

Original article <https://doi.org/10.12980/jclm.4.2016J6-182>

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Study on biting bugs encountered in the aquatic environments in Kashan, Isfahan Province, Iran

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ARTICLE INFO

Article history:

Received 7 Sep 2016

Received in revised form 23 Sep 2016

Accepted 8 Oct 2016

Available online 10 Oct 2016

Keywords:

Biting bug

Corixidae

Hemiptera

Notonectidae

Nepidae

ABSTRACT

Objective: To determine biting bugs of Hemiptera families presenting in the county of Kashan.**Methods:** For this descriptive study, samples were collected from 17 locations of lentic and lotic waters, 3 times for each. These specimens were identified by using a stereo microscope and morphological keys.**Results:** Out of 5535 specimens collected in three times of samplings, 3024 specimens (54.6%) belonged to order Diptera, 701 specimens (12.7%) belonged to Crustaceans, 691 specimens (12.5%) belonged to Trichoptera, 468 specimens (8.4%) belonged to Hemiptera, 303 specimens (5.5%) belonged to Ephemeroptera, 133 specimens (2.4%) belonged to Odonata, 104 specimens (1.9%) belonged to Coleoptera, 98 specimens (1.8%) belonged to Hydroacarina and 13 specimens (0.2%) belonged to Plecoptera. In this study, Families Corixidae, Notonectidae, Gerridae and Nepidae from Hemiptera order were identified 45.9%, 26.9%, 25.0% and 2.2%, respectively.**Conclusions:** These results lead to the conclusion that Hemiptera fauna is relatively rich in Kashan. More studies by entomologists and biologists are recommended to determine the benefits and damages of these insects on the environment.

1. Introduction

Arthropods are vital elements in most food and energy chains. While this group shows the highest variety among the invertebrates, little attention has been paid to its record and monitoring[1]. The monitoring of insects can provide a signal of environmental changes[2]. This can be valuable for the management of natural areas. Between aquatic insects, Coleoptera and Heteroptera represent a useful tool for evaluating biodiversity due to the great number of species they include[3]. Aquatic and semi aquatic Hemiptera fauna

is more varied in the tropics and subtropics. Only 631 species of all five infra-orders are known from the Palaearctic region, and 211 species from Europe and 166 from Russia[4,5]. Accidents caused by these creatures have been reported, affecting chiefly people who have contact with water streams. Water bugs have a long proboscis that causes severe pain and in some cases reversible limb paralysis after entering the body. Entering the proboscis to the animal's body might be infectious due to *Mycobacterium ulcerans*[6-8]. Hemiptera, usually identified as bugs, is recognized by the existence of a piercing and sucking beak like structure formed by the change of the mouth parts, leathery anterior pair of wings at the base and membrane at apical district and entirely membranous second pair. Some of the families of the bugs might be utilized in the biological control of mosquito larvae[9,10]. Several aquatic predatory hemipterans can cause painful bites if they are accidentally contacted or handled. These include the families of Belostomatidae (giant water bugs), Corixidae (water boatmen), Naucoridae (creeping water bugs) and Notonectidae (backswimmers). These families have distributed worldwide. Generally, their bites have

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Foundation Project: Supported by Social Determinants of Health Research Center and Department of Environmental Health of Kashan University of Medical Sciences (Grant No. 80024).

The journal implements double-blind peer review practiced by specially invited international editorial board members.

no problem side, burning or numbness, but bite of species of Belostomatidae family may take several hours[6]. Therefore, the best way to prevent water bug bites depends on the situation and people's awareness[11,12].

Aquatic insects belonging to order Hemiptera are not only used as fish food, bioindicators, predators and biological control agents, but also they are valuable for many organisms including fish, amphibians, waterfowl and other animals[2,13]. Nutrition of aquatics such as fish depends on aquatic arthropods strongly. This is more important in case of salmon, which the food and growing method can affect its taste easily[14,15]. Some of them have been evaluated in toxicological studies[16]. Biological diversity of these arthropods in clean water is absolutely important in studies about them. Any changes in their population and diversity can be known as a sign of unsuitable condition[15,17]. Freshwater have lotic (current) and lentic (stagnant) water ecosystems. Depths of lotic waters may vary from several centimeters to a large river. Rivers are ecosystems of lotic water. Lentic water is taken from the Latin word, which means the water is slow-moving or immobile. Lentic waters include ponds, lakes or wetlands. Water bug bites could be on both lentic and lotic ecosystems. When a bite takes place, the bite is painful with redness, swelling and itching. After the first bite, the victims may be more sensitive to the next bite. Each bite can cause serious allergic reactions. People are very sensitive to aquatic bug bites that cause itchy scalp, palms and soles, blister or rash, nausea, vomiting and breathing difficulties and anaphylactic reactions[14].

