

## Phytophagous Insects Associated with *Hieracium pilosella* (Asteraceae) in Hungary, Central Europe

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**ABSTRACT** During a 3-yr survey to find potential biological control agents against *Hieracium pilosella* L. (Asteraceae), a serious weed in many parts of the world, 130 phytophagous insect species were collected at 7 sites in Hungary. Most species belonged to the order Heteroptera (30 species, 23.1% of species), Homoptera (29, 22.3%), and Coleoptera (33, 25.4%). Most species were present in low numbers. Only 2 endophagous species (1.5%) were found. The percentage of rare species was high (66%), and the species turnover between years (74–83% at different sites) were high as well. These suggest an unstable insect assemblage. In comparison with other Asteraceae species, the phytophagous insect assemblages of *H. pilosella* contained few host-specific species. Only 4 species were genus-specific, and 2 of them, a gall wasp [*Aulacidea pilosellae* (Kieffer)] and a tephritid fly [*Tephritis ruralis* (Loew)] may be potential biological control agents.

**KEY WORDS** *Hieracium pilosella*, *Aulacidea pilosellae*, *Tephritis ruralis*, phytophagous insect fauna, biological control

THE *Hieracium* GENUS is a very diverse group within the Asteraceae, with many subspecies and hybrids (Webb et al. 1988, Simon 1992). Several species of this genus have become serious weeds in North America, Japan, and New Zealand (Vander Kloet 1978, Voss and Böhlke 1978, Scott 1984, Webb et al. 1988, Grundy 1989). One of the most widespread and problematic species is mouse-ear hawkweed (*Hieracium pilosella* L.). This species is native to the Palearctic region, from sub-Arctic Europe in the north to the Mediterranean in the south, and extends to western Asia (Bishop and Davy 1994). The leaves of the plant form tight rosettes close to the ground. *H. pilosella* is widespread in dry grasslands, especially in degraded or disturbed habitats such as roadsides and overgrazed pastures (Simon 1992, Bishop and Davy 1994). The plant spreads vigorously by stolons, and usually forms dense mats. In its native range, *H. pilosella* occurs in a wide range of plant communities, but is not characteristic of any of them (Bishop and Davy 1994). In Europe it is not considered a weed.

In New Zealand, the occurrence of *H. pilosella* was first reported in the 1920s (Allan 1924). Over the next 30 yr it remained relatively uncommon, but it started to spread in the 1950s, soon reaching its present "serious weed" status (Connor 1964, 1965, 1992). In some regions, especially the dry mountainous regions of the South Island overgrazed by sheep, it forms a near-total plant cover. Its characteristic growth form (the rosettes are firmly appressed to the ground) reduces feeding opportunities to livestock, causing a loss of agricultural production. In New Zealand, *H. pilosella* is considered a serious weed over an estimated 6 million hectares of pasture (Hunter 1992). Although

chemical control of *H. pilosella* is possible despite resistance to many herbicides (Scott 1984), it is prohibitively expensive in most areas. Methods such as overdrilling and fertilizing are also not economically viable to control the spread of this species (Makepeace et al. 1985, Scott et al. 1988, Scott et al. 1990). No host-specific insect species were found on mouse-ear hawkweed in New Zealand (Scott 1984, Syrett and Smith 1998), and it was proposed that candidate biological control agents could be sought in the species' native range in Europe (Syrett and Sárospataki 1993).

In this article I report on the results of a 3-yr faunistic survey of insects associated with *H. pilosella* in Hungary and on current information on the relative abundance and potential as biological control agents of the different taxa found.

### Materials and Methods

**Sampling Sites.** Seven sites in different hilly parts throughout northcentral Hungary were selected for regular sampling visits (Fig. 1.). General information about the sites is presented in Table 1. All sampling sites were xerothermic grasslands, where *H. pilosella* formed dense mats from 2 to 50 m<sup>2</sup> in extent. Four of the sites (Julianna major, Hármashatárhegy, Budapest, Síkfökút) were grazed or used as hay meadows. The remaining 3 were natural or seminatural grasslands. These areas of Hungary have similar climates to those parts of New Zealand severely infested by *H. pilosella* (Syrett and Sárospataki 1993). However, the presence of the dense, almost homogenous *H. pilosella* patches was also an important reason for the selection of sampling sites.

