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MACROPHYA DAHLBOM SPP. (HYMENOPTERA: TENTHREDINIDAE) FEEDING ON ASTERACEAE

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Abstract.—Two species of North American sawflies are newly reported to feed on plants in the family Asteraceae, bringing the total to four, all in the genus *Macrophya* Dahlbom. Larvae of *M. phylacida* Gibson feed on *Verbesina* spp. and those of *M. senacca* Gibson feed on *Solidago* spp. The larvae of each are described and illustrated.

Key Words: Tenthredininae, crownbeard, wingstem, goldenrod, rearing

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Given the diversity and ubiquity of plants in the aster family (Asteraceae), the scarcity of sawflies (Hymenoptera: Symphyta) using them as larval hosts is striking. All North American records of sawflies from this family involve the genus *Macrophya* Dahlbom (Tenthredinidae), although the polyphagous Holarctic species *Pachyprotasis rapae* (Linnaeus) is recorded from *Solidago* L. in Europe (Smith 1979), along with another *Pachyprotasis* Hartig and a species of *Tenthredo* Linnaeus (Lorenz and Kraus 1957, Macek et al. 2020). Yuasa (1922) listed *Rudbeckia laciniata* L. and *Solidago juncea* Aiton as hosts for *M. pulchella* (Klug), and *Symphyotrichum* [as *Aster*] *prenanthoides* (Muhl. ex Willd.) G. L. Nesom as the host for *M. lineata* (Norton), but adult specimens are not available to confirm these identifications, and Gibson (1980) indicated that either of the names may actually refer to *M. flavolineata* (Norton) or *M. simillima* Rohwer. Britton (1925) described and illustrated larvae feeding on *R. laciniata*, later reporting that the reared adults were *M. simillima* (Britton 1926), and this identification was confirmed by Gibson (1980). *Macrophya flavolineata* was recently reared from *Doellingeria umbellata* (Mill.) Nees (Eiseman and Smith 2020). Here we report the rearing of *M. phylacida* Gibson from *Verbesina occidentalis* Walter, and of *M. senacca* Gibson from *Solidago canadensis* L. and *S. gigantea* Aiton.

Materials and Methods

Early- to late-feeding-stage sawfly larvae found on Asteraceae in Georgia, North Carolina, and Massachusetts were placed in vials or jars along with leaves of their host plants. These containers were kept indoors,

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away from direct sunlight, and were checked daily. Larvae were photographed throughout their development, and fresh leaves were added as needed. When mature, or nearly so, the larvae were transferred to jars containing a moistened 1:1 mixture of sand and peat several centimeters deep. The leaves were removed after the larvae burrowed. Jars containing overwintering prepupae were stored in a refrigerator at 1–3 °C from 16 October 2020 to 1 March 2021. Photos of larvae and adults were taken by CSE using a Canon EOS Rebel XSi DSLR camera, MP-E 65 mm macro lens, and Macro Twin Lite MT-24EX flash unit.

Specimens are deposited in the National Museum of Natural History, Smithsonian Institution, Washington, DC (USNM). Reared adults were identified by DRS using Gibson (1980) and comparison with specimens in the USNM. In the "Specimens examined" sections, the first date given for each specimen indicates when the larva was collected, and the second date indicates when the larva was preserved or the adult emerged, as specified.

Descriptions are based on photographs of the larvae from which adults were reared. The "Photographs examined" sections list additional online photographs of larvae located by using the BugGuide Advanced Search (https://bugguide.net/adv_search/bgsearch.php) and the "Filters" option on iNaturalist (https://www.inaturalist.org/observations). Separate searches were conducted by CSE to display all observations identified as Symphyta that included the words "*Verbesina*," "wingstem," "crownbeard," "*Solidago*," or "goldenrod" in their descriptions. Records annotated with "BG" followed by a number can be found by adding that number to the end of this URL: https://bugguide.net/node/view/. For those annotated with "iNat", the number is added to the end of https://www.inaturalist.org/observations/.

New host and distribution records are preceded by an asterisk (*); these incorporate caught specimens in the USNM in addition to those reared as part of this study.

Results and Discussion

Macrophya phylacida Gibson (Figs. 1–4)

Specimens examined.—GEORGIA: Clarke Co., Athens, 33.986648, -83.496220, 11.v.2020, preserved 21–27.v.2020, Bill Sheehan, ex *Verbesina occidentalis*, #CSE6220 (2 larvae); same collection, adult emerged 10.iv.2021, #CSE6836 (1♀); NORTH CAROLINA: Orange Co., Duke Forest Old Bridge Trail, 14.v.2020, adult emerged 4.iv.2021, T.S. Feldman, ex *Verbesina occidentalis*, #CSE6808 (1♀).

