On the short-horned grasshopper (Orthoptera: Caelifera) fauna of northeastern Iran with some information on sweep sampling capture rates

Jabbari, A., Modarres Awal, M., Fekrat, L., Karimi, J. & Rashki, M.

a Department of Plant Protection, Faculty of Agriculture, Ferdowsi University of Mashhad, Mashhad, Iran
b Department of Biodiversity, Institute of Science and High Technology and Environmental Sciences, Graduate University of Advanced Technology, Kerman, Iran.

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In order to improve the knowledge of the Caelifera species of north-eastern Iran, faunistic investigations on grasshoppers of this region were carried out during 2013-2014. Collected specimens as well as deposited specimens in Insect Museum of Ferdowsi University of Mashhad were examined, in detail. Totally 19 species belonging to 17 genera, 9 subfamilies and three families were collected and determined. Among them Paranocarodes straubei is newly recorded for the fauna of Iran. In addition to faunistic records, differences in species diversity and captured numbers upon times of day were investigated via sweep sampling at two rangeland sites during 2013-2014. There were no significant differences among capture rates in various day hours; so standardized grasshopper sampling could be done between the hours of 8:00 and 16:00 to generate consistent estimates of rangeland grasshopper densities.

Key words: Caelifera, faunistic, Iran, Khorasan-e-Razavi, sampling, sweep net.

INTRODUCTION

Iran is a country with various geographic, climatic and vegetative zones which confluence of them has endowed a suitable platform for a rich and diverse faunal assemblage in this country. The Orthoptera are common and well known group of insects which can be found in various habitats throughout Iran. Many studies on orthopteroids and specially grasshoppers have enhanced faunistic knowledge of this order in this country (Alexandrov, 1947; Bey-Bienko, 1957, 1960; Descamps, 1967; Dirsh & Mirzayans, 1971; Azemayeshfard, 1974, 1975, 1983, 1990, 1991; Cejchan, 1974; Dirsh & Uvarov, 1957; Mirzayans 1951, 1959, 1990, 1991, 1998; Neyestanak, 2000 a,b,c; Garai, 2010, 2011). In comparison to other parts of Iran, a little work has been done on the fauna of grasshoppers in northeastern parts of Iran. Khorasan provinces were not studied well and the current research is thus focused on the mentioned area to determine species of short–horned grasshoppers in this region which has specific ecological characteristics for its diversity on climatic perspective with rich fauna and flora.

Because of the potential of most of the grasshoppers to cause economic damage, these insects are monitored in various provinces of Iran by ministry of agriculture annually to determine their potential for outbreaks (Taleban Fard and Shariati, 2010). So, the accurate estimates of their density...
have a tremendous effect on determination of management strategies especially the need for treatment. Despite the variability of methods of estimating grasshopper numbers, sweep sampling is the most common because of its cost-effectiveness as well as relatively rapid speed of assessment (Gardiner et al., 2005). Until now, sweep sampling has been used in several studies in order to estimate the population of grasshoppers in various times of day (Estano and Shepard, 1988; Whipple et al., 2010), but no studies have been performed in rangeland grasshoppers of Iran. In this study, in addition to faunistic records, we examined and compared the impact of time of day on sweep-net capture of various rangeland grasshoppers in north-east Iran.

MATERIAL AND METHODS

Faunistic study
This study is based on the material deposited in the Insect Museum of Ferdowsi University of Mashhad as well as those collected by the first author from different locations in Khorasan-e-Razavi province. The samplings were conducted mainly by sweeping or via hand-catching and the materials were transferred to killing jars. All of the specimens were pinned and labeled with accurate collection data. The material was deposited in the Insect Museum of Plant-Protection Department at Ferdowsi University of Mashhad. The specimens were identified by Dr. Battle Ciplak from Akdeniz University, Turkey.

Compare capture rates in two rangelands
One and two rangeland sites with mixed-grass vegetation and low grazing pressure were chosen for sweep samplings (Site1: 36.4808° N, 59.1572° E; Site 2: 36.5944° N, 58.9464° E) in Khorasan-e-Razavi province in 2013 and 2014, respectively. Sites 1 and 2 were near Golmakan and Akhlamad, respectively. The approximate distance between these two sites was about 15 Kilometers. Each of these two prairies was sampled over three consecutive days for three sampling periods between June and September. Twenty low and fast sweeps (Wipple et al., 2010) were taken at each site. Sweep samples were collected every four hours from 8:00 to 16:00 and at each time interval a different location within each site was sampled. The data were normally distributed so the one-way ANOVA (SPSS 16) was used to determine the differences in number of captured grasshopper specimens in various times of day.

