Parasitoid Complex Associated With the Overwintering Generation of *Swammerdamia pyrella* (Lepidoptera: Yponomeutidae) in Poland

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**ABSTRACT.** The study was conducted on fruit trees where bands of corrugated cardboard were attached around the trunks of the trees, which were used to catch the larvae of overwintering generation of the rufous-tipped swammerdamia moth, *Swammerdamia pyrella* (Villers) (Lepidoptera: Yponomeutidae). Twenty-five species of parasitic Hymenoptera have been described from *S. pyrella* in Poland including the report in this article of seven species belonging to the family of Ichneumonidae (three species) and superfamily Chalcidoidea (four species). The parasitoids *Gelis agilis* F. (Ichneumonidae), *Chrysocharis aquilae* (Erdős) (Eulophidae), *Catolaccus ater* (Ratzeburg) (Pteromalidae), and *Eupelmus urozonus* (Dalman) (Eupelmidae) had not been reported from the host before. *Trichistus pallipes* Holmgren (Ichneumonidae), *Dibrachys cavus* Walker (Pteromalidae) had the greatest effect on the natural regulation of *S. pyrella* population. Parasitization for the wintering cocoons of *S. pyrella* changed each year, but it was high throughout the study. The contribution of secondary parasitoids was much higher than primary parasitoids.

**Key Words:** Ichneumonidae, Chalcidoidea, pest, natural regulation

The rufous-tipped swammerdamia moth, *Swammerdamia pyrella* (Villers) (Lepidoptera: Yponomeutidae), is a common species throughout Europe, and occurs mostly in dispersed populations (Baraniak 1989). In the 1970s, it was a serious pest in many orchards of western Poland, especially those that were treated with insecticides (Kadłubowski and Szmyt 1985). Actually, *S. pyrella* is not present in the orchards with chemical pest control; therefore, interest in this species is minimal, resulting in a low number of reports about its occurrence in recent literature. However, a trend to reduce pesticides in crops of many plants creates new possibilities for the development of this species. The research indicates that *S. pyrella* successfully found its own niches, which are fruit orchards with limited pest management (Górsko-Drabik 2003) and newly planted apple orchards (Velcheva 2009). Therefore, it is important to understand the community of organisms that naturally reduce the number of *S. pyrella*. An assessment of their role makes it possible to evaluate the real threat posed by this species.

Larvae of *S. pyrella* feed on *Malus domestica* Borkh. (Buszko 1991), *Cerasus avium* (L.), *Prunus* spp. (Kadłubowski and Szmyt 1985), *Pirus* spp., *Sorbus* spp., and *Crataegus* spp. (Maciesiak and Boczek 1983). In the beginning, the larva feeds within a leaf, producing mine, then they leave the mines and feed on the surface as an exophagous species. It eats the epidermis and the flesh, leaving the nerves and the bottom skin. In addition, it ties the leaf edge with its web so that forms a “boat.” The leaves become brown and then dry out. The pupation takes place in a white spindle-like cocoon with thread-like insets on the leaves (first generation) and in bark crevices, on the trunks (second generation) (Maciesiak and Boczek 1983; Baraniak 1992).

So far, little information is available on the species structure of parasitoid community associated with *S. pyrella*, especially with the second generation of larvae overwintering in bark crevices of trees (Kadłubowski and Szmyt 1985). This article identifies the Hymenoptera parasitoid complex of *S. pyrella* in eastern Poland and defines the parasitization level of second-generation caterpillars.

**Materials and Methods**

**Study Area.** The study was conducted between 2001 and 2003 in three sites located in Lublin and its vicinity (SE Poland).

Site 1—a monastery garden in the centre of Lublin (UTM - FB 08; 51.247° N, 22.560° E). Ten apple, pear, and plum trees grown together with vegetables and ornamental plants were several decades old with large, branchy crowns. No treatment for plant protection was applied there. The garden was separated from a housing estate and a shopping center by a brick wall.

