Arcola malloi (Pastrana), the alligatorweed stemborer, a new synonym of Macrorrhinia endonephele (Hampson) (Lepidoptera: Pyralidae: Phycitinae)

James E. Hayden
Florida Department of Agriculture and Consumer Services,
Division of Plant Industry, 1911 SW 34th Street, Gainesville, FL 32608 USA

Jean-François Landry
Canadian National Collection of Insects, Arachnids, and Nematodes, Agriculture & Agri-Food Canada,
Ottawa Research and Development Centre, 960 Carling Ave, Ottawa, ON K1A 0C6, Canada

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James E. Hayden and Jean-François Landry

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Arcola malloi (Pastrana), the alligatorweed stemborer, a new synonym of *Macrorrhinia endonephele* (Hampson) (Lepidoptera: Pyralidae: Phycitinae)

James E. Hayden (JEH)
Florida Department of Agriculture and Consumer Services, Division of Plant Industry, 1911 SW 34th Street, Gainesville, FL 32608 USA; james.hayden@fdacs.gov

Jean-François Landry (JFL)
Canadian National Collection of Insects, Arachnids, and Nematodes, Agriculture & Agri-Food Canada, Ottawa Research and Development Centre, 960 Carling Ave, Ottawa, ON K1A 0C6, Canada; jean-francois.landry@canada.ca

Abstract. *Arcola malloi* (Pastrana, 1961) is a junior subjective synonym of *Macrorrhinia endonephele* (Hampson, 1918) syn. nov. (Lepidoptera: Pyralidae). The species is a biological control agent introduced in United States and Argentina to control alligatorweed, *Alternanthera philoxeroides* (Mart.) Griseb. (Amaranthaceae). The synonymy is recognized by comparison of type specimens, genitalic dissections, and DNA COI barcoding. *Vogtia* Pastrana, 1961 syn. nov. and *Arcola* Shaffer, 1995 syn. nov. are synonymized with *Macrorrhinia* Ragonot, 1887. *Macrorrhinia megalajuxta* (Neunzig and Goodson, 1992) comb. nov. is transferred from *Ocala* Hulst, 1892. Lectotypes are designated for *Divitiaca ochrella* Barnes and McDunnough, 1913, and *Divitiaca simulella* Barnes and McDunnough, 1913.

Key words. Biological control, DNA barcoding, *Divitiaca*, lectotype, Nearctic, Neotropics, *Ocala*, *Rhinaphe*, *Vogtia*.

Introduction

Hampson (1918) described *Rhinaphe endonephele* Hampson and *R. ignetincta* Hampson in Hypsotropinae (a taxon that is now synonymous with Pyralidae: Phycitinae: Anerastiini) (Horak 2003), with type localities respectively in Rio de Janeiro, Brazil and northern Argentina. Shaffer (1991) transferred the two species to *Divitiaca* Barnes and McDunnough, 1913, a phycitine genus outside of Anerastiini Ragonot, and illustrated the lectotypes. Neunzig (2003) synonymized these two species (Hampson’s lectotypes representing the male and the female respectively), and Neunzig also synonymized *Macrorrhinia signifera* Blanchard, 1976, described from Texas. Neunzig (2003) synonymized *Divitiaca* and *Ocala* Hulst, 1892 with *Macrorrhinia* Ragonot, 1887, thereby placing five Nearctic species in that genus, including *M. endonephele*. Shaffer (1995) listed all the then-known species among these genera, and one was subsequently described (Landry and Neunzig 1998). The on-line database GlobIZ (Nuss et al. 2003–2019) currently lists eight valid species of *Macrorrhinia*.

Pastrana (1961) established the monotypic genus *Vogtia* Pastrana and described *V. malloi* Pastrana from Buenos Aires, Argentina. Shaffer (1995) proposed *Arcola* as a replacement name for *Vogtia* (preoccupied by *Vogtia* Kölliker, 1853, Cnidaria). *Arcola malloi* is listed as such in the most recent North American pyraloid checklist (Scholtens and Solis 2015).