RESULTS
Totally, 19 species belonging to three families, nine subfamilies and 17 genera were collected and identified. Among them, Paranocarodes straubei (Fieber, 1853) is newly recorded for the fauna of Iran.

Family Acrididae MacLeay, 1821
Subfamily Acridinae MacLeay, 1821
Tribe Acridini MacLeay, 1821
Genus Acrida Linnaeus, 1758
Acrida bicolor (Thunberg, 1815)
Distribution: Mediterranean area including islands, Canary Islands, most countries of Africa including south of the Sahara, Asia Minor (Dirsh, 1966; Garai, 2010), Iran (Natanz, Binaloud) (Garai, 2010).
Material examined: Khorasan-e-Razavi, Quchan (37°10′61″ N, 58°50′94″ E), 4♀, 1♂, 9.VII.2013, Leg: A. Jabbari; Neyshabour (36°21′33 N, 58°79′58″ E), 3♀, 17.VII.2013, Leg: A. Jabbari.

Subfamily Calliptaminae Tinkham, 1940
Tribe Calliptamini Tinkham, 1940
Genus *Calliptamus* Serville, 1831

*Calliptamus coelesyriensis* Giglio-Tos, 1893  
**Distribution:** Samos Island, Turkey, Caucasus range, Azerbaijan, Iran: north-east and center of Iran (Garai, 2010).  
**Material examined:** Khorasan-e-Razavi, Mashhad (36°17′49″ N, 59°36′22″ E), 1 ♀, 25.VI.2013, Leg. N. Golami.

*C. italicus* (Linnaeus, 1758)  
**Distribution:** North of Africa, Turkey, from Caucasus through Iran, Afghanistan, west of Pakistan to north-west of Mongolia and west of China and western Siberia (Garai, 2010), Iran (Razan (Hamedan province), Kushk-e Nosrat (Fars province), Natan) (Garai, 2010).  
**Material examined:** Khorasan-e-Razavi, Golmakan (36°28′51″N, 59°09′26″E), 5 ♀, 2♂, 11.VII.2013, Leg. A. Jabbari; Chenaran, Kerengan (36°40′5″N, 59°9′26″E), ♀1, 12.VII.2013, Leg. A. Jabbari; Akhlamad (36°35′39″N, 58°56′44″E), 1 ♀, 18.VI.2013. Leg. A. Jabbari.

*C. barbarus cephalotes* Fisher-Waldheim, 1846  
**Distribution:** North Africa, Caucasus, Turkey, north Afghanistan, Kazakhstan, Mongolia, west China, Siberia, Iran (Zagros, Bostanabad, Azad-Ber, Lardam, Sahreza, Erak, Zanjan, Makoo) (Garai, 2010).  
**Material examined:** Khorasan-e-Razavi, Chenaran (36°456′ N, 59.1211° E), 30 ♀, 18.VI.2013, Leg. A. Jabbari; Shirhesar (36°34′20″ N, 59°23′19″ E), 1♀, 2.VIII.2013, Leg. A. Jabbari.

Subfamily Cyrtacanthacridinae Kirby, 1910  
**Tribe Cyrtacanthacridini Kirby, 1910**  
Genus *Anacridium* Uvarov, 1923  

*Anacridium aegyptium aegyptium* (Linnaeus, 1923)  
**Distribution:** South western Europe, Middle-Africa, Asia Minor, Caucasus, Kazakhstan, Afghanistan (Garai, 2010), Iran (Azad Shar, Khomer, Borazgan) (Garai, 2010).  
**Material examined:** Khorasan-e-Razavi, Chenaran (36°40′5″ N, 59°9′26″ E), 1♀, 27.VII.2013, Leg. A. Jabbari; Golmakan (36°28′51″N, 59°09′26″E), 8♀, 27.VII.2013. Leg. A. Jabbari; Mohsenabad (36°34′14″N, 59°14′12″E), 3♀, 27.VII.2013. Leg. A. Jabbari.

Genus *Schistocerca* Stål, 1873  

*Schistocerca gregaria* (Forskal, 1775)  
**Distribution:** North of Africa, Syria, Iraq, Afghanistan, Turkmenistan, Uzbekistan, Tajikistan, W-Pakistan (Hemp, 2009), Iran (Bidak, Demavend, Dehdib).  
**Material examined:** Khorasan-e-Razavi, Golmakan (36°28′51″N, 59°09′26″E), 3♀, 1.VII.2013. Leg. A. Jabbari; Gonabad (34°22′6″N, 58°44′16″E), 2♀, 11.VII.2013. Leg. A. Jabbari; Khat (34°34′35″N, 60°08′27″E), 4♀, 11.VII.2013. Leg. A. Jabbari.

