteriorly. Tegumen produced into pointed pseuduncus. Uncus split lengthwise, pointed. Gnathos with asymmetrical central element, with longitudinal keel. Valva relatively narrow, with prominent inner process in middle on ventral surface, outer margin rather straight in ventral view; sublateral process rather short, transverse bar of transtilla almost twice as long as sublateral process. Aedeagus: vesica with group of long needle like cornuti at anterior right hand side; two large slightly curved cornuti (Fig. 34), also some minute cornuti; aedeagus with two very long posterior prongs, slightly resembling cornuti in ventral view; one is the ventral carina or juxta process, the other the sclerotization of the dorsal lobe, at the left hand side (see lateral view in Fig. 14).

Female genitalia (Figs 46, 60). Abdominal tip broadly rounded. T8 wide, broadly truncate posteriorly, with ca. 12 setae on each half. T9 forming distinct anal papillae, with ca. 14 setae each. Posterior apophyses slightly shorter than anterior. Bursa total length ca. 870 µm. Vestibulum without sclerotizations. Corpus bursae elongate, suddenly narrowed anteriorly; signa different in length, ca. 275 µm and 350 µm respectively; 2–3 cells wide, outer margin with spiny margins. Ductus spermathecae convoluted almost from start, ca. 3 convolutions.

Biology – Hostplants: *Lotus* species, both endemic and widespread introduced species (see Table 1). Egg deposited on either side of a leaflet. Leafmine (Fig. 71) usually starting as a narrow gallery with thin broken frass, later gallery suddenly enlarging into elongate blotch; on *Lotus* with small leaflets eating out leaflet completely. Larval exit hole on leaf underside. There is a remarkable difference between mines from Madeira (Fig. 71) and from the Canary islands (KLIMESCH 1975, 1977): the early gallery in Madeiran mines is usually very much contorted, whereas the Canarian mines show a rather straight course. Larva yellow [from literature data, not examined].

Probably breeding continuously: larvae have been found in February, April, September, October and December, adults always emerged within 3–6 weeks after collecting.

Distribution (Fig. 75) – Only known from Canary Islands: Tenerife, La Palma, La Gomera, El Hierro (new record) and Madeira, including Porto Santo island.

Material examined – Portugal, Madeira: mines, larvae, Curral das Frias [Freiras] [28S CB12], 850 m, 21.ix.1997, O. Karsholt (RMNH); 1♂, 1♀, Porto Santo island, Pico do Castelo [28S CB75], 200 m, 17.i.1996, *Lotus* sp. e.l. 10.ii.1996, H. Henderickx (RMNH); Sao Vicente [28S CB03], 10 m,


*Trifurcula (Levarchama) anthyllidella* KLIMESCH

(Figs 2, 15–17, 30, 31, 35, 42, 47, 54, 55, 58, 65, 66, 72, 75)


*Trifurcula (Levarchama) anthyllidella*; VAN NIEUKERKEN et al. 2004a: 233 [distribution in Spain], VAN NIEUKERKEN et al. 2006: 380 [corrections].

Diagnosis – *Trifurcula anthyllidella* is by far the largest species of *Levarchama*, externally resembling other large and pale *Trifurcula* species, in Spain it can be confused with *T. (T.) pallidella* (DUPONCHEL, 1843) (see VAN NIEUKERKEN 2006), *T. (T.) immundella* (ZELLER, 1939), *T. calycotomella* A. et Z. LAŠTŮVKA, 1997 and with some as yet undescribed species. None of these has the conspicuous iroration of *anthyllidella*, nor the hairpencil on the hindwing underside. Some other large pale species have patches of yellow scaling on underside forewing (*T. luteola* VAN NIEUKERKEN, 1990 and *T. victoris* VAN NIEUKERKEN, 1990). Females are easily separated by the distinct pointed ovipositor. Male genitalia well recognisable by incurved outer margin of valva, inner lobe of valva and pointed gnathos; female genitalia by narrow truncate T8 and pointed S7.

Description – Male (Fig. 2). Forewing length 2.9–3.65 mm; wingspan ca. 5.6–7.4 mm. Head: frontal tuft white, occasionally mixed with grey-brown, collar white, comprising piliform scales; scape white with some grey-brown tipped scales. Antennae with 37–44 segments. Thorax and forewings uniform white, irrorate with a variable amount of grey-brown tipped scales, giving the whole wing a greyish appearance; underside dark grey-brown. Hindwing white, underside with velvety patch of raised scales; a long white hairpencil arising near frenulum, inserting under forewing costal fold. Abdomen grey-white, anal tufts white.

Female. Forewing length 2.8–3.3 mm, wingspan ca. 5.6–7.1 mm. Antennae with 32–38 segments. Hindwing without velvety patch, abdomen without tufts, ovipositor distinctly pointed; otherwise as male.