*Arcola malloi* was discovered, tested, and released to control alligatorweed (*Alternanthera philoxeroides* (Mart.) Griseb., Amaranthaceae) (Maddox 1970; Buckingham 1996) in the southeastern United States. Moths were introduced in 1971 in Gainesville, Florida and other sites in the Southeast (Brown and Spencer 1973), and it was hailed as a success for helping to control the weed, alongside two other insect biological control agents (Buckingham 1996). The species was also introduced in Australia in 1977 for the same purpose using South American source specimens, but despite becoming established, it did not significantly contribute to control alligatorweed (Julien et al. 2012).

In 2012, JFL and Paul Hebert (Centre for Biodiversity Genomics, University of Guelph), who were engaged in developing DNA barcode libraries, noticed that voucher specimens of *A. malloi* from Australia and specimens of *Macrorrhinia endonephele* from Florida shared DNA barcodes. This raised the
possibility that the two taxa were synonymous.

Independently in 2014, JEH noted that specimens of *A. malloi* were absent from the Florida State Collection of Arthropods in Gainesville, Florida (FSCA). This was curious because of the long tradition of aquatic weed control research at the University of Florida and the supposed success of *A. malloi* (Buckingham 1996). A few voucher specimens from the original release were eventually found in the FSCA Biological Control Collection, separate from the main Lepidoptera collection housed in the McGuire Center for Lepidoptera and Biodiversity (MGCL; Florida Museum of Natural History). On the other hand, numerous specimens identified as *Macrorrhinia endonephele* and *M. signifera* exist in the collection, starting from the early 1970s.

The purpose of this paper is to revise the status of the aforementioned taxa based on evidence provided by genitalia morphology supplemented by DNA barcode (COI) sequences. We also provide a synopsis and illustrations of other North American species of *Macrorrhinia* and designate lectotypes for two of them. We found published genitalia illustrations, which are all line drawings, inadequate for the smallest comparative details. In view of the close morphological similarity of the species, we provide comparable genitalia photos of all the species except *M. megajuxta* (Neunzig and Goodson, 1992), as well as a key to the species.

**Materials and Methods**

Collection acronyms are as follows:

- **ANIC** Australian National Insect Collection, Canberra, Australia
- **CBG** Centre for Biodiversity Genomics, University of Guelph, Guelph, ON, Canada
- **CNC** Canadian National Collection of Insects, Arachnids, and Nematodes, Ottawa, ON, Canada
- **FSCA** Florida State Collection of Arthropods, Florida Dept. of Agriculture and Consumer Services, Gainesville, FL, USA
- **MACN** Museo Argentino de Ciencias Naturales, Buenos Aires, Argentina
- **MEM** Mississippi Entomological Museum, Mississippi State University, Starkville, MS, USA
- **MGCL** McGuire Center for Lepidoptera and Biodiversity, Florida Museum of Natural History, Gainesville, FL, USA
- **USNM** National Museum of Natural History, Smithsonian Institution, Washington, D.C., USA

Specimens of *Macrorrhinia endonephele* from Florida and Louisiana, *M. signifera* from Texas, and *A. malloi* vouchers in the FSCA Biological Control Collection were examined by JEH. Specimens from the type series of *A. malloi* were borrowed by JFL from MACN, including two males and one female paratypes with the abdomen intact, and two genitalia slides (one male, one female) of paratypes prepared by Pastrana. Plans were made to obtain DNA barcodes (see below) from these paratypes in addition to examining their genitalia but this could not be realized. JFL also examined and dissected *M. endonephele* specimens from Florida, Massachusetts, South Carolina, and Texas (CBG, CNC, USNM), specimens from Argentina found among the unidentified USNM Phycitinae, as well as the holotype of *M. signifera*, and syntypes of *M. ochrella* (Barnes and McDunnough, 1913) and *M. simulella* (Barnes and McDunnough, 1913), both dissected and undissected. Specimens of other species of *Macrorrhinia* from the CNC, FSCA and USNM were also examined and dissected by both authors.