Site 2—a fruit orchard in Marynin (UTM - EB 98, 51.214° N, 22.427° E), 16 km away from Lublin. Apple, pear, and plum trees growing in an area of about 0.05 ha were 30–40-yr-old. They had not been sprayed, pruned, or fertilized.

Site 3—an apple orchard located in Leonów (UTM - FB 19; 51.340° N, 22.635° E) 14 km away from Lublin. It was a 5-ha orchard planted in 1986, and the main varieties included Cortland, Idared, and Golden Delicious. It was a commercial orchard with semi-dwarf plantings until 1993. Since then, no chemical treatments or fertilization has been applied.

**Traps.** In each site, 25-cm-wide stripes of corrugated cardboard were attached around the trunks of the trees, 30–60 cm above the ground. In sites 1 and 2, all the trees were taken into account, respectively, 10 and 13, whereas in site 3, 45 trees were randomly selected. The bands were attached around the trunks in May and removed in October. In total, 204 bands were used over the 3 yr of study. In the laboratory of the Department of Entomology (University of Life Sciences in Lublin), the collected traps were examined. The cardboard fragments with *S. pyrella* cocoons were cut out and they were placed individually in test tubes. The material prepared in this way was placed in an outside insectarium with the aim of exposing them to low temperatures. In February, the material was transferred into the laboratory and stored at room temperature (20–23°C) until the emergence of the adults (imagos of parasitoids or moths). Then they were killed by ethyl acetate, prepared, identified, and counted.

The recorded parasitoids were identified using the keys of Kasparyan (1981) and Triapitzin (1978). The nomenclature of parasitoids was verified after Kązmierczak (2004) and Noyes (2007). The obtained specimens of Hymenoptera were deposited in the Department of Entomology, University of Life Sciences in Lublin (Poland).

**Data Analysis.** The results into the degree of parasitization of the *S. pyrella* cocoons were statistically analyzed using a one-sided...
Table 1. List of parasitoids recorded from *S. pyrella*

| Superfamilies      | Families            | Subfamilies | Species                        | References                                      | Own research |
|--------------------|---------------------|-------------|--------------------------------|------------------------------------------------|-------------|
| Ichneumonoidea     | Ichneumonidae       | Pimplinae =Ephialtinae | *Itoplectis maculatus* | Kadłubowski and Szymt (1985) | –           |
|                    |                     |             | *Itoplectis alternans*      | Górská-Drabik (2003)                         | –           |
|                    |                     |             | *Gelis integer*             | Kadłubowski and Szymt (1985)                  | –           |
|                    |                     |             | *Gelis reater*              | Górská-Drabik (2003)                         | –           |
|                    |                     |             | *Gelis agilis*              | –                                              | +N          |
|                    |                     |             | *Hemitheis decipiens*       | Kadłubowski and Szymt (1985)                  | –           |
|                    |                     |             | *Hemitheis chionops*        | Kadłubowski and Szymt (1985)                  | –           |
| Metopiinae         |                     |             | *Triclistus pallipes*       | Kadłubowski and Szymt (1985)                  | +           |
|                    |                     |             | *Triclistus pygmaeus*       | Napiórkowska-Kowalik and Winiarzka (2001)    | –           |
| Ichneumonidae      |                     |             | *Phaeogenesis impiger*      | Górská-Drabik (2003)                         | –           |
|                    |                     |             | *Phaeogenesis minimus*      | Kadłubowski and Szymt (1985)                  | –           |
|                    | Microgastrinae      |             | *Herpetomus brunncornis*    | Napiórkowska-Kowalik and Winiarzka (2001)    | +           |
|                    |                     |             | *Herpetomus nusutus*        | Górská-Drabik (2003)                         | –           |
| Braconidae         | Microgasterinae     |             | *Apanteles xanthostigma*    | Kadłubowski and Szymt (1985) and             | –           |
|                    |                     |             |                               | Górská-Drabik (2003)                         | –           |
| Chalcidoidea       | Eulophidae          |             | *Agathidinae*               | –                                              | –           |
|                    |                     |             | *Chrysoschis aquilegiae*    | –                                              | –           |
|                    |                     |             | *Cirrocilus pictus*         | Kadłubowski and Szymt (1985)                  | –           |
|                    |                     |             | *Symphes acalle*            | Kadłubowski and Szymt (1985)                  | –           |
|                    |                     |             | *Elasmus albipennis*        | Kadłubowski and Szymt (1985)                  | –           |
| Pteromalidae       | Pteromalinae        |             | *Sphenolepis ✓ oreophilus*  | Kadłubowski and Szymt (1985)                  | –           |
|                    |                     |             | *Dibrachys cauves*          | Kadłubowski and Szymt (1985)                  | –           |
|                    | Eupelmidae          |             | *Catalocus ater*            | –                                              | +N          |
|                    |                     |             | *Eupelminus urozonus*       | –                                              | +N          |
| Total              |                     |             | 25                           | 21                                            | 7 (4N)      |

