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

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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 5,535 specimens collected in three times of samplings, 3,024 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 Hemipetera, 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.

Keywords:
Biting bug
Corixidae
Hemiptera
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Nepidae

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
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 such as fish depends on aquatic arthropods strongly. This is more important in case of salmon, which the food and growing method such as fish depends on aquatic arthropods strongly. This is more important.

In this study, the collection items included hand lens, small screens, wire netting, forceps, brush, dropper and glass vials. The samples were collected by a variety of techniques. Specimens of Crustaceans, Ephemeroptera and Odonata, larvae and pupae of Aedes and Culex were collected 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 5,535 samples collected during 3 times, the order of Diptera with 3,024 specimens (54.6%), Crustaceans with 701 (12.7%), order Trichoptera with 691 (12.5%), order Hemiptera with 468 (8.4%), order Odonata with 303 (5.5%), order Coleoptera with 133 (2.4%), order Coleoptera with 104 (1.9%), order Hydroacarina 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.

| Order       | 1st Time | 2nd Time | 3rd Time | Total | Percent (%) |
|-------------|----------|----------|----------|-------|-------------|
| Diptera     | 534      | 1,212    | 1,278    | 3,024 | 54.6        |
| Crustacea   | 122      | -        | 579      | 701   | 12.7        |
| Trichoptera | -        | 533      | 158      | 691   | 12.5        |
| Hemiptera   | 252      | 190      | 26       | 468   | 8.4         |
| Ephemeroptera| -      | 150      | 153      | 304   | 5.5         |
| Odonata     | 5        | 67       | 61       | 133   | 2.4         |
| Coleoptera  | 8        | 70       | 26       | 104   | 1.9         |
| Hydroacarina| 98       | -        | -        | 98    | 1.8         |
| Plecoptera  | -        | -        | 13       | 13    | 0.2         |
| Total       | 1,019    | 2,222    | 2,294    | 5,535 | 100.0       |

Table 1 Dispersion of aquatic arthropods of Kashan based on order.

| 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       | 26    | 2.8         |
| Shoorab    | -        | 12       | -        | 12    | 2.6         |
| Ghamsar    | 10       | -        | -        | 10    | 2.1         |
| Khomb      | -        | -        | 3        | 3     | 0.7         |
| Total      | 190      | 252      | 26       | 468   | 100.0       |

Table 2 Dispersion of Heteroptera in lentic and lotic waters based on place.

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 bitted 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.

| Heteroptera Family | Genus  | 1 | 2 | 3 | Total | Percent (%) |
|--------------------|--------|---|---|---|-------|-------------|
| Corixidae          | Hesperocorixa | 60 | 145 | 10 | 215   | 45.9        |
| Notonectidae       | Notonecta  | 88 | 25  | 13 | 126   | 26.9        |
| Gerridae           | Gerris    | 32 | 82  | 3  | 117   | 25.0        |
| Nepidae            | Nepa      | 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 larva 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 larvae 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.

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