**Morphological analysis.** Genitalia were dissected by maceration in 10 or 20% aqueous KOH, stained with Chlorazol black or Orange G, and slide-mounted in Euparal by standard methods (Robinson 1976, with variations presented in Landry 2007). The dissections were compared to Pastrana’s slides and illustrations in his 1961 original description of *Vogtia malloi*, and to the figures of *M. endonephele* and *M. signifera* in Blanchard (1976), Shaffer (1991), and Neunzig (2003), and to the diagnosis of *M. endonephele* in the latter work. Specimens were dissected of congeneric North American species, and of *M. pinta* Landry and Neunzig, 1998 from the Galapagos Islands (holotype and many paratypes in the CNC), and for some exotic species, the original descriptions and subsequent treatments were consulted (Zeller 1848; Heinrich 1956; Neunzig and Goodson 1992; Landry and Neunzig 1998). Specimens of the FSCA and MGCL are curated together in the MGCL, except the Biological Control Collection in the Doyle Conner Building, 1911 SW 34th Street, Gainesville, Florida. Morphological terms follow Klots
(1970) and Neunzig (2003), except for “phallus” instead of aedeagus.

Genitalia slides were photographed by JFL using a Nikon DS-Fi1 digital camera mounted on a Nikon Eclipse 800 microscope at magnifications of 100χ. Nikon’s NIS 2.3 Elements was used to assemble multiple photos of different focal planes into single deep-focus images, which were further edited in Adobe Photoshop CS6. Photographs of additional slides by JEH were taken with a Leica DM6 B compound microscope, a DMC6200 camera, and Leica Application Suite X to process the stacked images. Habitus photographs by JEH were taken with an Auto-montage Pro 5.01 system (Synoptics Ltd.) using a JVC camera and Leica Z16APO lens; those by JFL were taken with a Canon EOS 60 D camera and MP-E 65 mm lens, and Zerene Stacker application to process stacked images.

**DNA barcode analysis.** DNA extracts were prepared from one leg removed from each specimen. DNA extraction, PCR amplification of the barcode region of COI, and subsequent sequencing followed standard protocols at the Canadian Centre for DNA Barcoding in Guelph (deWaard et al. 2008). Laboratory protocols at this facility have been heavily optimized, and the current iteration can be accessed at http://www.ccdb.ca. Sequences, along with the specimen data, images, and trace files, are deposited in the Barcode of Life Data Systems (BOLD) (Ratnasingham and Hebert 2007; www.barcodinglife.org). Sequences of *M. endonephele* were compared with DNA barcodes for four other species of *Macrorrhinia* for which barcodes were available: *M. aureofasciella* Ragonot, 1887, *M. dryadella* (Hulst, 1892), *M. ochrella*, and *M. parvulella* (Barnes and McDunnough, 1913). All data are available through the following dataset: https://doi.org/10.5883/ds-mrrhinia (see also Appendix 1). Sequence analysis was conducted using MEGA 7 (Kumar et al. 2016), using the Kalign option for sequence alignment and the Kimura-2-parameter distance model for calculating genetic divergence estimates and generating a neighbor-joining distance tree.

**Results**

DNA barcodes of *M. endonephele* showed modest intra-specific variation (mean 0.38%, standard error 0.15) whereas inter-specific distances to four other species of *Macrorrhinia* were an order of magnitude greater (4.07–5.44%) (Table 1). The barcodes of two specimens of *A. malloi* from Australia were a close match (0.0–0.05%) to specimens of *M. endonephele* from the United States (Fig. 1). They shared the same Barcode Index Number (BIN = BOLD:AAE0182) and were nested within sequences from the United States. These two specimens, deposited in ANIC, are reared vouchers from the laboratory colony developed from source specimens from Argentina and used in the release of that species as a biological control agent of alligatorweed in Australia. Haplotype variation within United States specimens,

