Species diversity of centipedes during a year-round survey at two vineyard sites in Northern Israel

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Abstract Centipedes (Chilopoda) are mainly predators, which play essential roles in agroecosystems. In this work, pitfall traps were placed monthly during 1998 in two sites of vineyards in Northern Israel: the Geshur and Ramat Magshimim vineyards. The present research refers to the centipedes that were caught in these traps. Specimens of seven species of centipedes were caught in this work. Four centipede species were found in both vineyard sites: Thereuonema syriaca Verhoeff, 1905, Scutigera coleoptrata (Linnaeus, 1758), Scutigeridae gen. species, and Heschestius barhipes (Porath, 1893). Two species were found in the Geshur, and not in the Ramat-Magshimim vineyard: Lithobius (Monotarsobius) sp., and Harpolithobius halophilus Verhoeff, 1941. One species was found in the Ramat-Magshimim, and not in the Geshur vineyard: Lithobius carinatus L. Koch, 1862. In the Geshur vineyard, 52 specimens of 6 centipede species were found. In the Ramat Magshimim vineyard, 20 specimens of 5 centipede species were detected. These differences are probably related to the Geshur vineyard being close to natural Mediterranean shrubland, while the Ramat Magshimim vineyard is situated between cultivated areas.

Keywords agroecosystems; centipedes; Chilopoda; Lithobidae; Scutigeridae; vineyards

Introduction

Centipedes (Chilopoda) are mainly predators that play an essential role in agroecosystems. The following groups of centipedes of Israel, were analyzed on different occasions during the 2000s: Scutigeromorpha – by Negrea (2003), Lithobius (Fig. 1) – by Negrea (2005), Geophilomorpha – by Chipman et al. (2013). The Scutigeromorpha species that were found in Northern Israel are: Scutigera coleoptrata (Linnaeus, 1758) from the Upper Galilee and Golan Heights, and Thereuonema syriaca Verhoeff, 1905 also from the Upper Galilee and Golan Heights (Negrea, 2003). The Lithobius species that were found in Northern Israel are: Lithobius (Lithobius) carinatus L. Koch, 1862 from the Carmel Hills and the Lower Galilee (Zapparoli, 1991); Lithobius (Lithobius) erythrocephalus C. L. Koch, 1847 from the Upper Galilee and Golan Heights (Negrea, 2005); Lithobius (Porobius) parvicornis Porat, 1893 from the Upper Galilee, the Lower Galilee and Mount Gilboa (Zapparoli, 1991; Negrea, 2005); and Lithobius (Ezembius) zelanus (Chamberlin, 1952) from the Upper Galilee (Negrea, 2005). The present work is the first research on centipedes from vineyards in the Eastern Mediterranean region. Specifically, this work deals with the year-round distribution of centipedes caught by pitfall traps at two vineyards in Northern Israel.

Methods

The two studied sites were: the Geshur vineyard (32.813°N; 35.806°E; 406m ASL). The average annual precipitation in the Geshur vineyard is 500–600 mm, and in the Ramat Magshimim vineyard: 600–700 mm (according to Israel precipitation map: lib.cet.ac.il). During the survey period, both vineyards administered drip irrigation, and trellis systems included Vertical Shoot Positioning (VSP) or Ballerina for higher production. Chemical weed control was applied twice a year, and diseases and pests were treated with conventional control management.

Pitfall traps were used to collect surface-dwelling invertebrates. The traps were sunk into the ground with an opening at the soil level. A wooden plate, placed on 2-cm legs, was positioned on top of each trap to prevent litter and larger animal entrance. Ethylene glycol was added to the traps for animal preservation, as Ethylene glycol evaporates slowly and hardly smells. In 1998, invertebrates were collected from 213 pitfall traps placed monthly in the Geshur (148 traps) or Ramat Magshimim vineyard (65 traps). Although the number of pitfall traps varied between the two vineyards, they were placed simultaneously and left open for a similar time length (Table 1). The pitfall traps were left open each sampling month for 10–14 days. The number of traps set monthly in the Ramat Magshimim vineyard was about half that placed in the Geshur vineyard. In July 1998, 16 pitfall traps were placed in the Geshur vineyard, and no traps were set in the Ramat Magshimim vineyard. In August 1998, the traps were left open for a different period in the two vineyards (Table 1). All the pitfall traps were removed after each sampling period. The content of each trap was preserved in a bottle filled with Ethanol 70%.
Collected invertebrates were divided into different orders during 1998-2000, using a ‘Wild – Heerbrugg M5-98033’ binocular. Each of the bottles contained invertebrates of each of these orders. The centipedes caught in this work were identified by Professor Marzio Zapparoli from the University of Tuscia, Italy, in 1999.

Results

The distributions and frequencies of centipede species that were found in this work in the Geshur and Ramat Magshimim vineyards are presented in Tables 2 and 3, respectively. Seven species of centipedes were found in this work. Four centipede species were found in both vineyards: *T. syriaca*, *S. coleoptrata*, Scutigeridae gen. species, and *H. barbipes* (Porath, 1893). Two species were found in the Geshur, and not in the Ramat-Magshimim vineyard: *Lithobius (Monotarsobius)* species, and *Harpolithobius halophilus* Verhoeff, 1941. One species was found in the Ramat-Magshimim, and not in the Geshur vineyard: *Lithobius carinatus* L. Koch, 1862. From a general point of view, the centipedes caught in this work were found year-round, not in a specific season. The total number and richness of centipedes detected in this work were 52 specimens of 6 species from the Geshur vineyard and 20 specimens of 5 species from the Ramat Magshimim vineyard. Although more centipede species were found in the Geshur vineyard, Simpson’s diversity index was higher in the Ramat Magshimim than in the Geshur vineyard (0.8 vs. 0.644).

