A REVIEW OF THE NEARCTIC GENERA OF OLIGOTROPHIDI WITH PIERCING OVIPOSITORS (DIPTERA: CECIDOMYIIDAE)[1]

Raymond J. Gagne[2]

ABSTRACT: Descriptions of *Cystiphora, Procystiphora, Sackenomyia,* and *Lygocecis,* new genus, show that ovipositors modified for piercing plants have evolved independently at least 6 times within the supertribe Oligotrophidi. *Laubertia* is synonymized under *Cystiphora* and *Phlyctidobia* under *Sackenomyia. Sackenomyia viburnifolia* (Felt) is renamed and several new combinations are proposed.

DESCRIPTORS: Cecidomyiidae; Cystiphora, Procystiphora, Sackenomyia and Lygocecis n.g.; North America

At least four groups of species of Nearctic Oligotrophidi have ovipositors modified for piercing plant tissue. While preparing a key to the genera of Cecidomyiidae, I found that the generic placement of most of those species was haphazard. It showed little regard for the various adaptations of the female abdomens, but was based instead on what now appear to be superficial characters, such as the number of palpal segments and whether the tarsal claws are toothed or simple. *Cystiphora* and *Sackenomyia* each contained two unrelated species groups; one of them common to both genera. On the other hand, *Procystiphora,* based on Nearctic species, had been misinterpreted and contained 2 additional, separate groups of exotic species.

In this paper I am redescribing the several genera involved and describing a new genus for the practical purpose of properly placing the Nearctic species. I am also interested in determining generic affinities and the relationships of the Nearctic species to their exotic congeners to provide a foundation for future studies. The genera treated here are: *Procystiphora,* reared from *Juncus* and possibly *Carex; Sackenomyia,* leaf gallmakers on *Viburnum; Cystiphora,* leaf gallmakers on the composite tribe Cichoreae; and *Lygocecis,* new genus, stem gallmakers on *Salix.*

The various modifications of the female postabdomen in these genera and in the 2 exotic species groups formerly placed in *Procystiphora* show that a piercing ovipositor evolved at least 6 times within the Oligotrophidi. Three genera, *Sackenomyia, Procystiphora,* and *Lygocecis,* new genus, are so

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[2] Systematic Entomology Laboratory, Agricultural Research Service, USDA Mail Address: c/o U.S. National Museum, Washington, D.C. 20560.

specialized that their separate affinities are not apparent. *Cystiphora* and the 2 exotic species groups, here transferred to *Dasineura* (see discussion under *Procystiphora* for details), are, however, clearly derived from *Dasineura* in the broad sense. The males of all 3 groups fit easily into a general concept of *Dasineura,* a cosmopolitan, very large, and diverse genus, with almost 100 described species in the Nearctic Region alone.

The "Felt Collection" noted below is on a long-term loan to the Systematic Entomology Laboratory, USDA, from the New York State Museum in Albany.

Cystiphora Kieffer

Cystiphora Kieffer 1892: 212. Type-species, *Cecidomyia hieracii* Löw (Rübsaamen 1910: 337).

Laubertia Rübsaamen 1914: 94. Type-species, *schmidti* Rübsaamen (monotypic). *New synonym.*

Adult. Antenna with 11-12 flagellomeres. Palpus 2 to 4-segmented (3-segmented in Nearctic species). Wing vein R_5 joining C anteriad of wing apex. Tarsal claws each with strong tooth. Empodia as long as claws. Male abdomen: terga I-VI with complete row of caudal setae, without lateral setae, and with occasional scales; tergum VII as for VI but caudal setal row interrupted mesally; tergum VIII sclerotized only basally, naked except for basal pair of trichoid sensilla; sterna II-VII quadrate, weakly sclerotized and naked between caudal and middle setal rows; claspettes elongate, setulose, tapered to pointed apex; telomere widest near base, tapered to apical tooth; cerci large, ovoid; sternum X deeply bilobed. Female abdomen: anterior segments as in male; tergum VII quadrate except for lateral indentations, caudal setal row complete, naked cephalad except for trichoid sensilla; tergum VII sclerotized, shaped as in fig. 1, with caudal setae and basal pair of trichoid sensilla; sternum VII quadrate, with caudal and mesal rows of setae; segment VIII subspherical, surrounded basally by sclerotized band; ovipositor cylindrical, tapering evenly to pointed, weakly sclerotized cercus.

Pupa. Not seen.

Larva. Spatula clove shaped. Abdominal segments each with 4 dorsal papillae. Hind ventral papillae haired. Terminal segment with 4 setose papillae of uniform length.