<table>
<thead>
<tr>
<th>Species 1</th>
<th>Species 2</th>
<th>Distance</th>
<th>Std. Error</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>M. aureofasciella</em></td>
<td><em>M. dryadella</em></td>
<td>5.45%</td>
<td>0.95%</td>
</tr>
<tr>
<td><em>M. aureofasciella</em></td>
<td><em>M. ochrella</em></td>
<td>5.12%</td>
<td>0.88%</td>
</tr>
<tr>
<td><em>M. aureofasciella</em></td>
<td><em>M. parvulella</em></td>
<td>5.46%</td>
<td>0.90%</td>
</tr>
<tr>
<td><em>M. dryadella</em></td>
<td><em>M. ochrella</em></td>
<td>5.54%</td>
<td>0.89%</td>
</tr>
<tr>
<td><em>M. dryadella</em></td>
<td><em>M. parvulella</em></td>
<td>5.55%</td>
<td>0.96%</td>
</tr>
<tr>
<td><em>M. endonephele</em></td>
<td><em>M. aureofasciella</em></td>
<td>4.97%</td>
<td>0.93%</td>
</tr>
<tr>
<td><em>M. endonephele</em></td>
<td><em>M. dryadella</em></td>
<td>5.44%</td>
<td>0.92%</td>
</tr>
<tr>
<td><em>M. endonephele</em></td>
<td><em>M. ochrella</em></td>
<td>4.32%</td>
<td>0.76%</td>
</tr>
<tr>
<td><em>M. endonephele</em></td>
<td><em>M. parvulella</em></td>
<td>4.07%</td>
<td>0.78%</td>
</tr>
<tr>
<td><em>M. ochrella</em></td>
<td><em>M. parvulella</em></td>
<td>4.88%</td>
<td>0.83%</td>
</tr>
</tbody>
</table>
although an order of magnitude lower than interspecific differences, showed some heterogeneity despite being presumably all derived from lab colonies initially released in 1971.

The male and female genitalia of *M. endonephele* specimens from the United States, including the holotype of *M. signifera* from Texas, are very similar to those of *A. malloi* paratypes from Argentina. The shape of the male valvae, the shape of the gnathos, and the shape and spines of the female corpus bursae are diagnostic for *M. endonephele*. In particular, the gnathos is dorsally deeply concave and evenly curved (being straighter in other species), the distal margin of the valva is evenly rounded, and the spines in the corpus bursae are numerous and set on a linear sclerotized inner ridge that runs most of the length, plus several to many more spines along the broad anterior section of the ductus bursae (whereas other species have few or no spines). Differences in male genitalia are slight among *Macrorrhinia* species. Female genitalia afford more pronounced differences.

Slides or specimens of *A. malloi* could not be located in the USNM. The holotype and paratypes of *M. signifera* collected in 1975 are conspecific with *M. endonephele*. Blanchard’s female paratype of *M. signifera* collected in 1966 (slide A.B. 3531, numbered USNM 109,490) is not conspecific, and indeed not a *Macrorrhinia* species nor *Maricopa lativittella* (Ragonot), a related species (Heinrich 1956). The damaged female moth is gray with some orange scales, not fully orange. The corpus bursae is missing from the dissection, but the antrum does not have the V-shape characteristic of *Macrorrhinia* and *Maricopa lativittella*; furthermore, the puteoli of the tympanal organs are angled differently.

From both the morphological and genetic evidence, we conclude that *Arcola malloi* (Pastrana, 1961) **syn. nov.** is a junior subjective synonym of *Macrorrhinia endonephele* (Hampson, 1918). Vogtia Pastrana, 1961 **syn. nov.** and its replacement name *Arcola* Shaffer, 1995 **syn. nov.** are junior subjective synonyms of *Macrorrhinia* Ragonot, 1887. In addition, the South American species *Macrorrhinia megajuxta* (Neunzig and Goodson, 1992) **comb. nov.** is hereby transferred to formalize the combination online (Nuss et al. 2003–2019).

*Maricopa* Hulst is probably the sister-genus of *Macrorrhinia*, as suggested by Heinrich (1956) and reiterated by Neunzig (2003). (Both authors refer to it as *Valdivia* Ragonot, 1888, which Shaffer [1995] noted to be a junior homonym of *Valdivia* White, 1847 [Crustacea]). *Maricopa* includes three species distributed in Chile and the southern United States. The two genera share elongate, porrect labial palpi in both sexes, and forewing veins M3 and M4 are short-stalked. In both genera, males have broad valvae that are expanded distal of the sacculus, a broad tegumen and uncus (Fig. 12–19), and a narrow, aciculate phallus (Fig. 20–27). In females, the armature of the corpus bursae (if present) consists of numerous small spines (Fig. 50–55, 59–61) (absent in *M. aureofasciella* and *M. parvulella*), the posteriormost portion of the ductus bursae ends in a short, wide, V-shaped antrum, and the sinus vaginalis posteriord of the ostium bursae is covered with a zone of dense microtrichia (Fig. 68–73). The ductus seminalis is inserted variably on the anterior or posterior third of the ductus bursae (Fig. 50–52, 56–61).

