

PREY OF *SYMMORPHUS* WASPS (HYMENOPTERA: EUMENINAE) IN LITHUANIA

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Abstract. The studied populations of six solitary predatory wasps of the subfamily Eumeninae show a different degree of prey choice specificity. *Symmorphus murarius* and *S. crassicornis* may be considered as nearly monophagous, hunting only larvae of *Chrysomela* and sometimes closely related *Linaeidea*. *S. allobrogus* provisions its nests mainly with prey of Chrysomelinae leaf beetle larvae from the genera *Linaeidea*, *Gonioctena*, *Phratora* and *Plagioderia*. *S. bifasciatus* preys mostly on larvae of *Phratora* species, sometimes catching *Linaeidea* and *Plagioderia* as well. The latter two wasp species may be regarded as oligophagous. Another broadly oligophagous species, *S. debilitatus*, hunts mining larvae of Microlepidoptera of several families. *S. allobrogus*, *S. bifasciatus*, *S. crassicornis* and *S. murarius* seek their phytophagous prey on leaves of various deciduous trees and shrubs. These wasps do not show a clear preference for a particular plant species and sometimes provision the same nest, or even the same cell, with prey from different food plants. The monophagous *S. gracilis* hunts its only prey, larvae of the weevil *Cionus* sp., on the herbaceous plant, *Scrophularia* sp.

Key words: solitary predatory wasp, trap nest, prey choice, *Symmorphus*, Eumeninae, Vespidae

INTRODUCTION

Most solitary Eumeninae wasps (Hymenoptera: Vespidae) are mass provisioners that nest in wood borings and other pre-existing tubular cavities and construct their larval cells from the inside outwards, partitioning them with mud or leaf diaphragms and provisioning cells with stung insects as food for their larvae. They easily accept artificially prepared trap-nests such as burrows drilled in wood blocks or bundles of hollow reed or plastic tubes, facilitating the study of their biology (Cooper 1953; Koerber & Medler 1958; Thiede 1981; Collins & Jennings 1984; Gathmann *et al.* 1994). Most Eumeninae prey on larvae of Lepidoptera, others use larvae of Chrysomelidae and Curculionidae (Coleoptera) (Cooper 1957; Krombein 1964; Evans 1966; Cowan 1991; Itino 1992, 1997; McCallan 1993). Some of them are potentially useful biological control agents for herbivorous insects such as leafrollers (Jennings & Houseweart 1984; Collins & Jennings 1987; Harris 1994) or larvae of leaf beetles (Smiley & Rank 1986; Sears *et al.* 2001). In addition, functioning of the food web of plant, Chrysomelinae leaf beetle, and *Symmorphus* predatory wasp is one of the known model systems in recent studies of tritrophic interactions (Sears *et al.* 2001). Therefore, the study of the prey spectrum of *Symmorphus* is of particular interest. Prey of eight out of the nine European species of the

genus *Symmorphus* is known (Cumming 1989). Two of them, *S. debilitatus* and *S. connexus*, hunt caterpillars like other Eumeninae. The remaining European representatives of the genus prey on larvae of Coleoptera.

Species of *Symmorphus* exhibit different degrees of prey-specificity. Some of them, hunting larvae of a single, or of a few congeneric species, may be considered as monophagous. For instance, in Italy *S. crassicornis* hunts larvae of *Chrysomela populi* and *Ch. tremulae* (Bonelli 1988). In Japan *S. decens* seems to be feeding on *Gonioctena rubripennis* only (Hamanishi 1996).

The species hunting larvae of several genera from the same subfamily may be considered as oligophagous. One of them, Nearctic *S. cristatus*, which is most likely a sister species of Palearctic *S. allobrogus* (Cumming 1989), preys upon larvae of *Chrysomela aeneicollis*, *Ch. crotchii*, *Ch. schaefferi*, *Ch. scripta*, *Gonioctena americana*, and *Plagioderia californica* (Fye 1965; Sears *et al.* 2001). In Japan *S. foveolatus* mainly feeds on *Linaeidea aenea*, and sometimes on *Plagioderia versicolora* and *Gastrolina depressa* as well (Hamanishi 1996).

The species hunting a few related families of one order may be considered as broadly oligophagous, for instance, *S. gracilis*, which hunts larvae of Chrysomelidae and Curculionidae (Gathmann & Tschardtke 1999).