* N first record from *S. pyrella*.

Results

Twenty-five species of parasitic Hymenoptera have been described from *S. pyrella* in Poland including the literature data as well as seven species recorded by the Hymenoptera species throughout the study. In 2001, it was identified only as genus *Gelis*. The species composition of the parasitoid complex was changing during the study period. Only two species, namely *G. agilis* and *Triclistus pallipes* Holmgren, occurred in two successive years of studies, whereas the others were observed only in 1 yr. Among the recorded parasitoids, the species *Herpetomus brunncornis* (Gravenhorst), *E. urozonus* and *C. ater* are rarely found and in small numbers. The greatest number of parasitoids was observed in 2003 (Table 3).

The most numerous trophic groups were hyperparasitoids, involving only two species: *G. agilis* and *C. ater*. Four species have been identified only as genus *Gelis* (Table 3).

Of all the obtained parasitoids, 15.5% were primary parasitoids of *S. pyrella*, whereas the others fell within the unknown species of parasitic Hymenoptera from which hyperparasitoids were recorded. *T. pallipes* and *Dibrachys cauves* (Walker) were the most abundant species in the complex of primary parasitoids and they represented the greatest number of parasitized *S. pyrella* cocoons (Table 3). The contribution of *Ch. aquilegiæ*, *D. cauves*, and *E. urozonus* in parasitization is not as obvious because they can be both primary and secondary parasites (Table 4). *G. agilis* represented 94% of the community of secondary parasitoids.

In total, 30.4% of the wintering cocoons of *S. pyrella* were parasitized by the Hymenoptera species throughout the study. In 2001, it was at its highest 47.4%, whereas in 2002 and 2003 the level of parasitization was respectively at 13.5 and 12.7% (Fig. 1). The percentage of parasitized cocoons in 2001 was significantly higher than in 2002 as well as in 2003 (*P* < 0.05).

Discussion

The aim of this study was to document the parasitoid complex of *S. pyrella* in Poland. Using published reports and own studies showed that the parasitoids community is represented by 25 species grouped into two families, Ichneumonidae and Braconidae, as well as the superfamilies Chalcidoidea and Chrysocharidae. There is no information about other natural enemies of *S. pyrella* both in Poland and in Europe.

In Poland, the parasitoid community of *S. pyrella* was studied by Kadłubowski and Szymt (1985). They recorded 13 parasitoid species including seven belonging to the family of Ichneumonidae, one species from the family Braconidae, and five species from the superfamily Chalcidoidea. Later research increased this list with two species from Ichneumonidae (Napiórkowska-Kowalik and Winiarzka 2001). Górska-Drabik (2003) showed another four species from Ichneumonidae and two species from Braconidae, which were new to this host. The results presented in this article enlarged the list of the parasitoids complex of *S. pyrella* with three species belonging to the superfamily of Chalcidoidea and one species from the family of Ichneumonidae.
Hyperparasitoids were the most numerous trophic group, and among them, *G. agilis* was the species that occurred in the greatest number. Species from the genus *Gelis* Thnbg. are parasites of Ichneumonidae and Braconidae (Zajancˇkauskas et al. 1979, Kasparyan 1981). Piekarska-Boniecka (1997) described this species as hyperparasitoid of *Archips rosanus* L. while Sawoniewicz and Buszko (1994) gave another species—*Bucculatrix nigricomella* Zeller as its host.