Male genitalia (Figs 15–17, 30–31, 35, 42). Capsule longer than wide. Vinculum hardly excavated anteriorly. Tegumen produced into pointed pseuduncus. Uncus split lengthwise, pointed. Gnathos with central element with a sharp central pointed tip (Fig. 31). Valva (Fig. 30) rather narrow, outer margin distinctly incurved in middle, with narrow conspicuous inner process on ventral surface; sublateral process long, transverse bar of transtilla relatively long. Aedeagus elongate; vesica with group of long needle like cornuti at anterior right hand side; two large curved cornuti (Fig. 35)
Figs 11–14. *Trifurcula ridiculosa*, male genitalia in ventral view: 11–12 = slide 3706, Madeira, Porto Santo, 13–14, Lectotype, slide BM30259, aedeagus in lateral view, ventral side to the right. Abbreviations: ca = carinal process, dsl = dorsal lobe, vp = ventral process/juxta

*Acta zool. hung.* 53 (Suppl. 1), 2007
Figs 15–19. Trifurcula (Levarchama) species, male genitalia in ventral view (15, 16, 18) or lateral view (17, 19): 15–17 = *T. anthyllidella*, Spain (Almeria): Sierra Almahilla, slides 3715 (15) and 2795 (16, 17); 18, 19 = *T. peloponnesica*, Greece (Messinia): Exokhóri, slides 3710 and 3719. Abbreviations: ca = carinal process; dl = dorsal lobe.
Figs 28–33. *Trifurcula* (*Levarchama*) species, details of male genitalia. 28–30 = left valva in dorsal view, on same scale; 31–33 = gnathos in ventral view, on same scale. 28, 33 = *T. ridiculosa*, slide 2889, Madeira, São Vicente; 29, 32 = *T. peloponnesica*, slide 3710, Greece (Messinia): Exokhóri; 30, 31 = *T. anthyllidella*, slide 3715, Spain (Almeria): Sierra Almahilla.
and semi globular group of close set curved cornuti at left side, also some minute cornuti; aedeagus dorsal side distally ending with rounded sclerotized lobe with serrate margin at right side (Fig. 42).

Female genitalia (Figs 47, 54–55, 58). Abdominal tip distinctly pointed. S7 particularly distinctly produced into cuspidate tip (Fig. 55), ventrally covered with many setae. T8 narrow, truncate at tip, longitudinally split, with ca. 11–12 setae at either side of medial division line and a row of ca. 7

Figs 33–45. Trifurcula (Levarchama) species, details of male genitalia: 34–40 = larger cornuti in ventral view, all on same scale: 34 = T. ridiculosa, slide 2889; 35 = T. anthyllidella, slide 3715; 36 = T. peloponnesica, slide 3710; 37 = T. cryptella, slide 1719; 38 = T. eurema, slide 2290, Denmark, Tipperne; 39 = T. manygoza, slide 3717; 40 = T. ortneri, slide 2622. 41–45 = strongly sclerotized dorsal lobe of aedeagus in ventral view, all on same scale (in 44 and 45 part of ventral process/carina drawn as well): 41 = T. ridiculosa, slide 2889; 42 = T. anthyllidella, slide 3715; 43 = T. peloponnesica, slide 3710; 44 = T. ortneri, slide 2363; 45 = T. manygoza, slide 3717. Scales 50 µm
short setae along distal margin (Fig. 54). No distinct anal papillae. Anterior and posterior apophyses pronounced, of subequal length. Bursa total length ca. 1020 µm. Vestibulum with two indistinct sclerotizations and group of pectinations (Fig. 58). Corpus bursae elongate, suddenly narrowed anteriorly; signa subequal in length, ca. 420–440 µm; 3–4 cells wide, outer margin with spiny margins. Ductus spermatothecae convoluted almost from start, ca. 10 convolutions ending in elongate vesicle.

Biology – Hostplant: *Anthyllis cytisoides* and *A. terniflora*, small shrubs growing in garigue (mattoral) vegetations on limestone hills. Egg deposited on leaf underside. Leafmine (Figs 65–66, 72) starting as narrow, relatively straight, gallery with thin broken frass, later frass filling most of gallery, and gallery suddenly enlarging into elongate blotch; mine usually starting along leaf margin, later doubling back. Larval exit hole on leaf under- or upperside. Larva yellow, feeding with venter upwards.

Larvae found almost throughout the year, adults found from March to August, with extended period of emergence.

Distribution (Fig. 75) – Spain: Mallorca and along the South and East coast from Cadiz to Gerona on limestone, up into the mountains (VAN NIEUKERKEN et al. 2004a).

Material examined. Not repeated here, all the material was listed by VAN NIEUKERKEN et al. (2004a). Two records of this material have recently been removed, because they were incorrectly identified (VAN NIEUKERKEN 2006): Spain (Granada): Sierra Nevada, Carretera del Veleta, 1750 m, 15.vii.1971, J. KLIMESCH [re-identified as *T. cryptella*]; Spain (Málaga): Marbella 10 km N, 24–25.iv.2001, J. Junnilainen [re-identified as *Trifurcula pallidella*].

Trifurcula (Levarchama) peloponnesica VAN NIEUKERKEN sp. n.  
(Figs 3, 4, 18, 19, 29, 32, 43, 48, 56, 57, 59, 73, 76)

? ‘eine Neptikel’; SKALA 1937: 110 [description of mines on Corsica].

? Nepticula sp.; BUHR 1942: 29 [description of mines on Corsica].

? Trifurcula (Levarchama) sp.; VAN NIEUKERKEN et al. 2006: 99 [Corsica].

Trifurcula sp. 2; GOZMÁNY 2007: in press [Greece].


Paratypes 4 ♂, 5 ♀, 1 ♀, same data as holotype; 3 ♂, 4 ♀, Messinia: 1.5 km NE Exokhóri, gorge in Taitetos Oros, UTM 34S FF1386, 17.ii.1990, leafmines on *Anthyllis hermanniae*, EvN no 90054, e. l. 24.iii.–10.viii.1990, E. J. van Nieukerken. Genitalia slides 3179, 3710 (males), 3705, 3711 (females) (all in RMNH).

