

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

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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 (Whipple 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), Natanz) (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°40'5N, 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 (36.6456° N, 59.1211° E), 30♀, 18.VI.2013, Leg. A. Jabbari; Shirhesar (36 34' 20" N, 59 23' 19" E), 19♀, 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, Kerengan (36°40'5N, 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°34'14N, 59°14'12'E), 3♀, 27.VII.2013. Leg. A. Jabbari.

Genus *Schistocerca* stål, 1873***Schistocerca gregaria* (Forskål, 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°22'6N, 58°44'16E), 2♀, 11.VII.2013. Leg. A. Jabbari, Khaf (34°34'35N, 60°08'27E), 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°40'5N, 59°9'26' E), 3 ♀, 1♂, 24.VII.2013. Leg. A. Jabbari; , Quchan (37.1061° N, 58.5094° E), 2♀, 1♂, 24.VII.2013, Leg. A.

Jabbari, Torbat-e- Heydarieh, Oryan, (35°16'31"N, 59°14'49"E / 35.27528°N 59.24694°E), 1♀, 24.VII.2013, Leg. A. Jabbari; Mohsenabad (36°34'14"N, 59°14'12"), 1♀, 24.VII.2013, Leg. A. Jabbari.

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).

Material examined: Khorasan-e-Razavi, Gonabad (34°22'6"N, 58°44'16"E), 3♀, 2♂, 31.V.2013 Khaf (34°34'35"N, 60°08'27"E), 6♀, 1♂, 9.VI.2013, Leg. A. Jabbari.

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, Zanjan, Sivand, Miyane, Rieneh, Arak, Binaloud, Quazvin) (Garai, 2010).

Material examined: Khorasan-e-Razavi, Chenaran, Kerengan (36°40'5"N, 59°9'26" E), 15♀, 3.VII.2013. Leg. A. Jabbari; Golmakan (36°28'51"N, 59°09'26"E), 25♀, 3.VII.2013, Leg. A. Jabbari; Golmakan (36°28'51"N, 59°09'26"E), 15♀, 19.VI.2013, Leg. A. Jabbari; Akhlamad (36°35'39"N, 58°56'44"E), 15♀, 3.VII.2013, Leg. A. Jabbari, Mohsenabad (36°34'14"N, 59°14'12"E), 15♀, 3.VII.2013, Leg. A. Jabbari.

***Sphingonotus pilosus* Saussure, 1884**

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

Material examined: Khorasan-e-Razavi, Chenaran, Kerengan (36°40'5"N, 59°9'26" E), 18♀, 3.VII.2013. Leg. A. Jabbari, Golmakan (36°28'51"N, 59°09'26"E) ♀62, 3.VII.2013. Leg. A. Jabbari, Akhlamad (36°35'39"N, 58°56'44"E), 8♀, 3.VII.2013. Leg. A. Jabbari; Mohsenabad (36°34'14"N, 59°14'12"), 7♀, 3.VII.2013. Leg. A. Jabbari.

***Heliopterix humeralis* (Kuthy, 1907)**

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

Material examined: Khorasan-e-Razavi, Chenaran, Kerengan (36°40'5" N, 59°9'26" E), 21 ♀, 3.VII.2013. Leg. A. Jabbari; Golmakan (36°28'51"N, 59°09'26"E), 49♀, 3.VII.2013. Leg. A. Jabbari; Akhlamad (36°35'39"N, 58°56'44" E), 15♀, 3.VII.2013. Leg. A. Jabbari; Mohsenabad (36°34'14" N, 59°14'12"E), 10♀, 3.VII.2013. Leg. A. Jabbari.

***Oedalus decorus* (Germar, 1825)**

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

Material examined: Khorasan-e-Razavi, Chenaran, Kerengan (36°40'5"N, 59°9'26" E), 23♀, 3.VII.2013. Leg. A. Jabbari, Golmakan (36°28'51"N, 59°09'26"E), 47♀, 3.VII.2013. Leg. A. Jabbari, Akhlamad (36°35'39"N, 58°56'44"E), 16♀, 3.VII.2013. Leg. A. Jabbari, Mohsenabad (36°34'14"N, 59°14'12"E), 9♀, 3.VII.2013. Leg. A. Jabbari.