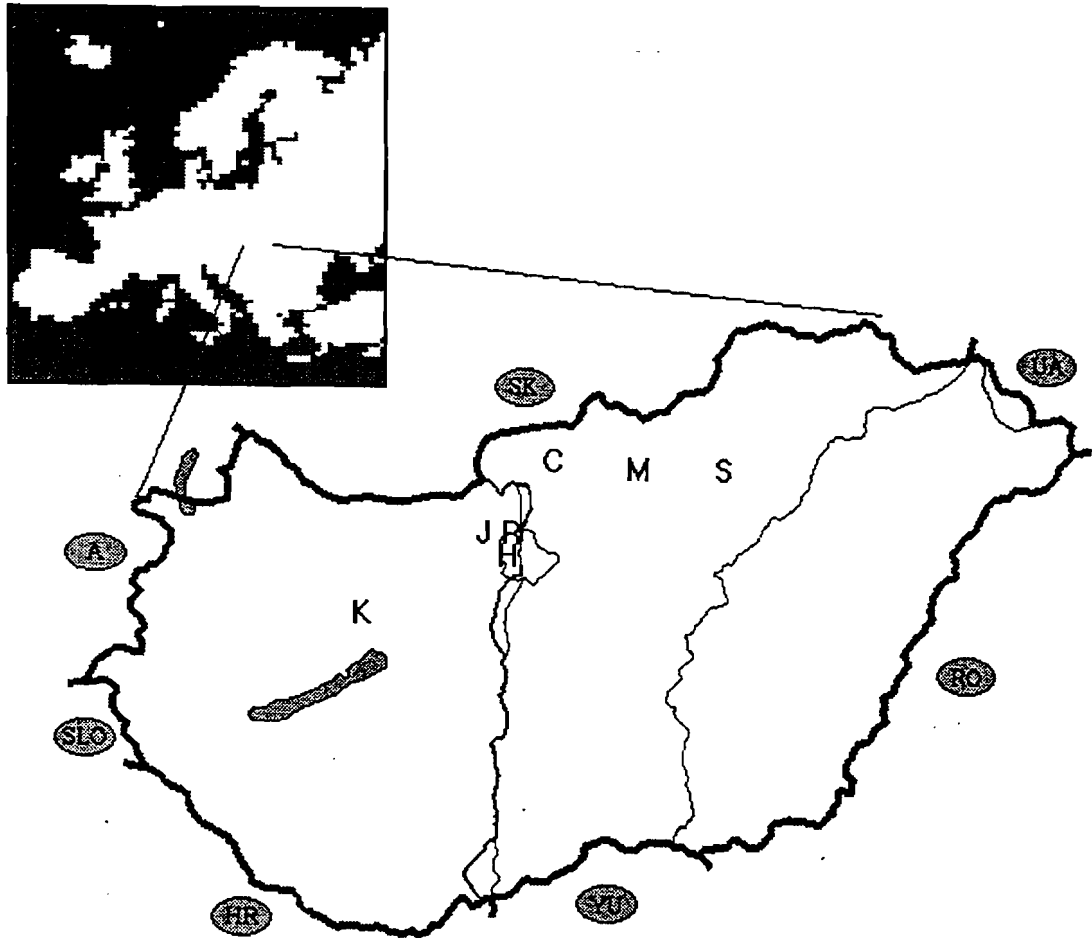


Fig. 1. The map of the sampling sites. K, Kádárta (Bakony mountains); J, Julianna major (Budai mountains); H, Hármashatárhegy (Budai mountains); R, Budapest (Budai mountains); C, Romhány (Cserhát mountains); M, Recsk (Mátra mountains); S, Sikfőkút (Bükk mountains).

**Sampling Methods.** The insect fauna of mouse-ear hawkweed was surveyed for 3 consecutive growing seasons (1992–1994). The growing season of *H. pilosella* started in April, with the appearance of new, fresh leaves on the overwintered rosettes. The main flowering season was in May, but flowers were found on individual plants through most of summer until late August or September. Surveys began in late April, and the sampling sites were visited weekly from late April

to the end of May, and fortnightly afterwards from June to September. Each site was visited 10 times in 1992 and 1994 and 9 times in 1993.

On each visit, 100 randomly selected rosettes and their new stolons were visually examined for insects. Any insect found was collected into a vial containing 70% ethyl alcohol. In the flowering season, 10 capitula were collected into a plastic tube, and taken to the laboratory and dissected for insects. The plants were

Table 1. Geographical and climatic characteristics of the sampling sites

| Site                 | Mountain location | Altitude, m | Latitudes (N) and Longitudes (E) | Mean annual rainfall, mm | Mean annual temp. °C |
|----------------------|-------------------|-------------|----------------------------------|--------------------------|----------------------|
| Kádárta (K)          | Bakony            | 220         | 47° 08' 17" 53'                  | 740                      | 8.2                  |
| Julianna major (J)   | Budai             | 300         | 47° 35' 18" 58'                  | 650                      | 8.3                  |
| Budapest (R)         | Budai             | 120         | 47° 36' 19" 02'                  | 630                      | 10.2                 |
| Hármashatár-hegy (H) | Budai             | 330         | 47° 32' 19" 00'                  | 640                      | 9.3                  |
| Romhány (C)          | Cserhát           | 190         | 47° 59' 19" 19'                  | 600                      | 9.8                  |
| Recsk (M)            | Mátra             | 230         | 47° 53' 20" 07'                  | 620                      | 9.0                  |
| Sikfőkút (S)         | Bükk              | 300         | 47° 52' 20" 26'                  | 580                      | 9.6                  |