In view of this relationship, the diagnostic characters and putative synapomorphies of *Macrorrhinia* are mainly of the female genitalia (Fig. 50–73). The corpus bursae is bean-shaped, with the inception of the ductus bursae situated on the right side of the corpus at about the mid-point or one-third. The posterior portion of the ductus bursae is narrow and slender (as long or longer than segments 8–10); its anterior portion just prior to joining the corpus bursae is dilated, not coiled, and more thickly walled (*M. ochrella*, *M. parvulella*) or slightly sclerotized (*M. endonephele*). The spines, if present, extend along the wall of the corpus bursae adjacent to the dilated ductus bursae. In *Maricopa*, the corpus bursae is ovoid and symmetrical, without a posterior lobe, and the anterior section of the ductus bursae has several large coils. This coiled section may be homologous with the dilated section in the male genitalia, and the anterior section of the ductus bursae has several compartments. In particular, the eighth sternite has eversible lateral coremata (Fig. 46–49) that *Maricopa* species lack.

Anerastiini and some genera removed from that taxon by Shaffer (1968) are also likely to be confused with *Macrorrhinia* because they share long, porrect labial palpi and indistinct maculation with *Macrorrhinia*. None have a scale-knot at the base of the male antenna as in *Macrorrhinia*, many have a reduced haustellum, and some have a conically projected frons. The valvae are not distally expanded. The ductus bursae is short and wide, not dilated anteriad; the corpus bursae is unarmed or has signa...
that are not spines.

**Synopsis of North American species of Macrorrhinia**

**Macrorrhinia Ragonot, 1887**


**Macrorrhinia endonephele** (Hampson, 1918)

Fig. 2–5, 12–13, 20–21, 28–30, 37–38, 46–47, 50–55, 68

*Rinaphe endonephele* Hampson 1918: 87.

*Rinaphe ignetincta* Hampson 1918: 87; synonymized by Neunzig 2003: 266.

*Vogtia malloi* Pastrana 1961: 268; new synonymy.


**Diagnosis.** The forewing length is 7.5–10.5 mm. The maculation is dull orange with scattered black scales, with faint antemedial and postmedial lines; males (Fig. 2–4) have a faint gray-black antemedial spot that is not developed in females (Fig. 5). The gnathos of the male genitalia (Fig. 28–30) curves evenly into a narrow, dorsally directed hook; the narrow distal part of the hook is as long as the base of the gnathos. The end of the sacculus (Fig. 12–13) is not strongly projected, so the distal margin of the valva is evenly rounded, not truncate. The corpus bursae (Fig. 50–55) is rather elongate, without constriction between the anterior and posterior lobes; the ductus bursae is dilated more than half of its length, nearly to the posterior end of the corpus bursae, which it parallels closely. There is a long row of spines on the wall of the corpus bursae nearest to the ductus bursae, another row in the ductus bursae facing the corpus bursae, and a few in the anterior angle of the corpus and ductus bursae. The posterior margin of the antrum (Fig. 68) is thickened and transversely straight, with slender lateral angles that are wider than the ductus bursae.

**Material examined.** Years of collection follow the specimen count. Specimens are in the FSCA and MGCL unless noted.

Macrorhinia aureofasciella Ragonot, 1887

Fig. 6, 16, 26, 31, 39, 49, 56, 70


**Diagnosis.** The forewing length is 6.5–11.0 mm. The maculation (Fig. 6) is mostly gray with a transverse orange band in the basal third from the costa to the posterior margin, proximally margined with black. The phallus (Fig. 26) has a series of small teeth in the distal portion. The lateral lobes of the juxta are short (Fig. 38). The corpus bursae (Fig. 56) lacks signa and constrictions, and the ductus bursae is dilated as far as the posterior end of the corpus bursae. The posterior margin of the antrum (Fig. 70) is convex with stout lateral projections that are almost as wide as the ductus bursae.