Photographs examined.—ARKANSAS: Johnson Co., Hagarville, 28.v.2016, mayfly1963, on *Verbesina alternifolia* (iNat 3331414); DISTRICT OF COLUMBIA: Rock Creek Park, 6.vi.2020, Katja Schulz, on *Verbesina alternifolia* (iNat 66862696); GEORGIA: Clarke Co., Athens, 28.iv.2020, Bill Sheehan, on *Verbesina occidentalis* (iNat 44547125); 24.v.2020, Bill Sheehan, on *Verbesina occidentalis* (iNat 47220239); 6.v.2021, Alan Rockefeller, on *Verbesina occidentalis* (iNat 77745215); ILLINOIS: Kane Co., Elgin, 27.vi.2015, Susan Wagoner, on ?*Verbesina* (BG 1758308); MARYLAND: Allegany Co., Little Orleans, Sue Muller, on *Verbesina alternifolia* (BG 1987823); Baltimore Co., Cromwell Valley Park, 6.vi.2018, Rich, on ?*Verbesina* (BG 1652381); MICHIGAN: Wayne Co., Dearborn, 19.vi.2008, Julie Craves, on *Verbesina alternifolia* (BG 1908973); MISSOURI: Audrain Co., Mexico, 30.v.2020, Lorie Volenberg, on *Verbesina alternifolia* (BG 1856485); Boone Co., 6.vi.2020, chert_hollow, on *Verbesina* (wingstem) (iNat 48735375); NEBRASKA:

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Figs. 1–8. Larvae and reared adults of Asteraceae-feeding sawflies. 1, *Macrophya phylacida* early instar. 2, *Macrophya phylacida* late feeding stage. 3, *Macrophya phylacida* prepupa. 4, *Macrophya phylacida* adult. 5, *Macrophya senacca* early instar. 6, *Macrophya senacca* late feeding stage. 7, *Macrophya senacca* prepupa. 8, *Macrophya senacca* adult.

Sarpy Co., Bellevue, Fontenelle Forest, 30.vi.2009, Roland Barth, on *Verbesina alternifolia* (BG 296701); NEW JERSEY: Hunterdon Co., Raven Rock, Bull's Island, 22.vi.2008, Anita Gould, on *Verbesina alternifolia* (BG 466762, iNat 505438); NORTH CAROLINA: Lincoln Co., Denver, 10.vi.2021, Joe Girgente, on wingstem (iNat 82441221); Orange Co., Chapel Hill, 16.v.2021, jtuttle, on *Verbesina* (iNat 79039007); Duke Forest Old Bridge Trail, 8.v.2020, Tracy S. Feldman, on *Verbesina occidentalis* (BG 1811137); OHIO: Clark Co., Springfield Township, 17.vi.2021, Matt Schultz, on *Verbesina* (iNat 83449053); Clermont Co., Kelly Nature Preserve, 15.vi.2008, Sharon Cates, on ?*Verbesina* (BG 192317); Greene Co., Beavercreek, 12.vi.2015, Tim Turner, on *Verbesina alternifolia* (BG 1084800);

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PENNSYLVANIA: Allegheny Co., vi.2021, B. Coulter, on wingstem (iNat 84114002); Bucks Co., Bowman's Hill Wildflower Preserve, 7.vi.2014, Bill Keim, on *Verbesina alternifolia* (BG 952444, iNat 2484592); Juniata Co., Thompsontown, 22.vi.2019, Ken Wolgemuth, on *Verbesina alternifolia* (BG 1684305); 17.vi.2021, Ken Wolgemuth, on ?*Verbesina* (BG 1985132); Washington Co., West Alexander, 18.vi.2011, Robin Armstrong Seeber, on ?*Verbesina* (BG 531424); TENNESSEE: Carter Co., vi.2021, hmhendrix, on *Verbesina* (iNat 83389552); Putnam Co., 23.v.2021, Holly Taylor, on *Verbesina alternifolia* (iNat 79959219); Williamson Co., Owl's Hill Nature Sanctuary, 15.v.2014, MHunter, on *Verbesina alternifolia* (BG 921925); VIRGINIA: Fluvanna Co., vi.2020, clara-c, on *Verbesina alternifolia* (iNat 48274791); Radford, Wildwood Park, 30.v.2011, Nancy Kent, on *Verbesina alternifolia* (BG 522435); 3.vi.2017, Nancy Kent, on *Verbesina alternifolia* (BG 1378894); Rockbridge Co., 25.v.2018, Allen Belden, on *Verbesina* (iNat 102319560); WEST VIRGINIA: Lewis Co., Weston, 160 Jackson Mill Rd., 16.vi.2021, becksnyc, on *Verbesina alternifolia* (iNat 83418944); same but 24.vi.2021 (iNat 84430485); WVU Jackson's Mill, 13.vi.2020, becksnyc, on *Verbesina alternifolia* (iNat 61520805); Tucker Co., 20.vi.2021, Randy Bodkins, on wingstem (iNat 83870533).