Finally, some species preying upon larvae of different insect orders might be considered as polyphagous. For instance, Gathmann and Tschamtko (1999) reported that *S. connexus* provisioned its nests with larvae of both Chrysomelidae and Microlepidoptera.

Prey of most other species of *Symmorphus* is unknown, or is known at the family level only. For example, the trap-nesting *S. angustatus*, *S. bifasciatus* and *S. murarius* are known to prey on the Chrysomelidae larvae, their species being unidentified (Gathmann & Tschamtko 1999).

The objective of the present study was to assess the prey range of the trap-nesting species of *Symmorphus* in Lithuania. Performing this research the author also intended to clarify whether wasps seek their prey on a single or multiple plant species.

MATERIAL AND METHODS

The field research was carried out in 1991–2003 in the localities Varnupys (Anykščiai district, 55°24'N 25°17'E), Bilšiai (Molėtai district, 55°08'N 25°16'E), Kaunas city (54°54'N 23°54'E) and Papiškiai (Pasvalys district, 55°56'N 24°16'E), Lithuania. Wasp nests were collected using bundles of 25–35 internode fragments of the previous year stems of *Phragmites australis* differing in diameter as trap-nests. These trap-nests were exposed on the walls of old wooden or (in Papiškiai) daubed buildings with colonies of solitary wasps (Fig. 1) from the middle of May until the middle of August. Every 7–14 days stem fragments with completed wasp nests, having visible external plugs, were substituted with new fragments of the similar diameter. As a result, trap-nests were never completely occupied, and wasp females could have a possibility to build multiple nests during the summer season. In total we obtained and studied 2,617 nests with 7,757 cells of six *Symmorphus* species.

Part of the nests (651 nest with 1,898 cells) was opened and studied before wasp larvae had consumed provision, and fresh prey specimens were identified up to species. The remaining nests were opened after wasp larvae had finished their development, and prey was identified by its remains, usually mandibles or head capsulae. In the latter case only part of the prey could be identified up to species, only genus or family being recognised of the rest. In the case of the Lepidoptera larvae it was only family that could be sometimes established.

Wasp species were identified using keys by Tobias and Kurzenko (1978), and Schmid-Egger (1994). The Chrysomelidae larvae were identified using keys by Ogloblin and Medvedev (1971), and Medvedev and Zaytsev (1978). Some larvae of leaf beetles, identical



Figure 1. Trap-nests of *Phragmites australis* internodes, used for obtaining nests of *Symmorphus* wasps, on the wall of an old wooden building in Varnupys.

with those found in wasp nests were collected alive on the study sites and reared up to imago to confirm the identification. The examination was made using a binocular microscope MBS–10, at a magnification 8× to 56×. Wasp nest data were processed using the database-managing system Microsoft Access 2000.

RESULTS AND DISCUSSION

The number of examined nests of the *Symmorphus* representatives was as follows: *S. allobrogus* – 2,189 nests, *S. murarius* – 239, *S. bifasciatus* – 92, *S. gracilis* – 33, *S. crassicornis* – 36, and *S. debilitatus* – 28. Prey, or its remains were recognised in 7,302 cells, its species being identified in 6,441 cell (Table 1). In most cases (98.4%) we managed to recognise a single prey species within a cell. This fact supports the view expressed by Cowan (1991) and Raveret Richter (2000) that hunting females may learn particular search habits and repeatedly return to locations of prey concentration. However, 1.6% of nest cells with identified prey (91 cell of *S. allobrogus*, eight cells of *S. murarius* and three cells of *S. bifasciatus*) contained two, or even

Table 1. Prey of the studied *Symmorphus* wasps in Lithuania: species, its food plant, the number and percent of nest cells containing that prey.