***Pyrgodera 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♂, 9VI.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).

Material examined: Khorasan-e-Razavi, Chenaran, Kerengan (36°40'5"N, 59°9'26" E), 2♀, 3.VII.2013, Leg. A. Jabbari; Golmakan (36°28'51"N, 59°09'26"E), 2♀, 3.VII.2013. Leg. A. Jabbari; Akhlamad (36°35'39"N, 58°56'44"E), 2♀, 3.VII.2013, Leg. A. Jabbari; Mohsenabad (36°34'14"N, 59°14'12"), 2♀, 3.VII.2013, Leg. A. Jabbari.

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).

Material examined: Khorasan-e-Shomali, Bidak (37°28'19"N, 57°13'11"E), 3♀, 11.VI.2000. Leg. F. Gamali; Khorasan-e-Shomali, Amirabad (37°51'18"N, 57°21'03"E), 10.VII.2003. Leg. S. Hosseini.

Genus *Paranocarodes* Bolívar, 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).

Material examined: Khorasan-e-Shomali, Boujnord (37°28'30"N, 57°20'00"E), 3♀, 15.VII.1998. Leg. M. Hosseini; Khorasan-e-Shomali, Ashkhaneh (37°33'41"N, 56°55'16"E), 2♀, 28.VII. 2004.

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

Distribution: South of Iran (Garai, 2010).

Material examined: Khorasan-e-Razavi, Gonabad (34°22'6"N, 58°44'16"E), 2♀, 9.VI.2013. Leg. A. Jabbari; Khaf (34°34'35"N, 60°08'27"E), 4♀, 9.VI.2013. Leg. A. Jabbari.

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).

Material examined: Khorasan-e-Razavi, Gonabad (34°22'6"N, 58°44'16"E), 2♀, 9.VI.2013. Leg. A. Jabbari; Khaf (34°34'35"N, 60°08'27"E), 4♀, 9.VI.2013. Leg. A. Jabbari.

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.

SPECIES	TIME		
	8: 00	12:00	4:00
<i>Oedipoda miniata</i>	22	25	18
<i>Eromopeza gibberto</i>	6	15	11
<i>Locusta migratoria</i>	2	8	4
<i>Caliptamus italicus</i>	9	14	16
<i>Schistocerca gregaria</i>	2	3	6
<i>Pyrgomorpha cognata</i>	3	2	0
<i>Locusta migratoria</i>	5	7	6
<i>Anacridium aegyptium</i>	0	3	2
<i>Dociostaurus maroccanus</i>	3	5	2
Total grasshoppers	52	82	65

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.

Species	Time		
	8:00	12: 00	4:00
<i>Oedipoda miniata</i>	52	68	60
<i>Caliptamus italicus</i>	37	42	24
<i>Locusta migratoria</i>	11	11	6
<i>Eromopeza gibberto</i>	31	22	23
<i>Pyrgodero armata</i>	10	9	9
<i>Schistocerca gregaria</i>	4	6	9
<i>Acrida bicolor</i>	0	1	0
<i>Dociostaurus maroccanus</i>	9	5	7
<i>Pyrgomorpha cognata</i>	8	6	7
Total grasshoppers	153	165	140

SAMPLING 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 *Eromopeza gibberto* were in the next two ranks.