Hosts.—*Asteraceae: *Verbesina occidentalis* Walter. In Georgia a few larvae were observed feeding on *V. alternifolia* (L.) Britton ex Kearney when it grew near *V. occidentalis*, but we estimate that 90–95% of larvae seen were on *V. occidentalis*. Most online records cited above give the host as *V. alternifolia* or unspecified *Verbesina*.

Distribution.—USA: *GA, KS, *KY, *NC, *OK, PA, VA (Gibson 1980, Smith 2006). Larvae apparently representing this species have been found in AR, DC, IL, MD, MI, MO, NE, NJ, OH, TN, and WV.

Phenology.—Adults have been collected in May in Kansas, May–June in Virginia, and June in Pennsylvania (Gibson 1980, Barrows and Smith 2014). They have not been observed farther south, but larvae are present by late April in Georgia and by early May in North Carolina. Larvae have been observed as late as 10 June in North Carolina and mid- to late June in more northern states. The successfully reared larva from Georgia burrowed into soil on 21 May, and our North Carolina specimen was from one of three larvae that burrowed between 27 and 30 May. The reared adults (Fig. 4) emerged 34–40 days after being removed from winter refrigeration.

Notes.—Larvae are mostly hidden on the undersides of leaves during the day. There is typically one larva per plant, but we have observed as many as five on different leaves of the same plant.

Description of larva.—*Early instars* (Fig. 1): Length ~7 mm. Head amber with black band on vertex and black surrounding ocelli; body entirely whitish. *Late feeding stage* (Fig. 2): Length ~13–23 mm. Head amber with black band extending from ocellus to black vertex and to opposite ocellus. Body amber with white waxy coating, with black spot on meso- and metapleuron, similar black supraspiracular spot on abdominal segments 1–9, smaller black subdorsal spots on abdominal segments 1–9, and small black spot above each proleg. *Prepupa* (Fig. 3): Length ~14–16 mm. Head cream-colored with brown band on vertex not quite reaching the ocelli. Body yellowish (without waxy coating), dorsally brown with scattered narrow, blackish transverse lines; pattern of dark lateral spots as in late feeding stage, but without spots above prolegs.

Macrophya senacca Gibson
(Figs. 5–8)

Specimens examined.—MASSACHUSETTS: Franklin Co., Northfield, 42.646907,

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-72.425103, 21.vi.2020, adult emerged 13.iv.2021, C.S. Eiseman, ex *Solidago gigantea*, #CSE6845 (1♀); 42.647319, -72.425211, 13.vi.2020, adult emerged 26.iv.2021, C.S. Eiseman, ex *Solidago canadensis*, #CSE6880 (1♀).

Photographs examined.—ONTARIO: Durham Co., Courtice, 2.vii.2019, Matthew Ireland, on goldenrod (iNat 28065749); Essex Co., Kingsville, 26.vi.2021, Quinten Wiegersma, on *Solidago* (iNat 84871132); Stormont, Dundas and Glengarry Co., Reveler Conservation Area, 14.vi.2015, christine123, on *Solidago canadensis* (iNat 19737994); QUEBEC: Les Collines-de-l'Outaouais Co., 1.vii.2015, christine123, on *Solidago canadensis* (iNat 19600141, 19737993); MINNESOTA: St. Louis Co., Duluth, Duluth Heights, 9.vii.2020, davidenrique, on *Solidago* (iNat 52741386); PENNSYLVANIA: Centre Co., Patton Township, 5932 Buffalo Run Road, 18.vi.2019, Michael Skvarla, on *Solidago* (iNat 27234966); TENNESSEE: Hamilton Co., 16.v.2020, billhaley, on goldenrod (iNat 46232932); VERMONT: Windham Co., Rockingham, 30.vi.2020, joannerusso, on goldenrod (iNat 51468851).

Hosts.—*Asteraceae: *Solidago canadensis* L., *S. gigantea* Aiton.

Distribution.—Canada: MB, NS, ON, QC; USA: CT, IA, IL, KS, *KY, MA, MD, MI, MN, MO, NC, NH, NY, OH, OK, PA, SD, TN, VA, VT, WI (Gibson 1980; Smith 2006, 2008).

Phenology.—Adults have mostly been collected in May and June, with records from late April in Oklahoma and Virginia, and as late as 12 July in Nova Scotia (Gibson 1980, Barrows and Smith 2014). Our reared larvae from Massachusetts were collected beginning on 13 June and burrowed into soil between 4 and 7 July; similar larvae have been found as early as 16 May in Tennessee and as late as 9 July in Minnesota.