Other material – Leafmines on *Anthyllis hermanniae*, from the two localities cited above and from the following: Lakonia: 3.5 km N Molaoi, maquis, 34S FF6578, 120 m, 14.ii.1990, EvN no. 90036; Lakonia: Nomia, 7 km SW Monemvasia, 34S FF7958, 100 m, 12.ii.1990, EvN no. 90027;
Diagnosis – *Trifurcula peloponnesica* is externally very similar to the allopatric and much larger *T. anthyllidella*. In the male genitalia it is easily distinguished by the rounded gnathos and the straight outer margin of the valva. Female genitalia differ from *anthyllidella* by pointed T8 (truncate in *anthyllidella*), group of spines in vestibulum in contrast to pectinations only and fewer convolutions in the ductus spermathecae (ca 7.5 against 10). Externally *T. peloponnesica* may be confused with other pale *Trifurcula* species in other subgenera, in the area where it occurs, particularly *T. (T.) pallidella*, which, however, is overall paler (see VAN NIEUKERKEN et al. 2004b).

Description – Male (Fig. 3). Forewing length 2.15–2.8 mm, wingspan ca. 4.6–5.7 mm. Head: frontal tuft pale ochreous, mixed with white to almost completely white, collar white, comprising piliform scales; scape white, with some dark tipped scales. Antennae with 33–34 segments. Thorax and forewings cream white, irrorate with brown tipped scales; underside grey. Hindwings white, underside with velvet patch of raised scales; hairpencil on hindwing underside present, but very difficult to distinguish. Abdomen pale grey, anal tufts whitish.

Female (Fig. 4). Forewing length 2.25–2.6 mm, wingspan 4.9–5.3 mm. Antennae with 27–33 segments. Hindwing without velvet patch, abdomen without tufts, but with pointed ovipositor; otherwise as male.

Male genitalia (Figs 18, 19, 32, 36, 43). Capsule slightly longer than wide. Vinculum hardly excavated anteriorly. Tegumen produced into pointed pseuduncus. Uncus split lengthwise, pointed. Gnathos with broad rounded central element. Valva basally broad, suddenly narrowed slightly before middle, with narrow conspicuous inner process on dorsal surface, outer margin straight in ventral view; sublateral process relatively long, transverse bar of transtilla short. Aedeagus rather broad and short; vesica with group of long needle like cornuti at anterior right hind side; two large curved cornuti (Fig. 36) and semi globular group of close set curved cornuti at left side, also some minute cornuti; aedeagus dorsal side distally ending with pointed sclerotized lobe at right side (Fig. 43).

Female genitalia. Abdominal tip distinctly pointed. S7 particularly distinctly produced into narrow cuspidate tip (Fig. 57), ventrally covered with many setae. T8 approximately triangular, longitudinally split, with ca. 11–12 setae at either side of medial division line (Fig. 58). No distinct anal papillae. Anterior and posterior apophyses pronounced, of equal length. Bursa total length ca. 825–840 µm. Vestibulum with pocket of small spines and pectinations (Fig. 59). Corpus bursae elongate, slightly narrowed anteriorly; signa 2–3 cells wide, outer margin of incomplete cells with spiny margins. Ductus spermathecae convoluted almost from start, ca. 7.5 convolutions, ending in a globose vesicle.

Biology – Hostplant: *Anthyllis hermanniae*, a small shrub growing in garigue or phrygana vegetations. Egg deposition not observed. Leafmine (Fig. 73) starting as narrow, relatively straight, gallery with thin broken frass, later frass filling most
Figs 46–51. *Trifurcula (Levarchama)* species, female genitalia in ventral (46, 47) and dorsal view: 46 = *T. ridiculosa*, slide 3714, Madeira, São Vicente; 47 = *T. anthyllidella*, slide 3716, Spain (Almería): Sierra Almahilla; 48 = *T. peloponnesica*, slide 3705, Greece (Messinia): Exokhóri; 49 = *T. cryptella*, slide 1720, Netherlands (Limburg), Kunrade; 50 = *T. eurema*, slide 2297, Spain (Málaga), Sierra Blanca; 51 = *T. ortneri*, slide 2626, Hungary, Budapest, Rupphegy
Figs 52–59. *Trifurcula (Levarchama)* species, female genitalia and details thereof: 52–53 = *T. manygoza*, slide 3718, Greece (Trikala): Oxinia, Paratype, in 53 detail of pectinations in vestibulum; 54–55 = *T. anthyllidella*, slide 3716, detail of abdominal tip, dorsal T8 (54) and more ventral S7 (55); 56–57 = *T. peloponnesica*, slide 3705, detail of abdominal tip, dorsal T8 (56) and more ventral S7 (57); 58 = *T. anthyllidella*, slide 3716, detail of pectinations in vestibulum; 59 = *T. peloponnesica*, slide 3705, detail of spines and pectinations in vestibulum
of gallery, and gallery suddenly enlarging into elongate blotch. Larval exit hole on leaf underside. Larva yellow, feeding with venter upwards.

Larvae found plentiful in February, and a few still in June. Adults in laboratory emerging over long period from March to August.

Distribution (Fig. 76) – Up to now only known with certainty from Greece: Peloponnesus, where I found the species everywhere I searched the host. Anthyllis hermanniae occurs on Corsica, very locally on Sardinia, Malta, on the Italian mainland only in southern Calabria and the Peninsola Salentina, in Greece on the Peloponnesus, Evvoia, Crete, the Aegean islands, southern Thrace and the west coast of Turkey: Asia Minor plus a few isolated localities in Albania and Montenegro (see map in RIKLI 1946: 480); records for Sicily appear to be incorrect (ILDIS 2005). In Corsica H. Buhr found also leafmines on this plant (SKALA 1937; BUHR 1942), and it is very well possible that they also belong to *T. peloponnesica*. However, this should be confirmed by reared material. In May 2006, P. SAMMUT (pers. comm.) searched in vain for mines on Malta.