Subfamily Gomphocerinae Fieber, 1853  
**Tribe Ramburiellini Defaut, 2012**  
Genus *Ramburiella* Bolívar, 1906  

*Ramburiella bolivari* (Kuthy, 1907)  
**Distribution:** Asia-Temperate, western Asia, Turkey (Eades et al. 2014).  
**Material examined:** Khorasan-e-Razavi, Chenaran, Kerengan (36°40′5″ N, 59°9′26″ E), 3 ♀, 1♂, 24.VII.2013. Leg. A. Jabbari; Quchan (37°10′6″ N, 58.5094° E), 2♀, 1♂, 24.VII.2013, Leg. A.

Family Dericorythidae Jacobson & Bianchi, 1905
Subfamily Dericorythinae Jacobson & Bianchi, 1905
Genus *Dericorys* Serville, 1838
*Dericorys albidula* Serville, 1838

**Distribution**: North of Africa, Syria, Iraq, Afghanistan, Turkmenistan, Uzbekistan, Tajikistan, W-Pakistan, Iran (Bidak, Demavend, Dehdib, Natanz) (Garai, 2010).


Subfamily Oedipodinae Walker, 1871
Tribe Oedipodini Walker, 1871
Genus *Oedipoda* Latreille, 1829
*Oedipoda miniata* Pallas, 1771

**Distribution**: Caucasus, Tajikistan, Afghanistan, western Pakistan, India, central Asia, Western Siberia (Garai, 2010), Iran (Zagros, Miyane, Geshlagh valley, Jevenly, Karaby, Geshlagh, Razan, Fasa, Sangar, Zageja Bala, Kivi, Lardam, Yasug, Erak, Miyane, Thangebolhayat, Khorambid, Nur, Miyane, Natanz, Zanjani, Sivand, Miyane, Rienek, Arak, Binaloud, Quazvin) (Garai, 2010).


*Sphingonotus pilosus* Saussure, 1884

**Distribution**: Caucasus range, Turkey, Turkmenistan, Iran (Jevenly, Geshlagh vall, Natanz, Thangebolhayat, Nur, Khorambid, Miyane, Khansar Dalekh) (Garai, 2010).


*Heliopterix humeralis* (Kuthy, 1907)

**Distribution**: Iran (Guilan, Isfahan) (Ghahari et al., 2009).


*Oedalus decorus* (Germar, 1825)

**Distribution**: Asia-Temperate, Caucasus, north of Caucasus, Dagestan (Eades et al., 2014).

Pyrgoder a armata Fisher Waldheim, 1846

Distribution: Russia (Eades et al., 2014), Iran (Azerbaijan, Ardabil) (Havaskary et al., 2012).

Material examined: Khorasan-e-Razavi, Gonabad (34°22’6”N, 58°44’16”E), Khaf (34°34’35”N, 60°08’27”E), 5♀, 2♂, 9.VI.2013, Leg. A. Jabbari.

Locusta migratoria Linnaeus, 1758

Distribution: South and East of Europe, Central Asia, W-China, Mongolia, Korea, Siberia, Iran (Azerbaijan, Gilan, Makoo) (Garai, 2010).


Family Pamphagidae Burmeister, 1840
Subfamily Pamphaginae Burmeister, 1840
Tribe Nocarodeini Bolívar, 1916
Genus Nocaracris Uvarov, 1928
Nocaracris cyanipes (Fischer von Waldheim, 1846)

Distribution: Asia-Temperate, Caucasus (Eades et al. 2014).


Genus Paranocarodes Bolivar, 1916
Paranocarodes straubei (Fieber, 1853)

This species is newly recorded for the fauna of Iran.

Distribution: Asia-Temperate, western Asia, Turkey, Northwest Anatolia, Brussa (Eades et al., 2014).


Subfamily Thrinchinae Stål, 1876
Genus Eremopeza Saussure, 1888
Eremopeza gibbera (Stål, 1876)

Distribution: South of Iran (Garai, 2010).


Family Pyrgomorphidae Brunner von Wattenwyl, 1882
Subfamily Pyrgomorphinae Brunner von Wattenwyl, 1882
Tribe Pyrgomorphini Brunner von Wattenwyl, 1882
Genus Pyrgomorpha Serville, 1838
Pyrgomorpha Cognata Krauss, 1877

Distribution: West of Europe, northern Africa, Levante, Turkey, Caucasus, Iraq, Iran, Afghanistan, West of Pakistan (Garai, 2010).

TABLE 1. Total number of adult and nymphal grasshoppers species collected during every four hours sweep samples from two rangelands sites in Khorasan-e-Razavi over three dates between June and September 2013.