Table 2. Phytophagous insects found in association with *H. pilosella* in Hungary, central Europe, 1992-1994

| Species                                       | Frequency class | Stages found | Collected from | Feeding type | Host Specificity | Present at    |
|---|-----------------|--------------|----------------|--------------|------------------|---------------|
| <b>Orthoptera</b>                             |                 |              |                |              |                  |               |
| Acrididae                                     |                 |              |                |              |                  |               |
| <i>Calliptamus italicus</i> L.                | C               | L            | L              | ECT          | —                | CM            |
| <i>Chorthippus</i> sp.                        | C               | L            | L              | ECT          | —                | K.J.H.R.C.    |
| <i>Coniphocerinae</i> sp.                     | O               | L            | L              | ECT          | —                | K.H.R.C       |
| <i>Oedipoda caerulescens</i> L.               | R               | L            | L              | ECT          | "                | M             |
| <i>Stenobothrus</i> sp.                       | O               |              | L              | ECT          | —                | R.M.S         |
| Thysanoptera                                  |                 |              |                |              |                  |               |
| Phlaeothripidae                               |                 |              |                |              |                  |               |
| <i>Haplothrips acanthuscelis</i> Karuy        | R               | A            | F              | ECT          | "                | K.M           |
| <i>Haplothrips angusticornis</i> Priesner     | C               | A            | F              | ECT          | "                | H.M           |
| <i>Haplothrips setiger</i> Priesner           | C               | A            | F              | ECT          | "                | K.S           |
| Thripidae                                     |                 |              |                |              |                  |               |
| <i>Frankliniella pallida</i> Uzel             | R               | A            | F              | ECT          | "                | K.H           |
| <i>Stenothrips graminum</i> Uzel              | R               | A            | F              | ECT          | "                | M             |
| <i>Taeniothrips frici</i> Uzel                | C               | A            | F              | ECT          | "                | K.J.H.R.C.M.S |
| <i>Thrips tabaci</i> Lindeman                 | O               | A            | F              | ECT          | "                | C.M.S         |
| <i>Thrips trehernei</i> Priesner              | O               | A            | F              | ECT          | "                | K.J.H.R.C.M.S |
| <b>Heteroptera (Hemiptera)</b>                |                 |              |                |              |                  |               |
| Berytidae                                     |                 |              |                |              |                  |               |
| <i>Berytinus crassipes</i> (Herrich-Schaffer) | O               | A            | L              | ECT          | "                | J.R.S         |
| <i>Neides tipularius</i> (L.)                 | R               | A            | L              | ECT          | "                | H             |
| Lygaeidae                                     |                 |              |                |              |                  |               |
| <i>Beosus maritimus</i> (Scopoli)             | R               | A            | L              | ECT          | "                | J             |
| <i>Dimorphopterus spinolai</i> (Signoret)     | R               | A            | L              | ECT          | "                | K             |
| <i>Lygaeidae</i> sp.                          | O               | L            | L              | ECT          | —                | R.M.S         |
| <i>Megalonotus chiragra</i> (F.)              |                 | A            | L              | ECT          | "                | J.H.C         |
| <i>Metatopanax origani</i> (Kolenat)          | O               | A            | L              | ECT          | "                | S             |
| <i>Nysius senecionis</i> Schilling            | R               | A            | L              | ECT          | "                | R             |
| <i>Nysius thymi</i> (Wolff)                   | O               | A.L          | L              | ECT          | "                | H.R           |
| <i>Oxycarenus pallens</i> Herrich-Schaffer    | R               | A            | L.F            | ECT          | "                | C             |
| <i>Trapezonotus arenarius</i> (L.)            | O               | A            | L              | ECT          | "                | H.S           |
| Miridae                                       |                 |              |                |              |                  |               |
| <i>Chlamydatus pillus</i> Reuter              | C               | A.L          | L.F            | ECT          | "                | K.J.H.R.C.M.S |