Etymology – *Peloponnesica*, an adjective, after the area where the species was first found.

**Trifurcula (Levarchama) cryptella** STAINTON

(Figs 5, 20, 37, 49, 61, 68)

*Nepticula cryptella* STAINTON, 1856 (12 January): 41. LECTOTYPE ♂ (designated by EMMET 1975): Switzerland: [Zürich, June], Frey, “6 2024”, STAINTON Coll., Genitalia slide 24090 (BMNH) [examined].

*Nepticula cryptella* FREY, 1856 (published later than May): 378.

? *Nepticula trifoli* SORHAGEN, 1885: 280. SYNTYPES: Leafmines, Germany: Hamburg, Eppendorfer Moor, Juli, on *Trifolium* sp., leg. Lueders & Sorhagen (types probably lost) [not examined, identity and identification host uncertain].

*Levarchama cryptella*; BEIRNE 1945: 207 [recombination]; EMMET 1976: 211 [British Isles].

*Trifurcula cryptella*; BORKOWSKI 1975: 501 [recombination, Poland].


Diagnosis – Differs from all other species by dark forewings with a costal spot only. In this it resembles a number of *Trifurcula (Glaucolepis)* species, such as *T. magna* A. et Z. LAŠTŮVKA, 1997 and *T. bupleurella* (CHRÉTIEN, 1907), which, however, lack the hairpencil on hindwing underside. Other Nepticulidae with this colour pattern may be confused, but differ by the generic characters. Male genitalia very similar to *T. eurema* and *manypoza*, but cornuti markedly larger (Fig. 37): largest 86–116 µm.

*Acta zool. hung.* 53 (Suppl. 1), 2007
Biology – T. cryptella is the most polyphagous Trifurcula species, occurring on several Lotus and Hippocrepis species, and also on Securigera varia and Anthyllis montana (Table 1). These genera – although all in the tribe Loteae – are not closely related (ALLAN & PORTER 2000, ARAMBARRI 2000, ALLAN et al. 2003).

The leafmines of T. cryptella (Fig. 68) are very similar to those of eurema, but in contrast to that, T. cryptella never pupates inside the mine; mines on Lotus are inseparable from those of T. manygoza. According to COMPTON (1981), T. cryptella prefers the terminal leaflet of a Lotus leaf (25 out of 33 mines). This author also provides information on three parasitic Hymenoptera (Eulophidae), reared from T. cryptella.

Present data suggest that T. cryptella is always univoltine, with the majority of larvae found from June to August, but especially in the south also in September and October. Adults fly from April to August.

Distribution – Widespread throughout Europe, northwards to southern parts of Norway and Sweden, but not in Finland, eastwards to Poland and the Balkan Peninsula, and south to the Mediterranean countries, but there rare and confined to mountainous regions: in Italy only recorded from the northern part, in Portugal in the Serra da Estrêla, in Spain in the Cantabrian mountains and possibly the Sierra Nevada. Absent from the Mediterranean islands. In this area not yet recorded from Albania, Belgium, Bosnia, Rumania, and Turkey.

Remarks – The record from Spain: Barcelona (VAN NIEUKERKEN et al. 2004a) was a misidentification for T. eurema (VAN NIEUKERKEN 2006). In the latter paper, T. cryptella was reported from the Sierra Nevada, based on material earlier misidentified as T. anthyllidella. These specimens were reported as reared from Rhamnus myrtifolius. I have checked photographs of these plants and mines kindly provided by ANDREAS SEGERER (Zucht: 1028), and they almost certainly represent Stigmella mines, most likely S. alaternella (LE MARCHAND, 1937) and the hostplant seems to be correctly identified (by P. LITZLER, Dijon). How the cryptella specimens got mixed into that material is a mystery. The specimens are very pale compared to normal cryptella, but show normal male genitalia. Further research of this population (if it exists) is required to find the correct host and to study the relationship between this (isolated?) population and more northern populations.

Trifurcula (Levarchama) eurema TUTT
(Figs 6, 21, 38, 50, 62, 69, 70)

Nepticula eurema TUTT, 1899: 332. LECTOTYPE (designated by VAN NIEUKERKEN & JOHANSSON 1990): Great Britain; England [Melvish, Sutherland], Harper Coll., Walsingham Coll., Genitalia slide BM24091 (BMNH) [examined].

Nepticula dorycniiella SUIRE, 1928: 128. SYNTYPES: France; Montpellier, iv.1927, SUIRE (depository unknown) (synonymised by VAN NIEUKERKEN 1986a: 15) [not examined].

Nepticula gozmányi SZŐCS, 1959: 417. HOLOTYPE ♂: Hungary; Római-fürdő, Budapest, 2 June 1957, e.l., leg. SZŐCS, gen. prep. no 669, GOZMÁNY (HNHM) (synonymised by VAN NIEUKERKEN 1986a: 15) [paratypes examined].

Levarchama eurema BEIRNE 1945: 207 [recombination]; EMMET 1976: 212 [British Isles].

Stigmella eurema; KLIMESCH 1951a: 66 [Italy].

Trifurcula eurema; BORKOWSKI 1975: 501 [recombination].