*C. ater* is another recorded hyperparasitoid species and is stated as a parasitoid of the Braconidae family mainly for *Apanteles* spp. (Trjapitzin 1978). It was also reported as hyperparasitoid of Gracillariidae (Stojanovic´ and Markocic´ 2005).

Numerous hyperparasitoids obtained in this study (70 individuals) could be the cause of an absence of primary parasitoids especially from the Braconidae family. Such species as *Apanteles xanthostigma* (Haliday), *Apanteles longicauda* Wesmael, *Earinus tuberculatus* (Wesmael), and *Oncophanes lanceolator* Ness, belonging to this family

### Table 3. Species of Hymenoptera recorded from the cocoons of *S. pyrella* in 2001–2003

| Species       | Number of individuals | Total | Contribution to the parasitoid complex (%) | Contribution to parasitization (%) |
|---------------|-----------------------|-------|-------------------------------------------|-----------------------------------|
|               | 2001  | 2002  | 2003 |                     |                                    |
| Parasitoids   |       |       |     |                     |                                    |
| *T. pallipes* | 3     | 1     | –   | 4   | 30.8 | 1.3 |
| *H. brunnicornis* | 2   | –     | –   | 2   | 15.4 | 0.7 |
| *Ch. aquilegiae* | –   | –     | 15 (2) | 15 (2) | 15.4 | 0.7 |
| *D. cavus*    | –     | 18 (4) | –   | 18 (4) | 30.8 | 1.3 |
| *E. urozonus* | –     | –     | 1   | 1   | 7.7  | 0.3 |
| Sum           | 5     | 19 (5) | 16 (3) | 40 (13) | 100 | 4.3 |
| Hiperparasitoids |       |       |     |                     |                                    |
| *G. agilis*   | 58    | 8     | –   | 66  | 92.9 | 23.4 |
| *Gelis* sp.   | –     | –     | 4   | 4   | 5.6  |      |
| *C. ater*     | 2 (1) | –     | –   | 2 (1) | 1.4  |      |
| Sum           | 60 (59)| 8     | 4   | 72 (71) | 100 | 23.4 |
| Total         | 65 (64)| 27 (13)| 20 (7)| 112 (84) | –   | 27.7 |

### Table 4. Parasitoids recorded from the cocoons of *S. pyrella* and their status

| Species       | Status              | Primary | Secondary | Endoparasite | Ectoparasite | Solitary | Gregarious |
|---------------|---------------------|---------|-----------|--------------|--------------|----------|------------|
| *I. maculator* | ++                  | ++      | + (of pupae) |              |              |          |            |
| *I. alternans* | ++                  | +       | + (of pupae) |              |              |          |            |
| *G. integer*   | +                   | +       | +          |              |              |          |            |
| *G. areator*   | +                   | +       | +          |              |              |          |            |
| *G. agilis*    | +                   | +       | +          |              |              |          |            |
| *H. decipiens* | + ?                 | + ?     | +          |              |              |          |            |
| *H. chionops*  | + ?                 | + ?     | +          |              |              |          |            |
| *T. pallipes*  | +                   | +       | +          |              |              |          |            |
| *T. pygmaeus*  | +                   | +       | +          |              |              |          |            |
| *T. spiracularis* | +      | +       | +          |              |              |          |            |
| *P. impiger*   | +                   | +       | +          |              |              |          |            |
| *P. minimus*   | +                   | +       | +          |              |              |          |            |
| *H. brunnicornis* | +     | +       | +          |              |              |          |            |
| *H. nasutus*   | +                   | +       | +          |              |              |          |            |
| *A. xanthostigma* | +        | +       | +          |              |              |          |            |
| *A. longicauda* | +                  | +       | +          |              |              |          |            |
| *E. tuberculatus* | +       | +       | +          |              |              |          |            |
| *Ch. aquilegiae* | +     | +       | +          |              |              |          |            |
| *C. pictus*    | +                   | +       | +          |              |              |          |            |
| *S. ocellae*   | +                   | +       | +          |              |              |          |            |
| *E. albipennis* | +                   | +       | +          |              |              |          |            |
| *S. oreophilus* | + ?                 | + ?     | +          |              |              |          |            |
| *D. cavus*     | +                   | +       | +          |              |              |          |            |
| *C. ater*      | +                   | +       | +          |              |              |          |            |
| *E. urozonus*  | +                   | +       | +          |              |              |          |            |