| <i>Halticus apterus</i> (L.)                  | O               | A            | L              | ECT          | "                | R             |
| <i>Hoplomachus thunbergi</i> (Fallén)         | C               | A.L          | L.S.F          | ECT          | "                | K.J.H.R.C.M.S |
| <i>Miridae</i> sp.                            | O               | A            | L              | ECT          | —                | K.H.S         |
| <i>Orthoccephalus saltator</i> (Hahn)         | C               | A.L          | L              | ECT          | "                | H.C.M.S       |
| <i>Plagiognathus chrysanthemi</i> (Wolff)     | R               | A            | L              | ECT          | "                | M             |
| pentatomidae                                  |                 |              |                |              |                  |               |
| <i>Dolycoris buccarum</i> L.                  | R               | A            | L              | ECT          | "                | M             |
| <i>Sciocoris cursitans</i> F.                 | C               | A.L          | L              | ECT          | "                | K.H.M.S       |
| Plataspidae                                   |                 |              |                |              |                  |               |
| <i>Coptosoma scutellatum</i> Geoffroy         | R               | A            | L              | ECT          | "                | C             |
| Pyrrhocoridae                                 |                 |              |                |              |                  |               |
| <i>Pyrrhocoris apterus</i> (L.)               | R               | A            | L              | ECT          | "                | S             |
| Rhopalidae                                    |                 |              |                |              |                  |               |
| <i>Rhopalus conspersus</i> (Fieber)           | R               | A            | L              | ECT          | "                | H.M           |
| <i>Stictopleurus abutilon</i> (Rossi)         | O               | A            | L              | ECT          | "                | R.M.S         |
| <i>Stictopleurus crassicornis</i> (L.)        | R               | A            | L              | ECT          | "                | J             |
| <i>Stictopleurus punctatonevrosus</i> (Goeze) | O               | A            | L              | ECT          | "                | J.C.M         |
| Scutelleridae                                 |                 |              |                |              |                  |               |
| <i>Eurygaster austriaca</i> (Schrank)         | R               | A            | L              | ECT          | "                | K             |
| <i>Odontoscylis fuliginosa</i> L.             | R               | A            | L              | ECT          | "                | C             |
| Tingidae                                      |                 |              |                |              |                  |               |
| <i>Dictyonota tricornis</i> (Schrank)         | R               | A            | L              | ECT          | "                | H             |
| <i>Calvatus maculatus</i> (Herrich-Schaffer)  | C               | A.L          | L              | ECT          | "                | S             |
| <b>Homoptera</b>                              |                 |              |                |              |                  |               |
| Aphididae                                     |                 |              |                |              |                  |               |
| <i>Acyrtosiphon pisum</i> Theobald            | R               | A            | L              | ECT          | "                | S             |
| <i>Aphis</i> sp. ( <i>pilosellae</i> Börner)  | C               | A.L          | L.F            | ECT          | —                | J.H.R.C.M.S   |
| <i>Dactynotus pilosellae</i> Börner           | C               | A.L          | L.S.F          | ECT          | "                | K.J.H.R.C.M   |
| <i>Macrasiphum euphorbiae</i> Thomas          | R               | A            | F              | ECT          | "                | R             |
| <i>Nasonovia pilosellae</i> Börner            | C               | A.L          | L.S.F          | ECT          | "                | K.J.H.R.C.M.S |
| Cercopidae                                    |                 |              |                |              |                  |               |
| <i>Lepyronia coleoptrata</i> (L.)             | R               | A            | L              | ECT          | "                | C             |
| <i>Philaenus spumarius</i> (L.)               | R               | A            | L              | ECT          | "                | C             |
| Cicadellidae                                  |                 |              |                |              |                  |               |
| <i>Agallia ribauti</i> Ossianilsson           | C               | A.L          | L              | ECT          | "                | J.R.C.M.S     |
| <i>Aphrodes makarovi</i> Zachvatkin           | C               | A.L          | L              | ECT          | "                | K.J.H.R.C.M.S |
| <i>Arocephalus lanquidus</i> Flor             | R               | A            | L              | ECT          | "                | K             |