Kashan is located in the center of Iran. Its climate provides temporary and permanent water bodies, especially in the southern areas. The temporary and permanent water habitats are suitable for aquatic arthropods. Because some or all life stages of aquatic arthropods are completed in such environment. The water can be an important factor in reproducing them[14,18,19].

This study aimed to investigate the biting bugs of aquatic environment during the spring and summer months in 2005–2010. The purpose of this project was to conduct a study for identifying the incidence and geographic location of biting bugs in aquatic environment in Kashan, and to assess the magnitude and distribution of the problem in order to optimize prevention and treatment.

2. Materials and methods

A descriptive study was conducted with a total sample size of 5535 larvae, nymphs, pupa and adults in 17 locations at 3 various times. In this study, the collection items included hand lens, small screens, wire netting, forceps, brush, dropper and glass vials. The samples based on the type of habitats, ecosystems and biological phase were collected by a variety of techniques. Specimens of Crustaceans, Ephemeroptera and Odonata, larvae and pupae of *Aedes* and *Culex* were sampled from several points of the streams by wire netting and tiny sieve.

Horse fly larvae were collected with forceps using wire netting from the aquatic plants and algae. Plecoptera larvae and Ephemeroptera nymph were collected from the water by pulling out the rocks. *Simulium* larvae were collected by pulling out the aquatic plants, stones and pieces of suspended wood in water. Aquatic insects such as bugs that moved fast and usually lived in the lentic waters were sampled using wire netting. After transporting to the entomology laboratory, samples were identified by using a stereomicroscope and morphological keys[20-23]. Regional specific resources for taxa of Iran[24], were used to identify at the family level in conjunction with other keys.

3. Results

From total of 5535 samples collected during 3 times, the order of Diptera with 3024 specimens (54.6%), Crustaceans with 701 (12.7%), order Trichoptera with 691 (12.5%), order Hemiptera with 468 (8.4%), order Ephemeroptera with 303 (5.5%), order Odonata with 133 (2.4%), order Coleoptera with 104 (1.9%), order Hydrocarina with 98 (1.8%) and order Plecoptera with 13 (0.2%), were identified (Table 1). The most and least hemipterans were found in ponds A, B, C and D with 332 specimens (71.0%) and Khomb with 3 specimens (0.7%), respectively (Table 2). Specimens of flies and Crustaceans were collected from lentic and lotic waters. Specimens of Trichoptera, Odonata, Ephemeroptera and all of the Hemiptera families were collected from the lentic waters.

Table 1

Dispersal of aquatic arthropods of Kashan based on order.

Order	1st Time	2nd Time	3rd Time	Total	Percent (%)
Diptera	534	1212	1278	3024	54.6
Crustacea	122	-	579	701	12.7
Trichoptera	-	533	158	691	12.5
Hemiptera	252	190	26	468	8.4
Ephemeroptera	-	150	153	303	5.5
Odonata	5	67	61	133	2.4
Coleoptera	8	70	26	104	1.9
Hydrocarina	98	-	-	98	1.8
Plecoptera	-	-	13	13	0.2
Total	1019	2222	2294	5535	100.0

Table 2

Dispersal of Heteroptera in lentic and lotic waters based on place.

Place	1st Time	2nd Time	3rd Time	Total	Percent (%)
Pond A, B, C, D	80	252	-	332	71.0
Ghohrood	44	-	8	52	11.1
Joshaghan	26	-	-	26	5.5
Margh	17	-	3	20	4.2
Khoncheh	13	-	-	13	2.8
Shoorab	-	-	12	12	2.6
Ghamsar	10	-	-	10	2.1
Khomb	-	-	3	3	0.7
Total	190	252	26	468	100.0

In order Heteroptera, families Corixidae (45.9%), Notonectidae (26.9%), Gerridae (25.0%), Nepidae (2.2%) were identified and reported (Table 3). In this study, only Notonectidae bug or

backswimmer bug bit the author. Notonectidae and Nepidae bugs are shown in Figures 1 and 2. The Notonectid bug is a predatory bug with a dent-like crest on its thorax. They feed on insects and can bite human by accidental impact. The bug stick on the human skin with its beak then injecting a salivary fluid to its victim. The fluid causes an immediate intense pain which lasted 3–6 hours. Bedbug bites are reported in the sporadic form in Kashan county.

Table 3

Dispersal of Heteroptera in lentic and lotic waters of Kashan according to family.

Hetroptera Family	Genus	1	2	3	Total	Percent (%)
Corixidae	<i>Hesperocorixa</i>	60	145	10	215	45.9
Notonectidae	<i>Notonecta</i>	88	25	13	126	26.9
Gerridae	<i>Gerris</i>	32	82	3	117	25.0
Nepidae	<i>Nepa</i>	10	-	-	10	2.2
Total	-	190	252	26	468	100.0



Figure 1. Backswimmer bug or Notonectidae were observed in pool habitats of Kashan, Iran.