<table>
<thead>
<tr>
<th>Species</th>
<th>8:00</th>
<th>12:00</th>
<th>4:00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oedipoda miniata</td>
<td>22</td>
<td>25</td>
<td>18</td>
</tr>
<tr>
<td>Eromoeza gibberto</td>
<td>6</td>
<td>15</td>
<td>11</td>
</tr>
<tr>
<td>Locusta migratoria</td>
<td>2</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Caliptamus italicus</td>
<td>9</td>
<td>14</td>
<td>16</td>
</tr>
<tr>
<td>Schistocerca gregaria</td>
<td>2</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Pyrgomorpha cognata</td>
<td>3</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Locusta migratoria</td>
<td>5</td>
<td>7</td>
<td>6</td>
</tr>
<tr>
<td>Anacridium aegyptium</td>
<td>0</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Dociostaurus maroceanus</td>
<td>3</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>Total grasshoppers</td>
<td>52</td>
<td>82</td>
<td>65</td>
</tr>
</tbody>
</table>

TABLE 2. Total number of adult and nymphal grasshoppers by species collected during every four hours sweep samples from two rangelands sites in Khorasan-e-Razavi over three dates between June and September 2014.

<table>
<thead>
<tr>
<th>Species</th>
<th>8:00</th>
<th>12:00</th>
<th>4:00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oedipoda miniata</td>
<td>52</td>
<td>68</td>
<td>60</td>
</tr>
<tr>
<td>Caliptamus italicus</td>
<td>37</td>
<td>42</td>
<td>24</td>
</tr>
<tr>
<td>Locusta migratoria</td>
<td>11</td>
<td>11</td>
<td>6</td>
</tr>
<tr>
<td>Eromoeza gibberto</td>
<td>31</td>
<td>22</td>
<td>23</td>
</tr>
<tr>
<td>Pyrgodero armata</td>
<td>10</td>
<td>9</td>
<td>9</td>
</tr>
<tr>
<td>Schistocerca gregaria</td>
<td>4</td>
<td>6</td>
<td>9</td>
</tr>
<tr>
<td>Acrida bicolor</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Dociostaurus maroceanus</td>
<td>9</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Pyrgomorpha cognata</td>
<td>8</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Total grasshoppers</td>
<td>153</td>
<td>165</td>
<td>140</td>
</tr>
</tbody>
</table>

SAMPLEING RATES
In 2013, a total of 199 specimens belonging to 9 species were collected and identified in rangeland site 1 (Table 1). There was not any significant difference in number of collected grasshopper specimens in various times of day (F = 0.530, P = 0.595).

In 2014, a total of 458 grasshopper specimens from 9 species were collected in two rangeland sites (Table 2). Although the number of captured species was highest at 12:00, but there were no significant differences among capture rate of specimens in various day hours (F = 0.828, P = 0.443) (Fig. 1). The most abundant species collected in our study was Oedipoda miniata; Caliptamus italicus and Eromoeza gibberto were in the next two ranks.
**Figure 1.** Mean±SE number of grasshoppers specimens captured in different times of day at rangeland site 1 in 2013.

**Figure 2.** Mean±SE number of grasshoppers specimens captured in different times of day at two rangeland sites in 2014.
DISCUSSION
The study of grasshopper and locust fauna in Khorasan provinces (Northeastern Iran) revealed the presence of 19 species, divided into 3 families including Acrididae, Pyrgomorphidae and Pamphagidae. Among these families, Acrididae was the best represented one with 7 subfamilies. Subfamily Oedipodinae was the largest, consisting of 6 species. The subfamilies of Acridinae, Dericoryuthinae, Gomphocerinae, Thrinchinae and Pyrgomorphinae were represented by only one species each. The Italian locust, *Calliptamus italicus*, and the migratory locust, *Locusta migratoria*, appear to be of economic importance in the region of Khorasan-e-Razavi. These species can invade various agricultural crops in Khorasan-e-Razavi and control programs should be applied annually in their aggregation centers to obstruct their drastic damages (Abivardi, 2001; Noorbakhsh et al. 2012). Although *Oedipoda miniata* was dominant species in our samplings in terms of number of collected specimens, but it does not have economic importance in our study region and no control measures performed against it.

The results of this study indicate that standardized sampling of grasshoppers can be conducted in various times of day between 8:00 and 16:00 and there is not any significant difference among capture rates in these hours. Because in some studies (Whipple et al., 2010), differences in number of captured grasshoppers by time of day was observed, there is need to further studies in more rangeland ecosystems during more times of day to determine the best time of sampling for accurate estimation of number of grasshoppers.

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