Table 2. Continued

| Species   | Frequency class | Stages found | Collected from | Feeding type | Host Specificity | Present at  |
|---|-----------------|--------------|----------------|--------------|------------------|-------------|
| <i>Artianus interstitialis</i> Gernar             | R               | A            | L              | ECT          | "                | J           |
| <i>Chanithus</i> sp.                              | R               | L            | L              | ECT          | —                | C           |
| <i>Diplocolenus</i> sp.                           | R               | L            | L              | ECT          | —                | M           |
| <i>Doratura stylata</i> (Boheman)                 | C               | A.L          | L              | ECT          | "                | K,J,H,C,M   |
| <i>Eupatoryx notata</i> Curtis                    | C               | A            | L              | ECT          | "                | J,C,S       |
| <i>Euscelus incisus</i> Kirschbaum                | R               | A            | L              | ECT          | "                | J,R         |
| <i>Goniagnathus brevis</i> (Herrich-Schaffer)     | C               | A.L          | L              | ECT          | "                | J,H,R,C,M,S |
| <i>Graphocraterus ventralis</i> (Fallén)          | O               | L            | L              | ECT          | "                | C,M         |
| <i>Jassargus</i> sp.                              | R               | A.L          | L              | ECT          | —                | J           |
| <i>Macrasteles</i> sp.                            | R               | L            | L              | ECT          | —                | H           |
| <i>Mocuellus collinus</i> (Boheman)               | R               | A            | L              | ECT          | "                | J           |
| <i>Mendrausis paucillius</i> (Feber)              | R               | A            | L              | ECT          | "                | H           |
| <i>Neocalitrus fenestratus</i> (Herrich-Schaffer) | C               | A.L          | L              | ECT          | "                | R,C,M,S     |
| <i>Psanmotettix</i> sp.                           | R               | A            | L              | ECT          | —                | J           |
| <i>Turrutus socialis</i> (Flor)                   | R               | A            | L              | ECT          | "                | K           |
| <i>Ulopa trivialis</i> Gernar                     | O               | A.L          | L              | ECT          | "                | C,M,S       |
| Delphacidae                                       |                 |              |                |              |                  |             |
| <i>Delphacidea</i> sp.                            | R               | A.L          | L              | ECT          | —                | J,S         |
| Dictyopharidae                                    |                 |              |                |              |                  |             |
| <i>Dictyophara panonica</i> (Gernar)              | R               | L            | L              | ECT          | "                | M           |
| <i>Dictyophara europaea</i> (L.)                  | R               | L            | L              | ECT          | "                | R           |
| Coleoptera  |                 |              |                |              |                  |             |
| Anobiidae   |                 |              |                |              |                  |             |
| <i>Anobiidae</i> sp.                              | R               | A            | L              | ECT          | —                | J           |
| Bruchidae   |                 |              |                |              |                  |             |
| <i>Charopus concolor</i> (F.)                     | R               | A            | F              | ECT          | "                | C           |
| <i>Spermophagus sericeus</i> Geoffroy             | R               | A            | F              | ECT          | "                | M           |
| Buprestidae                                       |                 |              |                |              |                  |             |
| <i>Anthaxia</i> sp.                               | R               | A            | L              | ECT          | —                | K           |
| Chrysomelidae                                     |                 |              |                |              |                  |             |
| <i>Aphthona lacertosa</i> Rosenthal               | R               | A            | L              | ECT          | "                | C           |
| <i>Cryptocephalus aureolus illyricus</i> Franz    | R               | A            | F              | ECT          | "                | J           |
| <i>Cryptocephalus flavipes</i> F.                 | R               | A            | F              | ECT          | "                | C           |
| <i>Cryptocephalus sericeus sericeus</i> L.        | R               | A            | F              | ECT          | "                | S           |
| <i>Cryptocephalus violaceus</i> Laich.            | C               | A            | F              | ECT          | "                | K,C,M,S     |
| <i>Galeruca pomonae</i> Scopoli                   | R               | A            | L              | ECT          | "                | M           |
| <i>Galeruca tanacetii</i> L.                      | R               | A            | L              | ECT          | "                | S           |
| <i>Longitarsus luridus</i> Scopoli                | R               | A            | L              | ECT          | "                | J           |
| <i>Oulema melanopus</i> L.                        | R               | A            | L              | ECT          | "                | S           |
| <i>Phyllotreta cruciferae</i> Goeze               | O               | A            | L              | ECT          | "                | C,S         |
| <i>Phyllotreta vittula</i> Redtb.                 | R               | A            | L              | ECT          | "                | S           |
| Curculionidae                                     |                 |              |                |              |                  |             |
| <i>Eusomus ovulum</i> Gernar                      | R               | A            | F              | ECT          | "                | K           |
| <i>Mecaspis alternans</i> Herbst                  | R               | A            | F              | ECT          | "                | M           |
| <i>Polydrusus incanus</i> Gyll                    | R               | A            | L              | ECT          | "                | S           |
| <i>Sibinia primita</i> Herbst                     | R               | A            | L              | ECT          | "                | S           |
| <i>Sitona sulcifrons</i> Thunberger               | R               | A            | L              | ECT          | "                | C           |
| <i>Stenopterapion melilati</i> Kirby              | R               | A            | L              | ECT          | "                | C           |
| <i>Trachyploeus alternans</i> Gyll                | R               | A            | L              | ECT          | "                | C           |
| Dasytidae   |                 |              |                |              |                  |             |
| <i>Dasytes subaeneus</i> Schönherr                | R               | A            | F              | ECT          | "                | H           |
| Lathridiidae                                      |                 |              |                |              |                  |             |
| <i>Lathridius</i> sp.                             | R               | A            | L              | ECT          | —                | S           |
| Mordellidae                                       |                 |              |                |              |                  |             |
| <i>Anaspis</i> sp.                                | R               | A            | F              | ECT          | —                | H           |
| <i>Mordellidae</i> sp.                            | R               | A            | F              | ECT          | —                | K,H         |
| Nitidulidae                                       |                 |              |                |              |                  |             |
| <i>Meligethes</i> sp.1                            | R               | A            | F              | ECT          | —                | K           |
| <i>Meligethes</i> sp.2                            | R               | A            | F              | ECT          | —                | K           |
| Oedemeridae                                       |                 |              |                |              |                  |             |
| <i>Nacerda ruficollis</i> F.                      | R               | A            | L              | ECT          | "                | K           |
| <i>Oedemera flavipes</i> (F.)                     | R               | A            | F              | ECT          | "                | M           |
| <i>Oedemera lurida</i> (Marsham)                  | R               | A            | F              | ECT          | "                | K,M         |
| <i>Oedemera virescens</i> (L.)                    | R               | A            | F              | ECT          | "                | M           |
| Tenebrionidae                                     |                 |              |                |              |                  |             |
| <i>Opatrum sabulosum</i> L.                       | R               | A            | L              | ECT          | "                | S           |
| Hymenoptera                                       |                 |              |                |              |                  |             |
| Cynipidae   |                 |              |                |              |                  |             |
| <i>Aulacidea pilosellae</i> (Kieffer)             | C               | A.L          | L              | END          | "                | K,H,R,C,M,S |
| Lepidoptera                                       |                 |              |                |              |                  |             |
| Gelechiidae                                       |                 |              |                |              |                  |             |
| <i>Acompsia cinerella</i> Clerck                  | R               | A            | L              | ECT          | "                | K           |