Figure 2. Water strider bugs, Gerridae, observed in Kashan, Iran.

The most effective way to prevent notonectids and other bug bites is to avoid contacting with them. In addition, bites of these bugs are generally painful, and they attack and destroy many harmful insects found in aquatic breeding places such as *Culex*, *Aedes* and *Anopheles* larvae living around homes and gardens. This is resulted in controlling and balancing biological environment. In this study,

all specimens of bugs were collected from freshwater. Water pH was measured from 6.9 to 7.2. The maximum flow rate, 100 L/s, and the minimum, 5 L/s, were measured. Water temperatures during the study ranged from 15 to 25 °C.

4. Discussion

This study shows that seven and three orders of aquatic insects and Crustacea exist in water bodies of Kashan, respectively. These results indicate that Kashan can provide a suitable environment for arthropods fauna. In addition, the frequency of orders and families is higher than other areas. About 8.4% of samples belonged to the family Corixidae, which usually lives in the pool basins and plotted waters[14]. Furthermore, Notonectidae family were found in mountain areas and clean fresh waters. These findings are consistent with that by Dehghani *et al*[19].

Most true bugs are not truly benthic and are rarely collected in springs and streams. They are all air breathers, so they have to return to the surface regularly to breathe. Some, like water striders (Gerridae), live on top of the water and never break the surface. Others, like backswimmers (Notonectidae) and water boatmen (Corixidae) rest just below the surface while they breathe and then dive to capture preys or escape threats[25]. A few bugs, including creeping water bugs (Naucoridae), giant water bugs (Belostomatidae) and water scorpions (Nepidae) spend a significant amount of time hanging on to substrates under water waiting for preys. Such bugs are generally considered benthic[12].

Several studies are conducted in colder areas, which have more water bodies than Kashan. It can be stated that low mean temperature can increase the diversity of orders and families of aquatic arthropods. Also, Kashan can be divided into two mountainous and desert areas, which have their own specific arthropods. Due to the significance of order Heteroptera in case of medical research and its role in biological control of pests, it has been considered more. Other studies have approved these results[6-8]. As the results show, families Corixidae, Notonectidae, Gerridae and Nepidae families are observed in Kashan. These families are the most important members of the aquatic food chain, and provide natural balance in the environment. Families of Heteroptera are generally considered to be beneficial because they attack and destroy many harmful insects found in aquatic breeding places such as *Culex*, *Aedes* and *Anopheles* larva around homes and gardens[8].

During the late spring and the midsummer period, the maximum of quantitative bugs were collected. Families Corixidae, Notonectidae, Gerridae and Nepidae from Hemiptera order were identified 45.9%, 26.9%, 25.0% and 2.2%, respectively. These results lead to the conclusion that Hemiptera fauna is relatively rich in Kashan. More studies by entomologists and biologists are recommended to determine the benefits and damages of these insects on the environment. In this case, the development of insectariums in order

to rear aquatic insects for exact identification of adults could be an essential step for understand aquatic fauna in the country.

Conflict of interest statement

We declare that we have no conflict of interest.

Acknowledgments

This project is supported by Social Determinants of Health Research Center and Department of Environmental Health of Kashan University of Medical Sciences (Grant No. 80024). This work would not have been possible without the help of many individuals that contributed in one way or another. The authors thank Deputy of Research and Department of Environmental Health of Kashan University of Medical Sciences, especially Mr. Varasteh, and those who supported the authors in this study.