Cystiphora contains 1 Nearctic and 7 Palearctic species, all reared from blister galls on leaves of Compositae of the tribe Cichoreae. The Nearctic species was reared from *Prenanthes.*

Laubertia, synonymized here, was erected for a species with the same kind of ovipositor (Rübsaamen 1914) and same general biology as *Cystiphora,* but with a 2-segmented palpus instead of the typical 4. The Nearctic species with its 3-segmented palpus fills the gap between *Cystiphora* and *Laubertia.* Also, Möhn (1955) shows the larvae of both genera to be very similar.

Cystiphora is distinctive only for the modifications of the female postabdomen, which are the sclerotized ring around segment VIII and the pointed ovipositor. The close resemblance of the males of *Cystiphora* and *Dasineura,* however, indicates a close relationship.

The larvae of *Cystiphora* have a reduced number of papillae, but, interestingly, there are the same reductions, i.e. loss of some dorsal and terminal papillae, in other widely separated gall midge genera found in leaf galls, viz. *Asteromyia* (Lasiopteridi) and *Caryomyia* (Cecidomyiidi).

Cystiphora canadensis Felt

Cystiphora canadensis Felt 1913b: 417.

Wing length: ♀, 1.2 mm. Female postabdomen as in fig. 1.
Syntypes: 3 ♀♀, reared VII-10-1913 ex blister leaf galls on *Prenanthes alba* L. or *P. altissima* L., Toronto, Canada, A. Cosens, a2441, in Felt Collection.

Lygocecis Gagné, new genus

Type-species, *Sackenomyia packardi* Felt.

Derivation of name: lygo = willow, cecis = gall; feminine gender.

Adult. Antenna with 18-20 short-necked flagellomeres. Palpus 2-3 segmented. Wing vein R_5 joining C at wing apex. Tarsal claws simple. Empodia as long as claws. Male abdomen: terga I-VII each with 2-3 caudal rows of short setae, no lateral setae, and covered with scales; sterna II-VII quadrate, entire, with several caudal rows of setae continuous with lateral setae; mesal area sparsely setose to naked; basimere elongate, densely setose; claspette glabrous, thin, elongate; telomere short, stout, with wide tooth; cerci large, barely separated mesally; sternum X long, narrow, deeply bilobed. Female abdomen: as in male except for postabdomen; segment VII membranous, tergum and sternum VII weakly defined; segment VIII subspherical, membranous, naked but for basal trichoid sensilla of tergum VIII, with a ventrobasal apodeme extending within segment VII; ovipositor elongate, basal half cylindrical, short-setose, distal half bilaterally flattened, strongly sclerotized basally, laterally in 2 long strips, and apically; cercus pointed, with scattered setae.

Pupa. Antennal horns very strongly developed. Prothoracic setae elongate. Face naked. Abdominal spicules of uniform size throughout.

Larva. Spatula strongly developed, apical collar very wide, multidentate. Abdominal segments with 4 tiny, dorsal papillae. Hind ventral papillae haired. Terminal segment with probably only 4 tiny papillae.

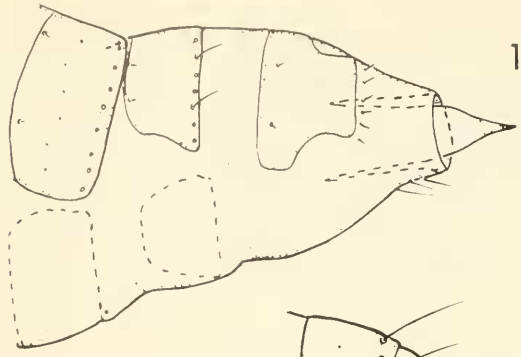
Lygocecis contains 2 described and at least 2 undescribed Nearctic species, all stem gallformers on willow. It shows certain superficial resemblances to *Rhabdophaga,* a large genus containing most willow gallmakers. Both genera have robust, very setose adults, a long R_5 wing vein, and many short-necked antennal flagellomeres, but those are not characters on which affinity can be based. *Lygocecis* has very distinct male genitalia, particularly the long, glabrous claspettes and stout telomeres. It differs from *Rhabdophaga* also in the distinct ovipositor, simple tarsal claws, and reduced larval papillae.

Lygocecis packardi (Felt), new comb.

Sackenomyia packardi Felt 1909: 290.

Wing length: ♂, 2.2-2.6 mm.; ♀, 2.0-2.8 mm. Palpus 2-segmented. Male genitalia as in fig. 8. Female postabdomen as in fig. 3. Pupal antennal horns bifid.
Syntypes: 2♂♂, 2♀♀, 3 pupal exuviae, and 2 larvae, from irregular twig swellings of *"Salix longifolia"* (=*S. interior* Rowles), adults emerged IV-15 to 16-1909, Canton, Mass., W. Packard, a1934, USNM Type No. 29338.