Table 2. Continued

| Species   | Frequency class | Stages found | Collected from | Feeding type | Host Specificity | Present at    |
|---|-----------------|--------------|----------------|--------------|------------------|---------------|
| Lyonetiidae   |                 |              |                |              |                  |               |
| <i>Lyonetia</i> sp.                                 | R               | A            | L              | ECT          | —                | C             |
| Oecophoridae  |                 |              |                |              |                  |               |
| <i>Holoscopia forficella</i> Scopoli                | R               | A            | L              | ECT          | "                | R             |
| <i>Plenrotia brevispinella</i> Zeller               | R               | A            | L              | ECT          | —                | C             |
| Pyralidae   |                 |              |                |              |                  |               |
| <i>Platytes cerussella</i> Chretien                 | R               | A            | L              | ECT          | "                | C             |
| Pterophoridae                                       |                 |              |                |              |                  |               |
| <i>Oxyptilus parvidactylus</i> Haworth              | R               | A,L          | L              | ECT          | "                | S             |
| Tineidae  |                 |              |                |              |                  |               |
| <i>Nemapogon granellus</i> L.                       | R               | A            | L              | ECT          | "                | M             |
| Tischeriidae  |                 |              |                |              |                  |               |
| <i>Tischeria marginata</i> Havorth                  | R               | A            | L              | ECT          | "                | C             |
| Tortricidae   |                 |              |                |              |                  |               |
| <i>Argyroplaca lacunana</i> Denis et Schiffermüller | O               | A            | L              | ECT          | "                | S             |
| <i>Clepsis helcolana</i> Froel                      | R               | L            | L              | ECT          | "                | J,M           |
| <i>Clepsis strigana</i> Hübner                      | R               | A            | L              | ECT          | "                | C             |
| Diptera   |                 |              |                |              |                  |               |
| Anthomyiidae  |                 |              |                |              |                  |               |
| <i>Anthomyia</i> sp.                                | R               | A            | F              | ECT          | —                | K,M           |
| Bombyliidae   |                 |              |                |              |                  |               |
| <i>Phthiria pulicaria</i> (Mikan)                   | O               | A            | F              | ECT          | "                | K,C           |
| Camillidae  |                 |              |                |              |                  |               |
| <i>Camilla atrimana</i> Strobl                      | R               | A            | L              | ECT          | "                | K             |
| Cecidomyiidae                                       |                 |              |                |              |                  |               |
| <i>Cecidomyia</i> sp.                               | C               | A            | L              | ECT          | —                | K,J,H,R,C,M,S |
| Chironomidae  |                 |              |                |              |                  |               |
| <i>Chironomus</i> sp.                               | O               | A            | L              | ECT          | —                | K,H,R         |
| Chloropidae   |                 |              |                |              |                  |               |
| <i>Meromyza nigricornis</i> Fedoseeva               | R               | A            | L              | ECT          | "                | J             |
| <i>Oscinella frit</i> species complex               | R               | A            | L              | ECT          | —                | H             |
| Conopidae   |                 |              |                |              |                  |               |
| <i>Thecophara</i> sp.                               | R               | A            | L              | ECT          | —                | S             |
| Lauxaniidae   |                 |              |                |              |                  |               |
| <i>Calliopygma aeneum</i> (Fallén)                  | R               | A            | L              | ECT          | "                | R             |
| Phoridae  |                 |              |                |              |                  |               |
| <i>Megaselia</i> sp.                                | R               | A            | L              | ECT          | —                | J             |
| Sarcophagidae                                       |                 |              |                |              |                  |               |
| <i>Phyligria stictica</i> (Meigen)                  | O               | A            | L              | ECT          | "                | R,M,S         |
| Sciomyzidae   |                 |              |                |              |                  |               |
| <i>Sciomyza</i> sp.                                 | R               | A            | L              | ECT          | —                | J             |
| Tephritidae   |                 |              |                |              |                  |               |
| <i>Tephritis ruralis</i> (Loew)                     | O               | A,L          | F              | END          | "                | J,C           |