Diagnosis – Differs from all other species of Levarchama by the dark forewings with a costal and dorsal spot, sometimes united as a fascia. Within European Trifurcula this colour pattern is unique. Other Nepticulidae with this colour pattern may be confused, but differ by the generic characters. Male genitalia almost inseparable from T. manygoza (see there), cornuti markedly smaller than in T. cryptella (Fig. 38): 49–75 μm.

Biology – Recorded from several Lotus and Dorycnium species, which, according to recent phylogenetic studies, belong to one clade (ALLAN et al. 2003). Here for the first time recorded from Dorycnium rectum and Lotus cythisoides (see material). The leafmines of T. eurema can usually be distinguished from sympatric T. cryptella by the habit of the larva to spin the cocoon inside the mine. However, occasionally populations or parts thereof do not pupate inside the mine. This may be caused by climatic conditions. T. eurema has at least two broods annually, probably more in southern Europe, where larvae can also be found in winter.

Distribution – Widespread throughout Europe, very similar to T. cryptella, northwards to southern Norway (AARVIK et al. 2004) and Sweden, but not in Finland, Poland or the Baltic states; more widespread and common in the Mediterranean region than cryptella and also common on the larger Mediterranean islands and eastwards to Bulgaria (BUSZKO & BESHKOV 2004), Asiatic Turkey and Ukraine (new record). In this area not yet recorded from: Albania, Belgium, Bosnia, Romania and Serbia-Montenegro.


Trifurcula (Levarchama) manygoza
VAN NIEUKERKEN, A. LAŠTŮVKA et Z. LAŠTŮVKA sp. n.
(Figs 7, 24–26, 39, 45, 52–53, 63, 76)

Trifurcula sp. 1; GOZMÁNY 2007: in press [Greece].


Acta zool. hung. 53 (Suppl. 1), 2007
Diagnosis – *Trifurcula manygoza* is recognised by its uniform pale ochreous wings, externally very similar to *T. ortneri*; the male genitalia are almost inseparable from those of *T. eurema*, the female from those of *T. cryptella*. From *T. ortneri* it is separated by the more obtuse angle of the valva inner margin, the less conspicuous dorsal lobe of aedeagus and the slightly smaller cornuti (longest 50–82 µm against 97–133 in *ortneri*).

Description – Male (Fig. 7). Forewing length 2.1–2.7 mm, wingspan ca. 4.7–6 mm. Head: frontal tuft, yellowish white to orange; collar white, comprising piliform scales; scape white. Antennae pale grey, with 32–34 segments. Thorax and forewings uniform yellowish white, with ochreous tipped scales; underside grey. Hindwings white, underside white, with velvet patch of raised scales; a long, ochreous, hairpencil arising on hindwing underside near frenulum, inserting under the forewing costal fold. Abdomen with anal tufts yellowish.

Female. Forewing length 2.55 mm, wingspan ca. 5.5 mm. Antennae with ca. 29 segments. Hindwing without velvet patch, abdomen without tufts; otherwise as male.

Male genitalia (Figs 24–26, 39, 45). Vinculum slightly indented anteriorly. Tegumen produced into pointed pseuduncus. Uncus split lengthwise, pointed. Gnathos with rounded central element. Valva elongate triangular, with obtuse angle medially on inner margin; sublateral process rather long, transverse bar of transtilla longer than sublateral process. Aedeagus short; vesica with group of long needle like cornuti at anterior right hind side; two large curved cornuti (Fig. 39) and semi globular group of close set curved cornuti at left side, also some minute cornuti; aedeagus dorsal side distally ending with rounded sclerotized lobe at right side (Fig. 45); juxta ending into bifurcate ventral carina.

Female genitalia (Figs 52, 53, 63). T8 divided, slightly narrowed posteriorly, each half with ca 21 setae; anal papillae each with 15–17 setae; apophyses subequal in length. Bursa total length 872 µm. Vestibulum with patch of close set pectinations near spermathecal papilla (Fig. 53); signa 3–4 cells wide. Ductus spermathecae with ca. 9½ convolutions, ending in a globose vesicle.

Biology – Hostplant: *Lotus corniculatus*. Egg deposited on leaf underside. Leafmine starting as narrow, rather straight gallery with frass in thin central line, often close to leaf margin, suddenly enlarging in large blotch, often consuming entire leaflet. Larval exit hole on leaf underside. Larva yellow. Cocoon made outside mine. Mines are inseparable from those of *T. cryptella* on the same host, so that vacated mines on *Lotus* in the Balkan area, where both species occur, cannot be identified.

Larvae found in July, adults collected in June and August.

Distribution (Fig. 76) – Croatia and north-western Greece. To be expected in the other Balkan countries.
Etymology – Manygoza: a noun in apposition. It is a pleasure for us to dedicate this species to Dr. LÁSZLÓ GOZMÁNY, in honour of his contributions to lepidopterology and particularly in his stimulation of studies on the Greek fauna. Since the name Trifurcula gozmanyi was already in use (unfortunately synonymised with _T. eurema_), we are using an anagram of his name: it should be pronounced in the Latin way with the ‘y’ as vowel (similar to ‘i’) and not in the Hungarian way where the ‘y’ only changes the sound of the previous ‘n’.

_Trifurcula (Levarchama) ortneri_ KLIMESCH  
(Figs 8, 22, 23, 27, 40, 44, 51, 64, 67, 74, 77)

_Nepticula (Levarchama) ortneri_ KLIMESCH, 1951b: 66. SYNTYPES: AUSTRIA: Wien, Leopoldsb erg, late viii–late ix., _Coronilla montana_, e.l. 28.iii – mid v., A. Ortner (ZSM) [not examined].  
_Stigmella ortneri_; KLIMESCH 1961: 763 [Austria].  
_Nepticula ortneri_; SZŐCS 1965: 89 [Hungary].  
_Trifurcula ortneri_; BORKOWSKI 1975: 501 [recombination, Hungary].  