| Wasp species | Prey group | Prey species | Food plant of the prey | N of cells | % of cells |
|---|------------------------|---|------------------------------|-----------------------------------|----------------------|
| <i>Symmorphus allobrogus</i> (6,223 cells in total) | Chrysomelinae | <i>Linaeidea aenea</i> | <i>Alnus incana</i> | 2,942 | 47.3 |
| | | <i>Gonioctena quinquepunctata</i> | <i>Padus avium</i> | 2,277 | 36.6 |
| | | <i>Phratora laticollis</i> | <i>Populus tremula</i> | 346 | 5.6 |
| | | <i>Gonioctena viminalis</i> | <i>Salix cinerea</i> | 189 | 3.0 |
| | | <i>Plagioderia versicolora</i> | <i>Salix</i> sp. | 91 | 1.5 |
| | | <i>Phratora atrovirens</i> | <i>Populus tremula</i> | 46 | 0.7 |
| | | <i>Hydrothassa hannoverana</i> | <i>Ranunculus</i> | 8 | 0.1 |
| | | <i>Gastrophysa viridula</i> | <i>Polygonum, Rumex</i> | 6 | 0.1 |
| | | <i>Phratora vulgatissima</i> | <i>Salix</i> sp. | 5 | 0.08 |
| | | <i>Phratora vitellinae</i> | <i>P. tremula, Salix</i> sp. | 4 | 0.02 |
| | | Chrysomelidae gen. sp. | | 402 | 6.5 |
| | | <i>Symmorphus murarius</i> (603 cells) | Chrysomelinae | <i>Chrysomela vigintipunctata</i> | <i>Salix cinerea</i> |
| <i>Chrysomela populi</i> | <i>Populus tremula</i> | | | 85 | 14.1 |
| <i>Chrysomela saliceti</i> | <i>Salix cinerea</i> | | | 70 | 11.6 |
| <i>Linaeidea aenea</i> | <i>Alnus incana</i> | | | 6 | 1.0 |
| <i>Chrysomela tremulae</i> | <i>Populus tremula</i> | | | 1 | 0.2 |
| <i>Chrysomela lapponicum</i> | <i>Salix, Betula</i> | | | 1 | 0.2 |
| <i>Chrysomela</i> sp. | | | | 325 | 53.9 |
| <i>Symmorphus crassicornis</i> (109 cells) | Chrysomelinae | <i>Chrysomela populi</i> | <i>Populus tremula</i> | 41 | 37.6 |
| | | <i>Chrysomela saliceti</i> | <i>Salix cinerea</i> | 21 | 19.3 |
| | | <i>Linaeidea aenea</i> | <i>Alnus incana</i> | 6 | 5.5 |
| | | <i>Chrysomela lapponicum</i> | <i>Salix, Betula</i> | 5 | 4.6 |
| | | <i>Chrysomela</i> sp. | | 36 | 33.0 |
| <i>Symmorphus bifasciatus</i> (170 cells) | Chrysomelinae | <i>Phratora laticollis</i> | <i>Populus tremula</i> | 146 | 85.9 |
| | | <i>Phratora vulgatissima</i> | <i>Salix</i> sp. | 10 | 5.9 |
| | | <i>Linaeidea aenea</i> | <i>Alnus incana</i> | 6 | 3.5 |
| | | <i>Phratora vitellinae</i> | <i>P. tremula, Salix</i> sp. | 2 | 1.2 |
| | | <i>Plagioderia versicolora</i> | <i>Salix</i> sp. | 1 | 0.6 |
| | | Chrysomelidae gen. sp. | | 8 | 4.7 |
| <i>Symmorphus gracilis</i> (107 cells) | Curculionidae | <i>Cionus</i> cf. <i>tuberculosis</i> | <i>Scrophularia</i> sp. | 107 | 100 |
| <i>Symmorphus debilitatus</i> (90 cells) | Lepidoptera | Lithocolletinae gen. sp. | | 10 | 11.1 |
| | | Gracillariinae gen. sp. | | 5 | 5.6 |
| | | Incurvariidae gen. sp. | | 5 | 5.6 |
| | | unidentified Lepidoptera | | 70 | 77.8 |

three prey species. Having in mind that (1) hunted chrysomelid beetles live on different food plants, and (2) the wasp female provisioning a single nest cell is under pressure to find food quickly (Evans 2002), we may assume that the *Symmorphus* wasps have comparatively flexible hunting behaviour being able to learn the new environment and quickly change their habits in situations of the 'usual' prey shortage.

S. allobrogus, the commonest species on study sites, provisioned its nests with larvae of ten Chrysomelinae species. Therefore, *S. allobrogus* may be regarded as an

oligophagous wasp. Its typical prey belongs to four related genera that live on four different deciduous trees or shrubs. However, the wasp sometimes captured larvae of Chrysomelinae that live on herbaceous plants as well.