C. common; O. occasional; R. rare; L. larvae; A. adult; L. leaves; F. flowers or flower shoots; S. stolons; END. endophagous; ECT. ectophagous. Abbreviations as on Fig. 1.

" Other Families

" Family Asteraceae.

" Genus *Hieracium*.

also inspected for signs of insect damage to find endophagous herbivores. During 1992, roots were collected from all sites on the first 5 occasions and dissected for insects.

**Identification and Assessing Commonness/Rarity and Host Specificity.** The material collected was identified by specialists to species where possible. For several specimens, especially larvae, identification was possible only to the genus or family level. These are included only if they represent a category not otherwise reported or if they were confidently identified as morphospecies separate from other, named species of the category.

Taxa found on *H. pilosella* were assigned to 1 of 3 frequency categories: common, occasional or rare. A species was categorized *rare* if it was collected as fewer than 3 individuals at different sites or as 5 in-

dividuals at only 1 site. A species was categorized *occasional* if it was more frequent than this, but fewer than 12 individuals were collected in total. A species was considered *common* if >12 specimens were collected.

Host specificity was assessed using information from the literature or on specialists advice. In the field, it was not always possible to separate true phytophages of *H. pilosella* from 'tourists' (Lawton and MacGarvin 1986). In this article, all species belonging to known phytophagous taxa are reported that were collected on *H. pilosella* during this survey. The distribution records in Table 2 represent data only from the 3 yr of field survey and do not include information from the literature. The percentage values of the species turnover between years ( $T_0$ ) were defined by

$$T_o = 100 (\mu_k / \mu_p)$$

where  $N_k$  is the number of species collected only in 1 of the 2 consecutive years, and  $N_p$  is the total number of species in the 2 yr.

Additional observations were conducted to estimate the infestation rates by 2 specialist phytophagous species. On 1 visit during the main flowering season in 1993, 100 flowerheads were collected from 3 sites (Kádárta, Romhány, and Síkfökút) each and dissected to count the flowerheads infested by larvae of the tephritid fly, *Tephritis ruralis* (Loew). One hundred rosettes were collected at the same 3 sites during each visit in 1993, and the leaves infected by galls of *Aulacidea pilosellae* (Kieffer) counted.

### Results and Discussion

During the 3 yr of study, 2,058 individuals representing 130 taxa were collected, of which 105 were identified to species level. Phytophagous insects associated with *H. pilosella* in Hungary are listed in Table 2. No insects or damage symptoms was found on the collected root material.

The most species-rich orders were the Heteroptera (30 species, or 23.1% of all taxa), Homoptera (29, 22.3%), and Coleoptera (33, 25.4%). Other orders represented were Orthoptera (5, 3.8%), Thysanoptera (8, 6.1%), Sternorrhyncha (5, 3.8%), Hymenoptera (1, 0.8%), Lepidoptera (11, 8.5%), and Diptera (13, 10%).

Different authors usually found lower numbers of species (11–106 species) on other composites than those of *H. pilosella*. (Boldt and Robbins 1990, 1994; Goeden and Teerink 1993; Wilson and Flanagan 1993; Briese et al. 1994; Fontes et al. 1994; Rosenthal et al. 1994; Freese 1995). However, McClay et al. (1995) found much higher species number (262) on *Parthenium hysterophorus* L. in North America. The percentage representation of the main insect orders in the fauna of *H. pilosella* is broadly similar to those reported in the above-mentioned papers.