Diagnosis – Externally _T. ortneri_ cannot be distinguished from _T. manygoza_ (see there). The male genitalia are distinguished from _manygoza, eurema_ and _cryptella_ by the valva with a prominent right or almost right angle medially in the inner margin (Figs 22–23). The dorsal lobe of the aedeagus is more prominent than in the related species (Figs 27, 40). Female genitalia hardly separable from those of _T. eurema_, but anal papillae usually with more setae (14–22 in contrast to 11–14); separated from _T. manygoza_ by the smaller number of coils (6–7½) in the ductus spermathecae.

Biology – Recorded from a variety of perennial _Coronilla_ species, here recorded for the first time from _C. viminalis_ SALISB. (see material). A possible record from _Hippocrepis emerus_ (HUEMER & TRIBERTI 2004) (as _Coronilla emerus_) is based on adults beaten from that plant; since _Coronilla minima_ occurs on these localities as well, this record is regarded as dubious and omitted from Table 1. An earlier record from _H. emerus_ (A. & Z. LAŠTŮVKA 1997) was based on a misidentification of _Coronilla valentina_ (Z. LAŠTŮVKA, in litt. 7.vi.2006), which superficially resembles _H. emerus_.  
_T. ortneri_ is usually found on limestone, the preferred soil for all recorded hosts.

The leafmine (Figs 67, 74) differs from most other _Levarchama_ species, because the transition between gallery and blotch is less abrupt, and the blotch therefore more a widened gallery.
Distribution (Fig. 77) – Widespread in Western Mediterranean: Portugal: Algarve (new record), Spain, France, three records in Italy (Emilia-Romagna, Veneto), one record from Croatia: Dalmatia, Morocco and Algeria (new records), eastern Austria, Hungary, Slovakia, Germany: Baden-Württemberg and Thüringen. The record for Morocco is based on mines (on *Coronilla viminalis*) only, which resemble those on *Coronilla minima* in Spain closely. Since no other species is known to make leafmines on *Coronilla* in this area, and *T. ortneri* is also found in Algeria,

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**Figs 60–64. Trifurcula (Levarchama) species, dorsal view of female terminalia (T8 and T9 or anal papillae):** 60 = *T. ridiculosa*, slide 3714; 61 = *T. cryptella*, slide 1720; 62 = *T. eurema*, slide 2297; 63 = *T. manygoza*, slide 3718; 64 = *T. ortneri*, slide 2625, Germany (Thüringen), Bad Blankenburg

*Acta zool. hung.* 53 (Suppl. 1), 2007
the identity of these mines as *T. ortneri* is most likely correct. Also the Portuguese record is based on mines only, on *Coronilla valentina* ssp. *glauca*.

Remarks – Earlier we stated (VAN NIEUKERKEN *et al.* 2004a, 2006) that specimens reared from *Coronilla minima* are always smaller and more greyish than central European specimens reared from *C. coronata*. Upon re-examination of the material, I cannot maintain this statement: although the material reared from *C. minima* does include some very small specimens, many specimens have a size and coloration not different from other populations. Leaflet-size of *C. minima* is variable, and it is expected that very small leaflets will produce smaller adults.


**DISCUSSION**

**Phylogeny**

An exhaustive search with Paup software for maximum parsimony found four shortest trees, with a tree length of 34 steps. 17 out of the 24 characters are parsimony informative, the indexes are CI = 0.765 and RI = 0.758. As outgroups the species *Trifurcula* (*Glaucolepis*) *headleyella*, *T. (T.) immundella* and *T. (T.) subnitidella* represent the other subgenera of *Trifurcula*. The Majority Rule Consensus Tree is given in Fig. 78. The shown position of *T. manygoza* is supported in three of the four trees, all other branches are the same as in the strict consensus tree.

On the basis of this analysis, the monophyly of *Levarchama* is supported by two apomorphies: the split uncus (character 9) and the anteriorly narrowed bursa (8). *T. ridiculosa* is sister to a core *Levarchama*, which monophyly is supported by four characters: vestibulum with group of pectinations (4), ductus spermathecae with many coils (7), aedeagus with globose group of cornuti (18) and male with hairpencil on hindwing underside (22). The monophyly of the species pairs *anthyllidella-peloponnesica* is supported by at least four characters in the female genitalia; however, some of these may be correlated with the narrowed ovipositor, an adaptation to oviposition on hairy leaves. Although the pair *eurema-cryptella* is
monophyletic in this analysis, this is only supported by one character (21). Sis-
ter-group relationship of *T. manygoza* and this pair is weakly supported by the
valval shape (14). A possible – not scored – character for *T. ortneri* and this group
of three, is the shape of dorsal lobe of the aedeagus, but this may also be the

Figs 65–70. *Trifurcula (Levarchama)* species, leafmines with larvae: 65–66 = *T. anthyllidella* on *Anthyllis cytisoides*, resp. Spain (Cádiz), Alcalá de los Gazules, 6.i.2001 and Spain (Málaga), Istán, 10.ii.1984; 67 = *T. ortneri* on *Coronilla mínima*, young larva, Spain (Madrid), Los Santos de la Humosa, 11.i.2001; 68 = *T. cryptella* on *Securigera varia*, France (Savoie), Modane, 1100–1200 m, 24.viii.1979; 69–70 = *T. eurema* on *Dorycnium pentaphyllum*, Greece (Fókis), Parnassos Oros, 1100 m, 28.ix.1980, in 70 larva in cocoon
Figs 75–77. Trifurcata (Levarchama) species, distribution: 75 = $T$. anthyllidella (black dots in Spain) and $T$. ridiculosa (grey dots in Macaronesia); 76 = $T$. manygoza (black dots) and $T$. peloponnesica (grey squares), record for Corsica uncertain, based on vacated mines; 77 = $T$. ortneri
plesiomorphic shape in the core *Levarchama* clade. The phylogeny within the group of the last four, very similar species, is therefore far from resolved and more characters, preferably from immatures and DNA are required for a better resolution.