Two other species, *S. murarius* and *S. crassicornis*, hunted only larvae of *Chrysomela* and closely related *Linaeidea*. Larvae of *Chrysomela populi* and *Ch. saliceti* seemed to be the prey shared by both wasp species on the study sites. However, *Ch. vigintipunctata*, commonly hunted by *S. murarius*, was never found to be used as prey by *S. crassicornis*.

More than 90% of the prey of *S. bifasciatus* belonged to the genus *Phratora*, only a few cells contained larvae of other Chrysomelinae genera. Hence, *S. bifasciatus* is a narrowly oligophagous species.

S. gracilis seemed to be monophagous on slimy larvae of the weevil *Cionus* sp., most probably *C. tuberculatus*, imagines of which were numerous on the plants of *Scrophularia nodosa* on study sites. In 68 examined nests of the species I have never found any other kind of prey, or remains of it, therefore I cannot confirm broad oligophagy of *S. gracilis*, reported by Gathmann and Tschardtke (1999).

S. debilitatus is the only studied representative of the genus using small mining caterpillars as prey. Most of unidentified remains of prey had a flat head capsula and were obviously those of mining Microlepidoptera. Although they belong to different families, they seem to be of close ecology and similar in appearance, thus I consider *S. debilitatus* to be a broadly oligophagous wasp species.

Food plants of prey show, that most studied *Symmorphus* species hunt mainly on leaves of various deciduous woody plants. None of these wasps seemed to show preference to a particular tree or shrub species, however, the available material is not yet sufficient to draw this conclusion concerning *S. debilitatus*. The only obvious exception is *S. gracilis*, hunting for its prey on a single herbaceous plant, *Scrophularia* sp.

CONCLUSIONS

1. The studied populations of *Symmorphus* wasps show a different degree of prey specificity. None of them was proved to be polyphagous. *S. murarius*, *S. crassicornis* and *S. gracilis* may be considered as monophagous. *S. allobrogus* and *S. bifasciatus* may be regarded as oligophagous. *S. debilitatus* may be considered as broadly oligophagous.

2. *S. allobrogus*, *S. bifasciatus*, *S. crassicornis* and *S. murarius* hunt on leaves of several deciduous tree and shrub species. They do not show preference to any particular plant species. *S. gracilis* hunts on the single herbaceous plant, *Scrophularia* sp.

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**SYMMORPHUS GENTIES KLOSČIAVAPSVIŲ
(HYMENOPTERA: EUMENINAE) GROBIS LIETUVOJE**

A. Budrienė

Santrauka

Šešių pavienių klosčiavapsvių (Hymenoptera, Eumeninae) rūšių ištirtos populiacijos skiriasi grobio pasirinkimo specifiškumu. *Symmorphus murarius* ir *S. crassicornis* gali būti laikomos beveik monofaginėmis, nes medžioja tik *Chrysomela* genties ir retkarčiais artimos *Linaeidea* genties lapgraužių lervas. *S. allobrogus* aprūpina palikuonis daugiausia Chrysomelinae pošeimio lapgraužių lervomis, priklausančiomis gentims *Linaeidea*, *Gonioctena*, *Phratora* ir *Plagioderia*. *S. bifasciatus* medžioja daugiausia *Phratora*, retkarčiais dar *Linaeidea* ir *Plagioderia* genčių lapgraužių lervas. Šios dvi vapsvų rūšys gali būti laikomos oligofaginėmis. Plačiai oligofaginė rūšis *S. debilitatus* medžioja įvairių drugių šeimų minuojančius vikšrus. *S. allobrogus*, *S. bifasciatus*, *S. crassicornis* ir *S. murarius* savo grobį medžioja ant įvairių sumedėjusių augalų lapų. Matyt, šios vapsvos neturi prieraišumo tam tikrai augalų rūšiai ir kartais prineša į tą patį lizdą ar net tą pačią akele grobio nuo skirtingų augalų. Monofaginė rūšis *S. gracilis* savo vienintelį grobį, straubliukų *Cionus* lervas, medžioja ant žolinio augalo – bervidžio (*Scrophularia* sp.).

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