This species is known from Massachusetts, Virginia, Illinois, and Texas. It differs from *porterae* in the 2-segmented palpus, the absence of spinose setulae on the distal half of the ovipositor, and the bifid pupal antennal horns.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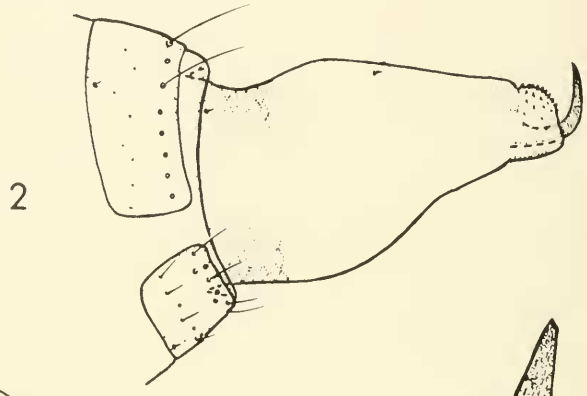
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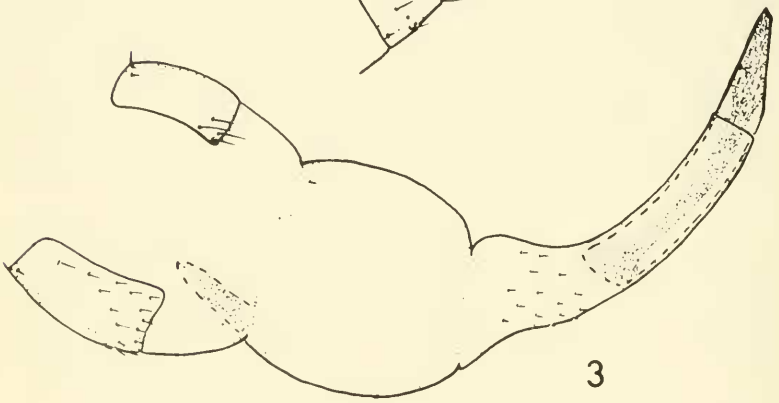
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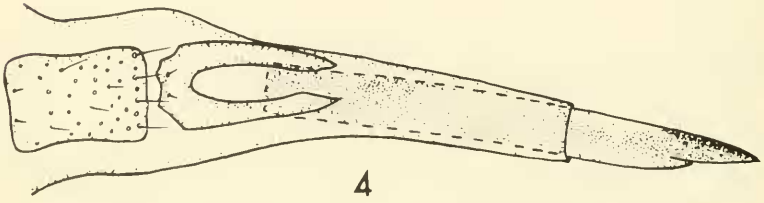
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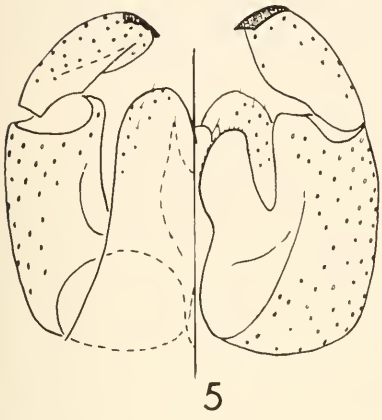