Notes.—A single early instar larva was found on *Solidago canadensis* on 13 June, resting coiled on the underside of a leaf in which it had eaten two holes 2–3 mm long. It continued to produce and enlarge holes for about ten days before transitioning to edge feeding. It burrowed into soil on 6 or 7 July. Two mid-instar larvae were found on *S. gigantea* on 21 June, likewise resting coiled on the undersides of leaves; both of these had burrowed by 4 or 5 July. The reared adults (Fig. 8) emerged 43–56 days after being removed from winter refrigeration.

Description of larva.—*Early instar* (Fig. 5): Length ~5–6 mm. Head light brown with black spot around ocelli. Body entirely whitish, except thorax with greenish tint dorsally and laterally. *Late feeding stage* (Fig. 6): Length ~16–20 mm. Head amber with stripe on vertex extending to upper frons and spot around and posterior to ocelli black. Body with dark gray dorsal stripe, light gray laterally with greenish tint on thorax, whitish ventrally extending to about spiracles; thoracic segments and abdomen with subdorsal row of black spots on each side, a second row of large supraspiracular black spots, a third row of small paired sublateral black spots on abdomen only, and a fourth row of black spots on and between coxae and above each proleg. *Prepupa* (Fig. 7) pale brown, with color pattern similar but fainter; head lacking spot posterior to ocelli.

Discussion.—Larvae of both species are typical of the Tenthredininae: Prolegs on abdominal segments 2–8 and 10; abdominal segments each with 7 dorsal annulets; left mandible with 3–4 lateral teeth and one mesial ridge; and 13–18 setae on tibiae of thoracic legs. They are most similar to the Selandriinae (except *Dolerus*) which have the same number of prolegs and annulets on the abdominal segments, but the Selandriinae have 5 lateral teeth and 2 mesial ridges on the left mandible and 10 or fewer setae on the tibiae (Smith and Middlekauff 1987).

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The larva of *M. senacca* has a pattern of spots similar to that of *M. flavolineata* Norton (Eiseman and Smith 2020), but the head of the latter is completely black above, without separate black spots behind the ocelli, and the feeding stages have a white waxy coating (as in *M. phylacida*). The larva of *M. nigra* (Norton), which has been reared from *Dasistoma macrophylla* (Nutt.) Raf. (Orobanchaceae) (Eiseman et al. 2017), is black above with a small ocellar black spot and the body lacks rows of supraspiracular and subdorsal black spots.

The color patterns and host plant should be adequate to distinguish the larvae of *M. phylacida* and *M. senacca*. The larva of *M. simillima* is apparently similar to that of *M. senacca*. Britton (1925) described the larvae of *M. simillima* on *Rudbeckia laciniata* as "light gray or dirty white with a darker gray median stripe, and a row of rather large black spots on each side about half-way between the spiracles and the median stripe. Around the spiracles there are small black dots, two on each thoracic segment and the last abdominal segment, and four on each of the other abdominal segments. Head, black on upper surface and more than half of face; lower portion of head, legs, prolegs and ventral surface of body, light gray or dirty white with yellowish tinge." Further rearing is needed to determine whether there is a consistent difference in head pattern between *M. simillima* and *M. senacca*. Among *Macrophya* larvae photographed on *R. laciniata* in Iowa, Missouri, New York, Ohio, and Virginia, some have patterns identical to that of *M. senacca* (BG 1537805, 1668325, 1829418), while others show more extensive black but still have more or less prominent pale areas on the vertex (BG 1045337, 1715194; iNat 100011625). Britton's (1925) photograph of five larvae does not show sufficient detail, but it appears that two of them have spots much larger than those of *M. senacca*, while the others (as with all of those in the online examples) have similar-sized spots. Thus, either *M. simillima* has a variable head pattern that can resemble that of *M. senacca*, or *M. simillima* is not the only *Macrophya* species feeding on *R. laciniata*, and *M. senacca* (or another species resembling it) also occurs on this host.

A few additional Asteraceae genera are known to host undetermined tenthredinine sawfly species in North America. CSE has found a larva of unknown genus feeding on *Bidens frondosa* L. in New York (Orange Co., Black Rock Forest) in late August (iNat 98557688), and a similar one was found on *Bidens* sp. in Maryland (Montgomery Co., Takoma Park) in early July (iNat 52073713). They were cream-colored and unmarked except for the black eyespots and central stripe on the vertex. Another larva occurs on *Coreopsis tripteris* L. in Illinois (BG 1837669), Indiana (iNat 98559317), and Michigan (BG 412065, 1688284, 1833835, 1908970) from mid-June to early July. It has a pale brown head with a black spot on the vertex, and its body is pale with a single row of supraspiracular black spots. CSE has also found a single larva on *Ageratina altissima* (L.) R.M.King & H.Rob. in Vermont (Chittenden Co., Essex, Woodside Park) in late June (iNat 98560206). It was yellow and covered dorsally and laterally with a white bloom; the head was dark above and the body was apparently unmarked.

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