The position of *T. ridiculosa* is remarkable: it is confined to the Macaronesian islands, but being a sister to the remaining core group of *Levarchama*, suggests that it is unlikely to be a rather young endemic species of Macaronesia. It may therefore be a Tertiary relict, originating from the continent or older islands. The radiation of *Lotus* species on the Canary islands is a relatively recent event, although no dating is given (ALLAN et al. 2004); recent radiation occurred in many plant and animal groups on these islands. Examples are the brooms (Genisteae) and the associated Psyllidae (PERCY & CRONK 2002, PERCY 2003) and in Lepidoptera the Blastobasidae on Madeira (KARSHOLT & SINEV 2004). It would therefore be interesting to study the populations of *T. ridiculosa* from the different islands with molecular methods, in order to investigate the divergence of these popula-

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**Fig. 78.** Cladogram of *Levarchama*. 50% Majority Rule Consensus tree of four shortest trees; the only difference with the strict consensus tree is the position of *T. manygoza*, which forms in the strict tree a polytomy with *ortneri* and the two species pairs; the position shown here occurs in three of the shortest trees. Apomorphies mapped on branches; see appendix for explanation of numbers. The hostplant genera are given at the right, *T. cryptella* is oligophagous and feeds also on *Anthyllis*, *Securigera* and *Hippocrepis*. The hostplants for the outgroup species refer to the species groups/subgenera they are representing.
tions. Morphologically there is no strong evidence for isolation, but the leafmines on Madeira differ from those on the Canary Islands. In psyllids on the Canary Islands a high within-species sequence difference was found for taxa occurring on different islands, while displaying morphological stasis (PERCY 2003).

*Levarchama* and the *Trifurcula (T.) subnitidella* group share the characters 17: dorsal lobe of the aedeagus, and 20: the presence of two large cornuti. Since the characters listed for the subgenus *Trifurcula* (VAN NIEUKERKEN 1986a) are not very strong, the alternative that *Trifurcula* s. str. is not monophyletic should also be considered. Tentative results of our molecular analysis, however, suggest that *Levarchama* and *Trifurcula* are well supported sistergroups. A further analysis of morphology and molecular characters is needed to clarify this relationship. In this respect the two South African species are of special interest, since one of these has a hairpencil similar to that of *Levarchama* (SCOBLE 1980, VAN NIEUKERKEN 1990).

**Hostplant relationships**

All cited hosts belong to the tribe Loteae (Fabaceae), including the formerly separate Coronilleae. Recent molecular studies have shown this clade to be monophyletic and to belong to the “Robinioid clade” (ALLAN & PORTER 2000; WOJCIECHOWSKI et al. 2000, 2004, ALLAN et al. 2003). It is therefore very likely that the ancestor of *Levarchama* was feeding on a member of this tribe. The *Trifurcula subnitidella* group is also specialised on Loteae (with one exception on *Onobrychis* in the Hedysaroid clade), whereas the other group (the *T. pallidella* group) is specialised on the Genisteae. Whereas all species in *Levarchama* are leafminers, all *Trifurcula* s. str. are stem-miners. If the monophyly of *Trifurcula* s. str. is correct, a likely evolutionary scenario could have been that the ancestor of *Levarchama + Trifurcula* was a leafminer on Loteae, and in the *Trifurcula* clade the stem mining habit was evolved; later within this clade a shift to Genisteae as hostplant occurred. For testing this hypothesis, a detailed cladistic analysis of the subgenus *Trifurcula* is required.

Within *Levarchama* the genus *Lotus* (including *Dorycnium*) is the most frequented host, with the pair *anthyllidella-peloponnecisa* specialising on *Anthyllis* and *T. ortneri* on *Coronilla*. In the shown cladogram this requires only two host shifts. In addition, *T. cryptella* has become more polyphagous than the other species, and is exploring a larger variety of not very closely related Loteae.

In the recent analyses of the phylogeny of Loteae (ALLAN & PORTER 2000, ALLAN et al. 2003), old world *Lotus* forms a monophyletic genus when *Dorycnium* is included. Intergeneric relationships were not fully resolved, but *Hippocrepis* is probably closer to the *Lotus* clade than any of the other genera.

*Acta zool. hung.* 53 (Suppl. 1), 2007
Acknowledgements – It is an honour to be able to dedicate this publication to Dr. LÁSZLÓ GOZMÁNY’s 85th birthday in 2006, especially by describing two new species from Greece: Dr. GOZMÁNY is known as a keen promoter of the study of the Greek fauna. It is sad that he did not live to see this volume in print.