Macrorhinia dryadella (Hulst, 1892)

Fig. 7, 18, 22, 35, 44, 57, 73

*Ocala dryadella* Hulst 1892: 61.

*Dolichorrhinia platanella* Grossbeck 1917: 131.

**Diagnosis.** The forewing length is 5.5–7.0 mm. The maculation (Fig. 7) is mostly gray with an orange antemedial spot in the posterior half of the forewing (not a completely transverse band), lined with black proximally. The male maxillary palpi have elongate hair-pencils. The gnathos (Fig. 35) is y-shaped, with a short dorsal subapical process. The corpus bursae (Fig. 57) is weakly constricted between the anterior and posterior lobes, and the ductus bursae is dilated half its length, as far as the posterior end of the corpus bursae. A small signum is present at the juncture of the dilated section of the ductus bursae. The posterior margin of the antrum (Fig. 73) is narrow with short, recurved lateral projections.


Macrorhinia ochrella (Barnes and McDunnough, 1913)

Fig. 8–10, 14–15, 23–24, 32–33, 40–42, 48, 59–60, 62–67, 69

*Divitiaca ochrella* Barnes and McDunnough 1913: 183.

*Divitiaca simulella* Barnes and McDunnough 1913: 183; synonymized by Neunzig 2003: 266.

**Diagnosis.** The forewing length is 4.5–6.5 mm. The maculation (Fig. 8–10) is cream with scattered black scales; good specimens have faint pink streaks on the anal fold in the basal area and along the radial veins. The gnathos (Fig. 32–33) has a wide base in sagittal view. The dilated section of the ductus bursae (Fig. 59–60) is reduced and looks like a boot, and it has one major row of spines on the posterior side and, in some specimens, a row of smaller spines on the anterior side (Fig. 62–67). The posterior margin of the antrum (Fig. 69) is transverse and slightly convex or sinuate with slender lateral projections that
are considerably wider than the ductus bursae.


*Divitiaca ochrella* syntypes (USNM): There are two syntypes in the USNM, one male and one female, with red-bordered labels inscribed “Divitiaca ochrella B. & McD Type [sex symbol]” in McDunnough’s handwriting, with collecting data matching the description. The male was illustrated in Barnes and McDunnough (1913, plate I, figure 3), and the genitalia later dissected by Heinrich (genitalia and wings on separate slides). The female was undissected. Because the male and the female are similarly inscribed as “Type” and the female genitalia of *Macrorrhinia* afford better specific differences, we selected the female for the lectotype and dissected it.


One paralectotype ♂, labelled as lectotype, additional label “Photograph Pl. 1 No. 3” [pale blue], slide USNM 101842, specimen # USNMENT00657701.

One male from Everglade [sic] from the Barnes Collection dated “Apr 16-23” is not a syntype (slide USNM 144171, specimen # USNMENT00657702).

*Divitiaca simulella* syntypes (USNM): as for *D. ochrella*, there is a pair of USNM syntypes bearing the inscription “Type”, as well as a third male specimen labelled as “cotype”, all on red-bordered labels in McDunnough’s hand. The male “type” was illustrated in Barnes and McDunnough (1913, plate I, figure 6) and its genitalia later dissected by Heinrich. The female “type” and the cotype were undissected. For the same reason as *D. ochrella*, we selected the female for lectotype and dissected it.


One paralectotype ♂, labelled as lectotype, additional label “Photograph Pl. 1 No. 6” [pale blue]; slide USNM 101844, specimen # USNMENT00657703. One paralectotype male, labelled as lectotype except for the word “Cotype”, slide USNM 144162, specimen # USNMENT00657705.

Additional ♂ specimen: Everglade [sic], Apr. 10, ’12; slide USNM 144172, specimen # USNMENT00657706; a white label “Divitiaca simulella B & McD” is by a different hand.