Only 7 of the species collected (5.4%) were specifically feeding on Asteraceae. Of these, 4 species (*Dactynotus pilosellae* Börner, *Nasonovia pilosellae* Börner, *Aulacidea pilosellae*, and *Tephritis ruralis* [3.1%]) are known to be monophagous on *H. pilosella* or feeding only on species within the genus *Hieracium* (nearly monophagous). In comparison, the insect fauna of the milk thistle [*Silybum marianum* (L.)] in the Palearctic region included 32% stenophagous species, and 7% of species appeared restricted to milk thistle and other closely related thistles (Goeden 1976). The insect fauna of Ambrosiinae in California has 27% stenophagous and 18.2% monophagous or nearly monophagous species (Goeden and Teerint 1993). Other surveys reported 10–20.1% monophagous species in the insect faunas of different species of Asteraceae (Boldt and Robbins 1990, 1994; Fontes et al. 1994; McClay et al. 1995). Although the literature reports more specific species on *H. pilosella* than I found during the 3 yr (Syrett and Sárospataki 1993), the insect fauna found on *H. pilosella* in Hungary was less host-specific than

those on other species of Asteraceae in Europe and North America.

Only 2 endophagous species were found (1.5%). This is a very low value in comparison to the phytophagous insect fauna of other Asteraceae (Goeden and Teerink 1993, McClay et al. 1995). This partly reflects the low number of oligophagous and stenophagous species, because internally feeding species are usually more host-specific (McClay et al. 1995).

Most of the species found on *H. pilosella* (86 species, or 66%) were classified as rare (Table 2). The majority of these (63 species, or 48.5% of the total species number) were singletons (only 1 individual collected over the duration of the study). Although the number of species of moths, flies, and especially beetles was high, the total number of individuals collected was low. The values of the species turnover between years were also high (74–83% at the different sites for the whole species list, and 63–70% for the species list without rare species). These suggest an unstable species composition of insect assemblage associated with *H. pilosella*, a fact that is also reflected in the high number of generalists collected on the plant.

From the list in Table 2, only 4 species are known to feed on species within the genus *Hieracium*. Two of them are aphids, *Dactynotus pilosellae* and *Nasonovia pilosellae*, both of which are reported to feed exclusively on *H. pilosella* or closely related *Hieracium* species (Börner 1952). These species form colonies on the leaves and flower shoots, and their feeding causes leaf rolling or bud degradation (Buhr 1964). Few signs of such damage were observed during the field study.

The other 2 host-specific species were the gall wasp, *Aulacidea pilosellae*, and the tephritid fly, *Tephritis ruralis*. *A. pilosellae* forms galls on the central vein of the leaves, and attacked leaves usually dry earlier than healthy ones (Ambrus 1974). The larvae of *T. ruralis* develop in the receptacle of the flowers and damage the seeds (Buhr 1964). Both species are considered monophagous on *H. pilosella*, although, *A. pilosellae* is occasionally also found on other *Hieracium* species.

One indicator of potentially useful biological control agents is their effect on the host plant in its native range (Crawley 1989, Guretzky and Louda 1997). In 1993, the infestation rate of flowerheads by *T. ruralis* was 10% at site C. I did not find any infested receptacle at the 2 other sites. The galling of rosettes was highest also at site C, where >30% of the *H. pilosella* rosettes were infected by *A. pilosellae*. At the other 2 sites sampled for galls (sites Síkfökút and Kádárta), the maximum infestation rate was only the half of this value.

Because of the vigorous vegetative reproduction of *H. pilosella*, seed damage by itself will not provide a total solution (Bishop and Davy 1984, Makepace 1985a). However, large scale spreading by *H. pilosella* could be reduced by *T. ruralis*. *A. pilosellae* damages the vegetative parts of the plants, hence it may have biological control potential. However, I did not find any rosettes with >2 infected leaves. As the number of leaves per rosette is usually 6 (Bishop and Davy

1994; unpublished data), it is doubtful whether this would constitute sufficient leaf damage to reduce the fitness of the rosettes. However, the potential damage to *H. pilosella* plants by *A. pilosellae* could be higher, because this species has several parasitoids in Hungary. Three species of parasitoid chalcidoid wasps [*Macroneura vesicularis* (Retzius) (Eupelmidae), *Eurytoma cynipsea* Boheman (Eurytomidae), and *Liodontomerus pannonicus* Ruschka (Torymidae) (Calcidoidea, Hymenoptera) were reared from the collected galls. This suggests that if *A. pilosellae* is introduced to a habitat without its parasites, it may reach much higher infestation rates.

In conclusion, the insect assemblage associated with *H. pilosella* in Hungary was species rich, but seems to be very unstable in species composition. The percentage values of the species turnover were high, and there were many rare species, which are probably only "tourists" in the assemblage. The percentage of endophagous species and specialist herbivores was also very low. Only 2 species, *A. pilosellae* and *T. ruralis*, seemed to be candidate biological control agents of *H. pilosella*, one damaging the vegetative and the other the reproductive parts of the plant.

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