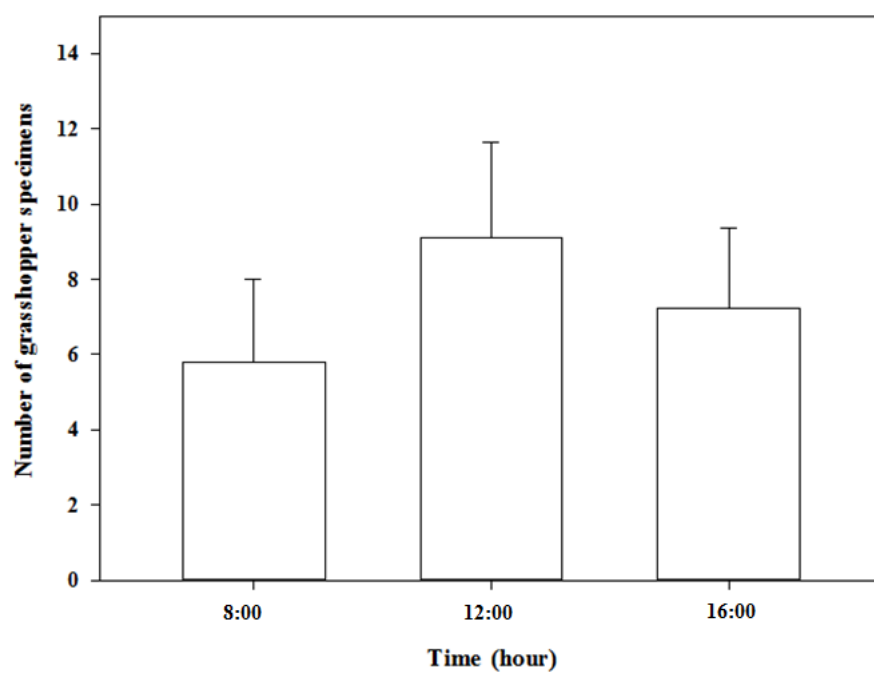


FIGURE 1. Mean \pm SE number of grasshoppers specimens captured in different times of day at rangeland site 1 in 2013.

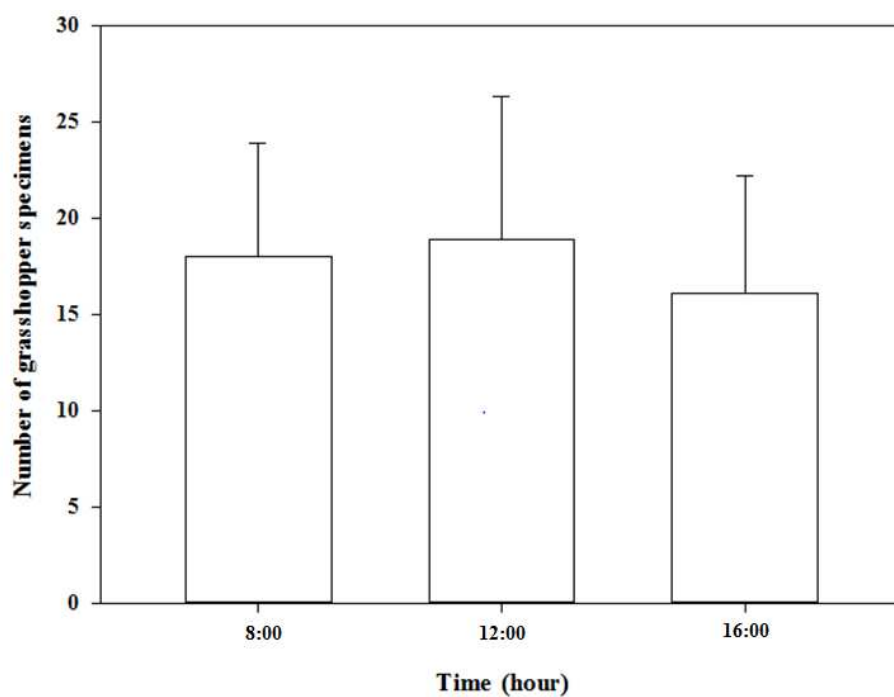


FIGURE 2. Mean \pm SE number of grasshoppers specimens captured in different times of day at two rangeland sites in 2014.