**Comments.** The slight difference in size and coloration between *M. ochrella* and *M. simulella* led Heinrich (1956) to doubt that they were different species, nevertheless he maintained them separate. He did not illustrate the genitalia of *M. simulella* citing their close similarity to those of *M. ochrella*. Neunzig (2003) judged them to be conspecific on account of finding no significant difference and synonymized them. We observed that the female genitalia of the two lectotypes, undissected prior to the present study, differed slightly in the shape of the corpus bursae (a possible artefact of stretching), the spination at the anterior end of the ductus bursae near its inception into the corpus bursae (this area is crumpled in the *M. ochrella* lectotype slide so difficult to compare), the size of the ostium bursae (proportionally wider in *M. ochrella*) and the extent of the zone of microtrichia of the sinus vaginalis (more extensive in *M. ochrella*). Recently observed specimens from Monroe Co., Florida showed variation in female genitalia similar in extent to intraspecific variation exhibited by *M. endonephele*. We conclude that this supports maintaining their synonymic status.

**Macrorrhinia parvulella** (Barnes and McDunnough, 1913)

Fig. 11, 17, 25, 34, 43, 58, 71

*D. parvulella* Barnes and McDunnough 1913: 183.

*D. parvulella* consociata Heinrich 1956: 190 ("race").
Diagnosis. The forewing length is 4.5–6.0 mm. The maculation (Fig. 11) resembles that of *M. ochrella* but is darker, rather cream-orange with dark scales and complete transverse lines, and the hind wings are darker gray than those of the other species. The gnathos (Fig. 34) is not tapered, having a broadly rounded apex and recurved point. The ductus bursae (Fig. 58) is not dilated near the corpus bursae; this section instead is represented by an appendicular lobe attached to the corpus bursae adjacent to the ductus bursae. Spines and signa are absent. The antrum (Fig. 71) is proportionally small and narrower than the zone of microtrichiae with a convex posterior margin and short lateral projections.


Comments. We examined the holotype but not the dissection slide of *M. parvulella consociata* (Heinrich), described from Colombia. Shaffer (1995) listed it at the subspecies rank, and we have no reason to change its status.

The following two species are included for comparative purposes.

*Macrorrhinia pinta* Landry and Neunzig, 1998

Fig. 19, 27, 36, 45, 61, 72


Diagnosis. The forewing length is 4.6–7.0 mm. (The range given in Landry and Neunzig (1997) who listed 82 specimens is 5.0–8.0 mm. No specimen measured more than 7.0 mm among the 69 specimens examined.) The maculation is similar to *M. aureofasciella* but the transverse bands are more subdued or indistinct and do not reach the costa (not illustrated). The gnathos (Fig. 36) is similar to that of *M. endonephele*. The phallus (Fig. 27) is laterally curved, whereas it is straight or nearly so in the other species. The corpus bursae (Fig. 61) is barely constricted in the middle as in *M. aureofasciella*, but the appendicular lobe is larger with the posterior portion broadly dilated and extended to the posterior end of the corpus bursae. The ductus bursae is barely dilated at the level of the corpus bursae and its inception is situated near the base of the appendicular lobe near the juncture of the corpus bursae. There are no signum nor spines except for a small sclerotization at the juncture of the appendicular lobe. The posterior margin of the antrum has a “winged” appearance with a mesial indentation and curved lateral projections wider than the ductus bursae (Fig. 72).


*Maricopa lativittella* (Ragonot, 1887) (Not figured)

*Ciris lativittella* Ragonot 1887: 18.

Diagnosis. The male genitalia are rather similar to those of *Macrorrhinia* species except for a differently shaped sternum 8. The female ductus bursae has 4–5 large coils, and the corpus bursae is ovoid and small relative to the wide ductus bursae, without signa. Illustrations of the genitalia are in Heinrich (1956).


Discussion

Shaffer (1991) and Neunzig (2003) apparently overlooked Pastrana (1961). The purpose of Shaffer (1991) was not to revise the genus but simply to remove the species from Peoriinae Hulst, a taxon that
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Horak (2003) subsequently synonymized with Anerastiini. Heinrich did not treat M. endonephele and M. ignetincta because they were still in Anerastiinae, so Pastrana (1961) would have had the same issue if he had consulted Heinrich (1956). We agree with the validity of Neunzig's (2003) other specific and generic synonymies in Macrorrhinia. His focus in that publication on the Nearctic fauna necessitates the transfer of *M. megajuxta*.