References

- [1] Saunders DJ, Meeuwig JJ, Vincent ACJ. Freshwater protected areas: strategies for conservation. *Conserv Biol* 2002; **16**(1): 30-41.
- [2] Lock K, Adriaens T, van de Meutter F, Goethals P. Effect of water quality on waterbugs (Hemiptera: Gerromorpha & Nepomorpha) in Flanders (Belgium): results from a large-scale field survey. *Ann Limnol Int J Lim* 2013; **49**: 121-8.
- [3] Fernández LA, López Ruf ML. Aquatic Coleoptera and Heteroptera inhabiting waterbodies from Berisso, Buenos Aires Province, Argentina. *Rev Biol Trop* 2006; **54**(1): 139-48.
- [4] Kanyukova EV. [*Aquatic and semiaquatic bugs (Heteroptera, Nepomorpha, Gerromorpha) of the fauna of Russia and adjacent countries*]. Vladivostok: Dal'nauka; 2006. [Russian].
- [5] Saulich AH, Musolin DL. [*Seasonal development of aquatic and semiaquatic true bugs (Heteroptera)*]. Saint Petersburg: St. Petersburg University Press; 2007. [Russian].
- [6] Haddad Jr V, Schwartz EF, Schwartz CA, Carvalho LN. Bites caused by giant water bugs belonging to Belostomatidae family (Hemiptera, Heteroptera) in humans: a report of seven cases. *Wilderness Environ Med* 2010; **21**(2): 130-3.
- [7] Haddad V Jr. Environmental dermatology: skin manifestations of injuries caused by invertebrate aquatic animals. *An Bras Dermatol* 2013; **88**(4): 496-506.
- [8] Merritt RW, Walker ED, Small PL, Wallace JR, Johnson PD, Benbow ME, et al. Ecology and transmission of Buruli ulcer disease: a systematic review. *PLoS Negl Trop Dis* 2010; **4**(12): e911.
- [9] Saha N, Aditya G, Bal A, Saha GK. A comparative study of predation of three aquatic heteropteran bugs on *Culex quinquefasciatus* larvae. *Limnology* 2007; **8**(1): 73-80.
- [10] Bazzanti M, Bella VD, Grezzi F. Functional characteristics of macroinvertebrate communities in Mediterranean ponds (Central Italy): influence of water permanence and mesohabitat type. *Ann Limnol Int J Lim* 2009; **45**: 29-39.
- [11] Merritt RW, Cummins KW. *An introduction to the aquatic insects of North America*. 3rd ed. Dubuque: Kendall Hunt Pub Co; 1995.
- [12] Cranshaw W, Thomas C, Kondratieff B, Walker G. Life in a Colorado water garden: the insects and other invertebrates associated with water features. Fort Collins: Colorado State University; 2010. [Online] Available from: <http://bspm.agsci.colostate.edu/files/2013/03/Water-Garden-Insect-Publication.pdf> [Accessed on 25th July, 2016]
- [13] Clark F. A study of a population of *Microneecta scutellaris* Stal (Hemiptera: Corixidae) in Lake Naivasha, Kenya. *Hydrobiologia* 1992; **248**(2): 115-24.
- [14] Dehghani R. *An introduction to aquatic arthropods*. 1st ed. Tehran: Farmanesh Publications; 2012.
- [15] Dehghani R, Zarghi I, Aboutalebi M, Barzegari Z, Ghanbari M. Fauna and habitat of aquatic arthropods of Kashan in 2010. *Bangladesh J Med Sci* 2014; **13**(3): 306-10.
- [16] Külkölyüoğlu O. On the usage of ostracods (Crustacea) as bioindicator species in different aquatic habitats in the Bolu region, Turkey. *Ecol Indic* 2004; **4**(2): 139-47.
- [17] Dudgeon D. Riverine wetlands and biodiversity conservation in tropical Asia. In: Gopal B, Junk WJ, Davis JA. editors. *Biodiversity in wetlands: assessment, function and conservation*. Leinden: Backhuys; 2000. p. 35-60.
- [18] Dehghani R, Miranzadeh MB, Yosefzadeh M, Zamani S. Fauna aquatic insects in sewage maturation ponds of Kashan University of Medical Science 2005. *Pak J Biol Sci* 2007; **10**(6): 928-31.
- [19] Dehghani R, Almasi H, Asadi MA. Fauna of aquatic insects in Kashan. *Feyz J Kashan Univ Med Sci* 2005; **8**(4): 24-9.
- [20] Freitag H. Aquatic insect emergence collections of rivers in the St. Paul National Park, Palawan, Philippines and methodological implications for ecological and biodiversity studies. *J Aquatic Sci* 2005; **2**(2): 66-78.
- [21] Bouchard RW Jr. *Guide to aquatic invertebrates of the upper midwest*. Ferrington LC Jr, Karius ML, editors. St. Paul: University of Minnesota; 2004.
- [22] Bouchard RW Jr. *Guide to aquatic macroinvertebrates of the upper midwest*. St. Paul: University of Minnesota; 2004. p. 208.
- [23] Sundermann A, Lohse S, Beck LA, Haase P. Key to the larval stages of aquatic true flies (Diptera), based on the operational taxa list for running waters in Germany. *Ann Limnol Int J Lim* 2007; **43**: 61-74.
- [24] Merritt RW, Cummins KW. *An introduction to the aquatic insects of North America*. Dubuque, Iowa: Kendall/Hunt Publishing Company; 1996.
- [25] Adams J. *A bug's life in the Columbia slough: handbook of aquatic invertebrates and macroinvertebrate monitoring in the Columbia slough Watershed*. Portland: The Columbia Slough Watershed Council; 2005, [Online] Available from: https://nrmp.dfw.state.or.us/web%20stores/data%20libraries/files/Watershed%20Councils/Watershed%20Councils_656_2_ColSlough_MacroInvert_Handbook2006.pdf [Accessed on 25th July, 2016]