*The status of the obtained parasitoid species is given according to de Graham (1969), Trjapitzin (1978), Görny (1979), Zajančkauskas et al. (1979), Kasparyan (1981), Noyes (2003), Stojanović and Markocić (2005), Mafi and Ohbayashi (2010).*

![Fig. 1. Parasitization level of *S. pyrella* cocoons in 2001–2003. Histograms with the same letters above do not differ significantly (*P* < 0.05).](image-url)
were parasitoids of *S. pyrella* (Zajančkaukas et al. 1979, Kadłubowski and Szmyt 1985, Górška-Drabik 2003). *A. xanthostigma* was recorded in Górška-Drabik (2003) study as the most effective parasitoids from the family of Braconidae—it is parasitized ~10% of *S. pyrella* larvae and pupae. An important role of genus Apanteles was also emphasized by Lucchese (1941). In the orchards of central Italy, it parasitized 80% of the population of *S. pyrella* larvae. The group of primary parasitoids included five species although the status of three of them (*Chrysocharis pentheus* (Walker), *E. urozomos*, and *D. cavus*) is not clear. According to Trajpinț (1978), *D. cavus*, from the family of Pteromalidae, can be a primary or secondary polyphagous parasitoid of many species of Lepidoptera as well as some Diptera and Hymenoptera. It was reported from *Iponomeuta malinellus* (Zeller) (*Yponomeutidae*) as well as other families’ of moths like Lymantridae, Choreutidae, and Tortricidae (Zajančkaukas et al. 1979). Winiarska and Anasiwiecz (1989) enumerated this species as a parasitoid of the moths’ larvae wintering under the bark of apple trees. It was also reported from the larvae of second generation of *S. pyrella* (Kadłubowski and Szmyt 1985). However, *E. urozomos* obtained from *S. pyrella* can be a primary or secondary parasitoid. It is a part of the parasitoid complex of Coleoptera, Lepidoptera, and Diptera (Górny 1979). Reported from *Callisto denticulata* (Thunberg) (*Göriska-Drabik and Napiórkowska-Kowalik 2009*) and another species of the family Gracillariidae (Grabenweger 2004). *Ch. aquilegiae* is also a new parasitoid of *S. pyrella*, which has not been reported so far. This species is known as a parasitoid of different species of Diptera and Coleoptera, mainly however of moths (Trajpinț 1978, Szczepański 1983, Hansson 1985, Adachi 1998, Jenser et al. 1999, Noyes 2007). It can also be a secondary parasitoid (Trajpinț 1978).

*T. pallipes* had been earlier reported by Kadłubowski and Szmyt (1985), as *Trichilus pallidilus* Dalla Torre from cocoons of first generation *S. pyrella*. This species is an endoparasite of Tortricidae, Phycitidae, and other moths (Kasprany 1981, Jonaitis 2000). It was reported from *Strophedra weirana* (Hu¨bner, 1825) (Lepidoptera, Yponomeutidae). Wiadomos ´ci Entomologiczne (Seria B.) 10: 3–19.

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