The Scutigeridae detected in this work were of the same three species in both vineyards and were caught year-round. However, their frequencies were higher in the Geshur than in the Ramat Magshimim vineyard. The Lithobidae species found in this work differed between the two vineyard sites, but their distribution partially overlapped between sites. The frequencies of Lithobidae found in this work were higher in the Ramat Magshimim than in the Geshur vineyard.

Discussion

Three of the seven centipede species found in this work: *S. coleoptrata*, *H. barbipes*, and *L. carinatus* were also found in Cyprus (Simaiakis et al., 2013). Of these species, *S. coleoptrata* was also detected in Bulgaria (Stoev, 2002; Bachvarova et al., 2017). The number and richness of centipedes caught in this work seem to be higher in the Geshur than in the Ramat Magshimim vineyard. Simpson’s diversity index was higher in the Ramat Magshimim than in the Geshur vineyard, but this difference seems insignificant. These findings can be related to the fact, that at a distance of 100–200 meters south of the Geshur vineyard, there was or is a strip of a nature reserve of Mediterranean shrubland, which goes in a west-east direction along 2 kilometers. However, the Ramat Magshimim vineyard is situated between cultivated areas. Cohen et al. (2015) showed that many natural landscapes around groves or vineyards favor agricultural plant biodiversity. If plant diversity in such a vineyard is high, then animal biodiversity should also be
Table 2. Frequencies of different species of centipedes in the Geshur vineyard during 1998.

<table>
<thead>
<tr>
<th>Family</th>
<th>Species</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct-Nov</th>
<th>Dec</th>
<th>Total collections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scutigeridae</td>
<td>Thereuonema syriaca</td>
<td>–</td>
<td>1</td>
<td>5</td>
<td>2</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>3</td>
<td>6</td>
<td>17</td>
</tr>
<tr>
<td>Scutigeridae</td>
<td>Scutigera coleoptrata</td>
<td>1</td>
<td>6</td>
<td>8</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>26</td>
</tr>
<tr>
<td>Scutigeridae</td>
<td>Scutigeridae gen. sp.</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>5</td>
</tr>
<tr>
<td>Lithobidae</td>
<td>Lithobius (Monotarsobius) sp.</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>5</td>
</tr>
<tr>
<td>Lithobidae</td>
<td>Harpolithobius halophilus</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
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<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>1</td>
</tr>
<tr>
<td>Lithobidae</td>
<td>Hessebius barbipes</td>
<td>–</td>
<td>1</td>
<td>1</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
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<td></td>
<td>1</td>
<td>8</td>
<td>14</td>
<td>3</td>
<td>3</td>
<td>5</td>
<td>8</td>
<td>1</td>
<td>3</td>
<td>6</td>
<td>52</td>
</tr>
</tbody>
</table>

Table 3. Frequencies of different species of centipedes in the Ramat Magshimim vineyard during 1998.

<table>
<thead>
<tr>
<th>Family</th>
<th>Species</th>
<th>Jan</th>
<th>Feb</th>
<th>Mar</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct-Nov</th>
<th>Dec</th>
<th>Total collections</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scutigeridae</td>
<td>Thereuonema syriaca</td>
<td>–</td>
<td>–</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>–</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Scutigeridae</td>
<td>Scutigera coleoptrata</td>
<td>1</td>
<td>–</td>
<td>–</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>–</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Scutigeridae</td>
<td>Scutigeridae gen. sp.</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>1</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>1</td>
</tr>
<tr>
<td>Lithobidae</td>
<td>Lithobius carinatus</td>
<td>–</td>
<td>–</td>
<td>3</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Lithobidae</td>
<td>Hessebius barbipes</td>
<td>–</td>
<td>2</td>
<td>3</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>1</td>
<td>7</td>
<td>4</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>–</td>
<td>–</td>
<td>20</td>
<td>20</td>
</tr>
</tbody>
</table>

high. Centipedes are predators, so their distribution in the area, should be a function of the frequencies of their prey which mainly includes other invertebrates. Consequently, it is unsurprising that centipede frequency and richness were higher in the Geshur than in the Ramat Magshimim vineyard. The centipedes caught in this work were found year-round, not in a specific season. This finding also fits the fact, that the invertebrates eaten by these centipedes, appear on the ground surface in these same vineyards during most of the year (Ittai Warburg, unpubl. data).

The specimens of Scutigeridae gen. species caught in this research, both from the Geshur and Ramat Magshimim vineyards, seem to be the first reports of this centipede species from Northern Israel. The specimen of L. (Monotarsobius) sp., caught in the Geshur vineyard on August 1998 seems to be the first report of this species from the Golan Heights.

The number of Scutigeridae detected in the Geshur vineyard is much bigger than that of the Ramat Magshimim vineyard. The number of Lithobidae found in the Ramat Magshimim vineyard is larger than that of the Geshur vineyard. These two statements also hold if we compare the same numbers of pitfall traps per vineyard area. These phenomena reflect some ecological differences between the two studied vineyards. The higher number of Scutigeridae found in the Geshur vineyard, can also be related to the natural Mediterranean shrubland located close to this vineyard, potentially contributing to the richness of the fauna in the Geshur vineyard.

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Dr. Rakefet Sharon did the fieldwork in this research, and also provided some data on the agricultural parameters of the vineyards, and the fieldwork. I would like to thank hereby also Professor Marzio Zapparoli from the University of Tuscia in Italy for identifying the centipedes. Thanks to Noam Givon for the centipede photo, that appears in this article. Thanks also to Professor E. Hornung from the Veterinary University in Budapest, Hungary, for identifying that centipede. This project was funded between 1998–2000, by a grant from the Foundation of Regional Research and Development, of the Ministry of Science and Technology of the State of Israel.

References