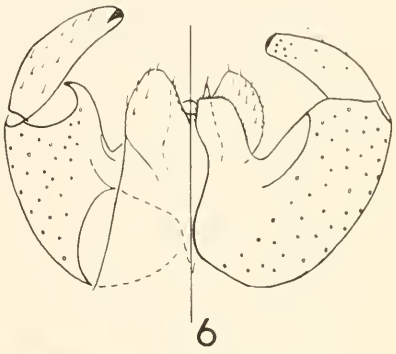

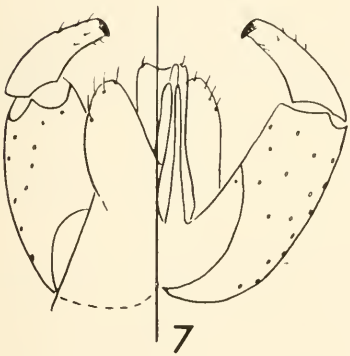

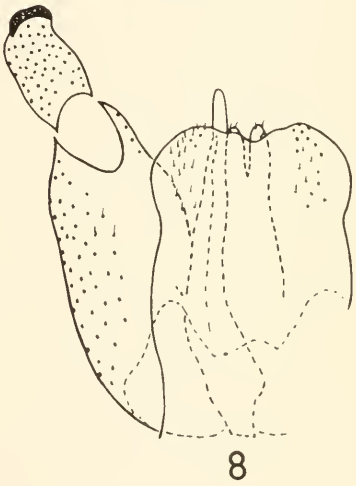

Figs. 1-4, female postabdomens: 1, *Cystiphora canadensis,* segments VI to end, incl. (dorsolateral view); 2, *Sackenomyia acerifolia,* VI to end, incl. (lat.); 3, *Lygocecis packardi,* VII to end, incl. (lat.); 4, *Procystiphora coloradensis,* VII to end, incl. (dorsal, but distal half of ovipositor lateral).

Figs. 5-8, male genitalia (left half, dorsal view; right half, ventral): 5, *Procystiphora colorandensis;* 6, *P. junci;* 7, *Sackenomyia viburnifolia;* 8, *Lygocecis packardi.*

Lygocecis porterae (Cockerell), new comb.

Rhabdophaga porterae Cockerell 1904: 155.

Wing length: ♀, ca. 2.0 mm. Palpus 3-segmented. Female with recurved spinose setulae on basal half of ovipositor. Pupa with long, undivided antennal horns.

Syntypes: 3♀♀, pupal exuvium, from twig gall on willow, I-31-1904, near Las Vegas, New Mexico, W. Porter & M. Cooper, in USNM.

Procystiphora Felt

Procystiphora Felt 1915: 212. Type-species, *coloradensis* Felt (orig. des.).

Adult. Antenna with 15 flagellomeres. Palpus elongate, 4-segmented. Wing vein R_5 joining C slightly anteriad of wing apex. Tarsal claws each with small basal tooth. Empodia longer than claws. Male abdomen: terga I-VI with only caudolateral setae and covered with scales; tergum VII as for VI but with several lateral setae; tergum VIII sclerotized only basally, naked but for basal pair of trichoid sensilla; sterna II-VIII quadrate, entire, each with complete caudal row or rows of setae, several scattered lateral and central setae, and uniformly covered with scales; claspettes wide, blunt-tipped; telomere somewhat flattened, the apical tooth wide; cerci large, rounded; sternum X deeply incurved, the lobes pointed. Female abdomen: as in ♂ except for postabdomen; tergum and sternum VII as long as preceding sclerites but narrower, more strongly sclerotized, and with complete rows of caudal setae; tergum VIII bifid beyond base, longer than tergum VII, and strongly sclerotized; ovipositor very long, the distal half sclerotized, bilaterally compressed the pointed cercus covered with tiny setae.

Immature stages unknown.

This genus differs from the other genera considered here by the shape of the ♂ claspettes and sternum X, the small-toothed claws and long empodia, and the shape of the female abdominal sclerites; but possibly even more important than those characters is that the abdominal sterna lack a middle row of setae and are covered with scales even immediately cephalad of the caudal setae, an area that is naked in most other Oligotrophidi.

Procystiphora contains 2 Nearctic species reared from *Juncus* and possibly *Carex*. *Sterrhaulus corneolus* (Rübsaamen) reared from *Carex* in Germany has a piercing ovipositor and may belong here, but I have not seen specimens.

Three extra-Nearctic species have been placed in *Procystiphora* but are here transferred to *Dasineura*. These are *Dasineura autumnalis* (Mamaev), new combination, *D. mangiferae* Felt, restored combination, and *D. indica* (Grover and Prasad), new combination. The first species has been reared from elm in Europe, the 2 last from mango in India. *D. autumnalis* is probably more closely related to typical *Dasineura* than to the 2 mango midges. Except for the piercing ovipositor, the 3 species fit well in *Dasineura* for the following reasons: the tarsal claws have large teeth, the empodia are as long as the claws; the abdominal terga II-VI have lateral setae and the caudal setal rows, both of which are complete; and the male claspettes are attenuate and setulose.

Procystiphora coloradensis Felt

Procystiphora coloradensis Felt 1915: 212.

Wing length: ♂, 2.6 mm.; ♀, ?. Male genitalia as in fig. 5. Female postabdomen as in fig. 4.

Syntypes: 2♂♂, ♀, "possibly from *Carex*," VII-21-1914, Long's Peak Inn, Long's Peak, Colorado, a2573, in Felt Collection.

Procystiphora junci Felt

Procystiphora junci Felt 1922: 166.