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, Dericorythinae, 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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LITERATURE CITED

Abivardi, C., 2001. Iranian Entomology: An Introduction, Volume 2, Applied Entomology. Springer Verlag, Heidelberg.

Noorbakhsh, S., Sahraian, H., Soroosh, M. J., Rezaii, V and Fotoohi, A. R., 2012. List of pests, diseases and weeds of major agricultural products and the recommended methods for their control. Plant Protection Organization. [in Persian]

Alexandrov, N. V., 1947. Les Acridiens des regions Nord, Nord-Est et Nord-Ouest de l'Iran. Entomologie et Phytopathologie Appliquées 3: 76-15.

Azemayeshfard, P., 1974. Identification and distribution banded wings grasshopper (Orth: Oedopodinae) of Karadj. Entomologie et Phytopathologie Appliquées 39:30-38.

Azemayeshfard, P., 1975. An investigation about morphology and biology of *Aiolopus talassinus* F. under laboratory conditions. Entomologie et Phytopathologie Appliquées 39: 20-25.

Azemayeshfard, P., 1983. Investigation on the biology of *Acrotulus insubricus* Scop . In Karadj vicinity and under laboratory condition. Proceeding of VII. Plant Protection Congress, Iran, University of Tehran, 38 - 39 pp.

Azemayeshfard, P., 1990. Investigations on the band – winged grasshoppers (Oedipodinae) of Iran. Boletin de Sanidad Vegetal, Plagas 20: 145- 150.

- Azemayshfard, P., 1991. Investigation of long horned grasshoppers (*Polysarcus fieber*) in Iran. [Abstract]. *Metaleptea* 13: 13.
- Bey-Bienko, G. J., 1957. New and interesting grasshoppers (Orthoptera, Acrididae) from Iran. *Zoologicheskij Zhurnal* 36: 1698 – 1703. [In Russian, English summary].
- Bey-Bienko, G.J., 1960. New Iranian Acridoidea (Ergebnisse der Entomologischen Reisen Willi Richter, im Iran 1954 und 1956 -Nr. 28). *Stuttgarter Beitrage zur Naturkunde, Stuttgart* 36: 1-7.
- Cejchan, A., 1974. Results of the Czechoslovak - Iranian entomological expedition to Iran 1970 No. 7. Orthoptera, Tettigoniidae: A new species of Nephoptera Uvarov, 1929, from Iran. *Acta Entomologica Musei Nationalis Pragae Suppl.*, 6: 91- 94.
- Cressman, K., Monitoring desert locusts in the Middle East: An Overview. Yale School of Forestry & Environmental Studies. [Cited 6 Apr 2015.] Available from URL: <http://environment.yale.edu/publication-series/documents/downloads/0-9/103cressman.pdf>.
- Descamps, M., 1967. Revue et diagnose préliminaire de quelques Pamphagidae et Acrididae d'Iran (Orth. Acridoidea). *Bulletin de la Société entomologique de France* 72: 27-37.
- Dirsh, V.M., 1966. Acridoidea of Angola. *Museo do Dundo. Publicações culturais de Companhia de Diamantes de Angola*, 74: 15-511.
- Dirsh, V. M., Mirzayans, H., 1971. Some Iranian Acridoidea (Orthoptera). *Journal of Entomology Series B, Taxonomy* 40(2): 111-116.
- Dirsh, V.M., Uvarov, B. P., 1957. An interesting grasshopper from Iran. *Journal of Entomologische Berichte Amsterdam* 17: 24-26.
- Eades, D.C., Otte, D., Cigliano, M.M. and Braun, H., Orthoptera Species File. Version 5.0/5.0. [Cited 20 Dec 2014]. Available from URL: <http://Orthoptera.Species File.org>.
- Estano, D. B., Shepard, B. M., 1988. Influence of time of day and sweeping pattern on catches of green leafhoppers (GLH). *International Rice Research Newsletter* 13: 22.
- Ghahari, H., Havashary, M., Tabari, M., Ostovan, H., Sakenin, H. and Satar, A., 2009, An annotated catalogue of Orthoptera (Insecta) and their natural enemies from Iranian rice fields and surrounding grasslands. *Linzer Biologische Beitrage* 41(1): 639-672.
- Garai, G. A., 2010. Contribution to the knowledge of the Iranian Orthopteroid insects I. (Plates 61, 62). *Esperiana* 15: 393-417.
- Garai, G. A., 2011. Contribution to the knowledge of the Iranian Orthopteroid insects II. Description of three new species of Iranian Platycleidini and one of Drymadusini (Plates 1-8). *Esperiana Band* 16: 67-72.
- Gardiner, T., Hill, J., Chesmore, D., 2005. Review of the methods frequently used to estimate the abundance of orthoptera in grassland ecosystems. *Journal of Insect Conservation* 9: 151-173.