The collection dates of *M. endonephele* circumstantially support the fact that it was introduced in the early 1970s (cf. Brown and Spencer 1973) and rapidly dispersed. The oldest specimens of *M. endonephele* in the FSCA that were collected in the environment were caught at light in Gainesville in 1972. Gainesville was one of the ten original release sites of the alligatorweed stem borer in 1971 (Brown and Spencer 1973). Preserved specimens of immature stages could not be located. The species quickly dispersed across the Southeast, reaching Louisiana by 1974 (FSCA, leg. V.A. Brou). The species reached Texas by 1975, represented by Blanchard's types of *M. signifera* from eastern Texas; the one paratype from 1966 that antedates the release is not conspecific. A specimen from Massachusetts trap-collected on 27 September 2010 could indicate a recent range expansion or represent a vagrant.

The original laboratory colonies that provided the specimens released in 1971 may have been collected from multiple Argentine populations, which would explain the observed haplotype heterogeneity. The moths were collected from the vicinity of Buenos Aires (Belle Vista area), Argentina (Brown and Spencer 1973).

**Key to Macrorrhinia Ragonot**

The following key is global, including Neotropical species. It does not include *M. placidella* (Zeller, 1848), which is of dubious association and is known only from the unique, damaged lectotype (Heinrich 1956).

1. Forewing color mostly gray, with distinctly contrasted black and orange scales in antemedial area ................................................................. 2
   — Forewing color mostly orange, pale ochre, or cream, with black scales in antemedial area absent or diffuse ........................................ 4

2. Maxillary palpus of male without elongate scales; lobes of juxta rounded and not longer than wide; dilated part of ductus bursae tapered and narrower in posterior half. .........
   — Maxillary palpus of male with elongate scales; lobes of juxta acute or longer than wide; dilated part of ductus bursae of even width or with posterior half wider than anterior ........ 3

3. Gnathos with subapical process; lobes of juxta short and acute; signum present at juncture of ductus bursae and corpus bursae; distribution: Florida, USA ....... *M. dryadella* (Hulst)
   — Gnathos without subapical process; lobes of juxta rounded and much longer than wide; signum absent; distribution: Argentina ............. *M. megajuxta* (Neunzig and Goodson)

4. Forewing length ≥7.5 mm; valva with distal margin evenly curved; corpus bursae with long row of spines extended nearly to posterior end ......... *M. endonephele* (Hampson)
   — Forewing length ≤7.0 mm; valva with distal margin straight in ventral half because of extended sacculus; corpus bursae without spines or only a few spines inside ductus bursae ........ 5

5. Forewing postmedial line absent; phallus curved; appendix bursae present, almost as large and long as posterior half of corpus bursae; distribution: Galapagos Islands *M. pinta* Landry and Neunzig
   — Forewing postmedial line present; phallus straight or nearly so; appendix bursae absent or present and small; distribution: Florida, USA ........................................ 6

6. Forewing postmedial line interrupted; hind wing whitish and semihyaline; gnathos evenly tapered and curved; expanded part of ductus bursae small, containing a few small spines; corpus bursae without appendix .................. *M. ochrella* (Barnes and McDunnough)
   — Forewing postmedial line continuous; hind wing smoky gray; gnathos not tapered, having parallel dorsal and ventral edges; ductus bursae not expanded near corpus bursae, without
spines; corpus bursae with small appendix, about half the length of posterior half of corpus bursae ............................................. *M. parvulella* (Barnes and McDunnough)

Acknowledgments

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Literature Cited


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Appendix 1. Summary of records in BOLD dataset DS-MRRHINIA used in the barcode analysis.

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**Figure 1.** DNA barcode neighbor-joining tree for *Macrorrhinia endonephele* and four congeneric species. Scale bar = divergence of 0.5% using Kimura-2-parameter distances. Solid dots denote individual specimens followed by their unique identifiers (Specimen IDs). Red dots indicate voucher specimens of *Arcola malloi* released in Australia for the biological control of alligatorweed.
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