Wing length: ♂, 2.0 mm.; ♀, 1.8 mm. Male genitalia as in fig. 6.
Syntypes: 2♂♂, 8♀♀, reared from *Juncus dudleyi* Wieg., X-6-1921, Centralia, Ill., W.B. Cartwright, A3209, in Felt Collection.

Sackenomyia Felt

Sackenomyia Felt 1908: 361. Type-species, *Rhopalomyia acerifolia* Felt (orig. des.).
Phlyctidobia Kieffer 1912: 200. Type-species, *Oligotrophus solmsi* Kieffer (orig. des.). *New synonym.*

Adult. Antenna with 10-12 flagellomeres. Palpus 3-segmented. Wing vein R_5 joining C. anteriad of wing apex. Tarsal claws simple (in type-species) or toothed. Empodia as long as claws. Male abdomen: terga I-VI with complete, sparse caudal row of setae, occasional lateral setae, and several scales; tergum VII sclerotized only basally, only caudolateral setae present; tergum VIII sclerotized only basally, naked except for basal pair of trichoid sensilla; sterna II-VIII quadrate, naked between caudal and middle setal rows; claspettes elongate, narrow parallel-sided, glabrous; telomere short, widest near base, tapering gradually to apical tooth; cerci large, ovoid; sternum X weakly concave apically. Female abdomen: anterior segments as in male; segments VII-VIII tubular, slightly sclerotized; terga VII-VIII not differentiated from surrounding area, both naked, identifiable only by basal pair of trichoid sensilla; sternum VII either apparent only by basal pair of trichoid sensilla (as in type-species) or quadrate with caudal row and other scattered setae; ovipositor short, cultrate, tapering abruptly beyond segment VIII to the strongly sclerotized, minutely setose cercus.

Pupa. Antennal horns with acute, pigmented apices. Prothoracic setae elongate. Metathoracic spiracles elongate, sclerotized. Face naked. Abdominal spicules of uniform size.

Larva. Spatula clove-shaped. Abdominal segments each with 4 dorsal papillae. Hind ventral papillae haired. Terminal segment with 4 setose papillae of uniform length.

Sackenomyia contains 4 species: 3 Nearctic, listed below, and the Palearctic species, *S. solmsi* (Kieffer) (n. comb.), of which I have seen a male and a female from the Barnes Collection. All form blister leaf galls on *Viburnum* spp.

Unlike the other genera treated here, the female abdominal terga VII and VIII have almost lost their identity. The cultriform cercus is also unique. The male genitalia differ from those of *Cystiphora* (and hence *Dasineura)* by the elongate, thin, glabrous claspettes. The larvae of *Sackenomyia* and *Cystiphora* resemble one another in the loss of a pair of papillae on each of the abdominal segments and of 2 pairs of terminal papillae. Inasmuch as the same reduction has occurred also in such widely separated genera as *Asteromyia* in the Lasiopteridi and *Caryomyia* in the Cecidomyiidi, I am inclined to consider the similarities between larvae of *Sackenomyia* and *Cystiphora* as separately derived.

Within *Sackenomyia, S. commota* has the more primitive characters with its toothed claws and well-developed female abdominal sternum VII, whereas the other 3 species have simple claws and a much reduced sternum VII.

Sackenomyia acerifolia Felt

Rhopalomyia acerifolia Felt 1907: 25 (as *acerifoliae)*

Wing length: ♀, 1.2 mm. Female postabdomen as in fig. 2.
Holotype, ♀, swept V-1-1906, Albany, N.Y., C38, in Felt Collection.
This species is very likely synonymous with *viburnifolia.* Its name is due to the fact that it was swept from maple leaves.

Sackenomyia viburnifolia Felt

Sackenomyia viburnifolia Felt 1909: 290.

Wing length: ♂, 1.0 mm.; ♀, 1.2-1.3 mm. Male genitalia as in fig. 7. Female postabdomen as in fig. 2.
Syntypes, 2 ♂♂, 3 ♀♀, 3 larvae, adults reared V-1909 ex purplish, fusiform, vein swellings on *Viburnum dentatum* L., Magnolia, Mass., C.H. Clark, a1896, in Felt Collection.

Sackenomyia commota Gagne, new name

Cystiphora viburnifolia Felt 1911: 480. Secondary junior homonym of *viburnifolia* Felt 1909.

Wing length: ♀, ca. 1.2 mm.
Holotype, ♀, reared V-5-1909, ex blister leaf gall on *Viburnum ? lentago* L., Magnolia, Mass., C.H. Clarke, a1897, in Felt Collection.
This species is renamed *commota* for the excited manner in which the mature larvae of *Sackenomyia* spp. move about when disturbed.

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