- Havaskary, M., Farshbaf pour Abad, R., Kazemi, M. H., Satar, A. and Rafeii, A., 2012. A contribution to the short-horned grasshoppers (Orthoptera: Acrididae) from Arasbaran and vicinity, NW Iran. *Munis Entomology and Zoology* 7(2): 970-977.
- Mirzayans, H., 1951. Les Orthopteres de l'Iran. *Entomologie et Phytopathologie Appliquees* 12-13: 28-33.
- Mirzayans, H., 1959. Liste des Orthopteres et leurs distribution en Iran. *Entomologie et Phytopathologie appliquees* 18: 10-28.
- Mirzayans, H., 1990. A harmful bush-cricket from Gorgan area *Decorana capitata* (Uv.) (Tettigoniidae: Dectinae). *Journal of Entomological Society of Iran* 10: 37-42.
- Mirzayans, H., 1991 Three new genera and four new species of Orthoptera from Iran. *Journal of Entomological Society of Iran, supplementary* 6: 1-26.
- Mirzayans, H., 1998. The list of Orthoptera in the collection of Plant Pest and Diseases Research Institute of Iran. *Insect Taxonomy Research Department Publication* 3.
- Neyestanak, M. M., 2000 a. A faunal investigation on the long-horned grasshoppers (Orthoptera-Tettigoniidae) of Gazvin to Damavand district - Abstract book I – XXI- International Congress of Entomology; 20-26 Aug 2000, Brazil.
- Neyestanak, M. M., 2000 b. Introduction of six new ensiferous Orthoptera for the fauna of Iran. 14th Iranian Plant Protection Congress, September: 338.
- Neyestanak, M. M., 2000 c. A preliminary survey on the Orthopteroidea of the Iranian island of Persian Gulf. 14th Iranian Plant Protection Congress, September: 339.
- Peveling, R., Attignon, S., Langewald, J., Ouambama, Z., 1999. An assessment of the impact of biological and chemical grasshopper control agents on ground-dwelling arthropods in Niger, based on presence/absence sampling. *Crop Protection* 18: 323–339.
- Taleban Fard, A. A. and Shariati, M. H., Another view to the outbreaks of the saxaul locust, a problem or natural reaction. [Cited 5 Apr 2015.] Available from URL: <http://www.nr-khr.ir/Portals/0/tagh.pdf>.
- Whipple, S. D., Brust, M. L., Hoback, W. W., Farnsworth-Hoback, K. M., 2010. Sweep sampling capture rates for rangeland grasshoppers (Orthoptera: Acrididae) vary during morning hours. *Journal of Orthoptera Research* 19(1):75-80
- Purivirojkul, W., & Areechon, N. 2008. A survey of parasitic copepods in marine fishes from the Gulf of Thailand, Chon Buri province. *The Kasetsart Journal, Natural Science* 42, 40-48.
- Rangnekar, M.P. 1955. *Pseudocaligus laminiatus* sp. nov. and *Diphylllogaster aliuncus* sp. nov. (Copepoda) parasitic on Bombay fishes. *Journal of the University of Bombay* 23, 44-52.