For the loan of material and information I am indebted to: GIORGIO BALDIZZONE (Asti, Italy), BENGT Å. BENGTSSON (Färjestäden, Sweden), OLEKSIY V. BVIDZILYA (Zoological Museum Kiev, Ukraine), MARTIN F. V. CORLEY (Faringdon, UK), DONALD R. DAVIS (National Museum of Natural History, Smithsonian Institution, Washington DC, USA), WILLEM N. ELLIS (Zoological Museum Amsterdam, Netherlands), HANS HENDERICKX (Mol, Belgium), ROLAND JOHANSSON (Växjö, Sweden), JARI JUNNILAINEN (Vantaa, Finland), LAURI KAILA (Finnish Museum of Natural History, Helsinki, Finland), OLE KARSHOLT (Zoological Museum, Copenhagen, Denmark), U. ROESLER (formerly Landessammlungen Karlsruhe, Germany), SALVADOR TALAVERA and JAVIER HERRERA MALIANI (Dept Biologia Vegetal y Ecologia, Universidad de Sevilla, Spain), PAOLO TIBERTI (Verona, Italy), KEVIN TUCK (Natural History Museum, London), PAUL SAMMUT (Rabat, Malta), ANDREAS SÉGERER (Zoologische Staatssammlung, Munich, Germany) and ANDRÁS VOJNITS (formerly, Hungarian Natural History Museum, Budapest, Hungary) and ANDRÁS KUN (Hungarian Natural History Museum, Budapest, Hungary). KEES VAN DEN BERG (National Museum of Natural History Naturalis, Leiden) is acknowledged for making several genitalia preparations. I am particular grateful to ZDENEK and ALES LASTŮVKA for allowing me to incorporate their material into the now jointly described *T. manygoza* and for much information and discussion. I would like to thank RIENK DE JONG (National Museum of Natural History Naturalis, Leiden) for comments and corrections on an earlier version.

REFERENCES


Received June 12, 2006, accepted February 1, 2007, published July 30, 2007
APPENDIX

Scoring of characters for phylogenetic analysis

**Female genitalia**

1. S7 tip: rounded (0), distinctly pointed (1)
2. T8, distal margin: broad (0), narrowed (1)
3. T9 anal papillae: distinct (0), absent (1)
4. Vestibulum: without pectinations (0), with group of pectinations (1)
5. Vestibulum: without sclerotization(s) (0), with sclerotization(s) (1)
6. Ductus spermathecae, basal straight part: much shorter than coiled part (0), long, longer than coiled part (1)
7. Ductus spermathecae coils: fewer than 5 (0), more than 5 (1)
8. Corpus Bursae: regularly narrowed anteriorly (0), with much narrowed anterior appendix (1)

**Male genitalia**

9. Uncus: Slightly indented medially (0), Deeply divided longitudinally (1)
10. Gnathos central element: rounded (0), sharply pointed (1)
11. Gnathos central element: symmetrical (0), asymmetrical (1)
12. Valva outer margin: evenly rounded or straight (0), distinctly bent (1)
13. Valva inner margin: without medial process (0), with medial process (1)
14. Valva inner margin medially: with obtuse angle(0), with almost right angle (1)
15. Transverse bar of transtilla: present (0), absent (1)
16. Ventral process of aedeagus: approximately triangular (0), ending bifid (1)
17. Aedeagus tube, sclerotised terminal lobes: absent (0), with dorsal lobe (usually) at right side, distinct (1), with more ventral lobe, at left side, distinct (2)
18. Cornuti globose group: absent (0), present (1)
19. Cornuti, basal group of long spines: absent (0), present (1)
20. Number of large cornuti: one (0), two (1), three (2)
Adults
21. Forewing pattern: pale uniform (0), darker, with distinct pale spot(s) or fascia (1)
22. Hairpencil on hindwing underside: absent (0), present (1)
23. Venation R sector, connection between R2+3 and Rs: present (0), absent (1)

Larval feeding
24. Mine type: leafmine (0), stemmine (1)
REVIEW OF THE SUBGENUS TRIFURCULA (LEVARCHAMA),
WITH TWO NEW SPECIES (LEPIDOPTERA: NEPTICULIDAE)

NIEUKERKEN, E. J. VAN
National Museum of Natural History Naturalis
PO Box 9517, 2300 RA Leiden, The Netherlands; e-mail: nieukerken@naturalis.nl

Corrections

Unfortunately, errors indicated to the editors after proof reading were not
incorporated in the printed journal version. They have been corrected in the pdf
version that is now online.

page 102, line 1 of text: ‘we’ is replaced by ‘I’  [ For the collection we use]

page 102, par. 5, line 1: the ‘I’ in NIEUKERKEN is set in SMALL CAPS

page 102, paragraph 6, line 2: a multiplication sign is added after the figures 20
(before objective), 10 and 20.

page 208, figure numbers 9 and 10 are added in the figure

page 109, checklist.
The 3 synonymous names are indented in the pdf further than the other names,
to show the difference from full species names: trifoli, dorycniella, gozmanyi

page 111. original reference for anthyllidella has been altered 3 times:
'Anthylli' into 'Anthyllis'
'Anthyllis cytioides' set in Italics
'not examined' changed into 'not examined'

page 123, section remarks, line 6: ZUCHT is set in normal letters, not SMALL
CAPS.

page 123, line 2 from bottom: Menken is set in SMALL CAPS

page 127, section diagnosis, line 7: (6-7") is replaced by (6-7½)

Page 135, line 6: Bengt is set in SMALL CAPS

Page 135, line10, “Jari Junnilainen (Vantaa, Finland),” is inserted

Page 135, references:

ALLAN, ZIMMER ea: 10. before “Royal Botanic” has been deleted

page 136:
ILDIS: changed into [Visited on: 12 December 2006]


Erik van Nieukerken