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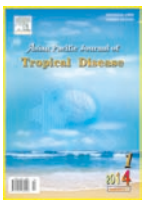

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Prevalence of aquatic entomofauna, the predators of mosquitoes, in the Zayandeh River of Central Iran

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PEER REVIEW

Peer reviewer

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Comments

This is a good study in which the authors evaluated the distribution of aquatic insects. The results are interesting and suggested that due to insecticide resistance in the vector, the replacement of biological control was by predatory insects. It is appropriate for publication.
Details on Page S243

ABSTRACT

Objective: To determine the fauna of aquatic insects in Zayandeh River of Isfahan carried out in Tehran University of Medical Sciences in 2011.
Methods: This study was performed in Isfahan, central of Iran in Zayandeh River. This was a descriptive study. Having fulfilled sampling for several times, we collected nearly 76 samples from different parts of river. Then they were sealed in an individual jars containing some water obtained from their habitat. Next, the insects were put in jars containing 70% ethylic alcohol.
Results: A total of 76 matured samples of aquatic insects from the Zayandeh River were obtained. Among them, the order of Hemiptera which were the most prevalent order including two families: gerridae (n=27, 35.52%), and notonectidae (n=11, 14.47%). Other order were found belonging to Odonata from the family of coenagrionidae (n=12, 15.78%), coleoptera from the family of Carabidae (n=15, 19.73%) and prostigmata from the family of Hydrachindae (n=11, 14.47%). This was the first faunestic study carried out in Zayandeh River of Isfahan of Iran.
Conclusions: The results are appropriate for future researches to detect more ecological aspects of aquatic arthropods and their role for biological control of vectors which transmit disease to human and animals.

KEYWORDS

Aquatic insects, Biological control, Iran

1. Introduction

Aquatic insects are a group of arthropods who live a half of their life cycle in the water. Some of them live near water or their life to some extent depends on water. These insects are called semi aquatic insects. They are important regarding either transmitting pathogens in some stages of their life, or concerning water contamination indexes. Adult insects lay their eggs at different modes near or into water. Some of them lay their eggs singly, while others throw eggs from air into the water. Some aquatic insects are able to transmit various pathogens to both

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human and animals. Some diseases transmitted by these arthropods[1]. Blackfly and horsefly are able to transmit severe diseases to human via biological or mechanical route. Some insects at the adult stage suck blood from human and therefore arouse some acute or chronic dermatological allergy and dermatitis. Aquatic insects are found in various water environments. They are prevalent in large water environment, the sea-shore and rivers. Almost all water ecosystems can be considered as an appropriate environment for some special species of aquatic insects. The most important places for them are large and small rivers, streams, beaches, shallow holes with stagnant water, pools and floodgates, lakes, mineral water and drinking water pools. Having various ecosystems, small and large flowing waters and also the presence of lakes, dams, natural and artificial rivers, Iran is suitable habitats for the growth of these arthropods which are considered as the national fauna for its environment.

Isfahan is located in the lush plain of the Zayandeh River, at the foothills of the Zagros mountain range. No geological obstacles exist within 90 km north of Isfahan, allowing cool northern winds to blow from this direction. Situated at 1 590 meters above sea level on the eastern side of the Zagros Mountains, Isfahan has an arid climate. Despite its altitude, Isfahan remains very hot during the summer with maxima typically around 36 °C. However, with low humidity and moderate temperatures at night, the climate can be very pleasant. During the winter, days are mild but nights can be very cold and snow has occurred at least once every winter. However, on the whole Isfahan's climate is extremely cold in winter. Therefore, Isfahan is suitable for sampling and study on fauna of aquatic insects through seasonal activity.

In Iran, only one order of aquatic insect is well studied. Although there is a list of orders and families of aquatic insect from small rivers and streams in Isfahan, it doesn't include fauna of Zayandeh River. Zayandeh River is appropriate for the growth of aquatic insects in some cases. Shade environment is needed for the reproduction and growth of insects living in the area. This is provided by the growth of floated grass on the surface of the water or the stones of the river bottom[2]. Our hypothesis was that Zayandeh River may have a variety of aquatic insects, which could play an important role in maintaining the organism or transmitting it to human. Considering the significance of aquatic insects regarding transmitting pathogens and also their role in changing organic materials in life cycle, the current study was conducted to determine the fauna of aquatic insects in Zayandeh River of Isfahan carried out in Tehran University of Medical Sciences in 2011.

2. Materials and methods

This study was performed in Isfahan, central of Iran in 2011. The study was performed on the Zayandeh River which received flow rate of 400 m^3/day. The collection equipments were composed of D frame net-collector and plastic pipette. This was a descriptive study. Having fulfilled several times sampling, we collected nearly 76 samples from different parts of river. After collection, they were sealed in an individual jars containing some water obtained from their habitats. Subsequently, the insects were placed in jars containing 70% ethylic alcohol. The date and location of sampling were reported on the label. The samples were transferred to the laboratory of department of medical entomology of Tehran University of Medical Sciences for species identification. The samples were studied using stereo-typed microscope and the numbers were determined. The results were recorded on a data sheet based on the order and family. After drawing the figures and designing the tables, the results were analyzed. The main documents were used for identifications.

3. Results

During several times' sampling, total 76 matured samples of aquatic insects from the Zayandeh River were obtained. Among them, the order of Hemiptera which was the most prevalent order included two families: Gerridae, n=27, 35.52%, and Notonectidae, n=11, 14.47%. Other order were found belonging to Odonata from the Family of Coenagrionidae (n=12, 15.78%), Coleoptera from the Family of Carabidae (n=15, 19.73%) and Prostigmata from the Family of Hydrachindae (n=11, 14.47%) (Table 1). Collected samples' identification was carried out by the characteristics of Borror [6] morphological key by using stereo-typed microscope. The most important features used in identification belonged to external genitalia organs, also other organs traits were wing, leg, antenna and mouth parts (Figure 1).

Table 1
The distribution prevalence rate of some aquatic insects dwelling in Zayandeh River of Isfahan.

Order	Family	No	Percent (%)
Hemiptera	Gerridae	27	35.52
Hemiptera	Notonectidae	11	14.47
Odonata	Coenagrionidae	12	15.78
Prostigmata	Hydrachindae	11	14.47
Coleoptera	Carabidae	15	19.73

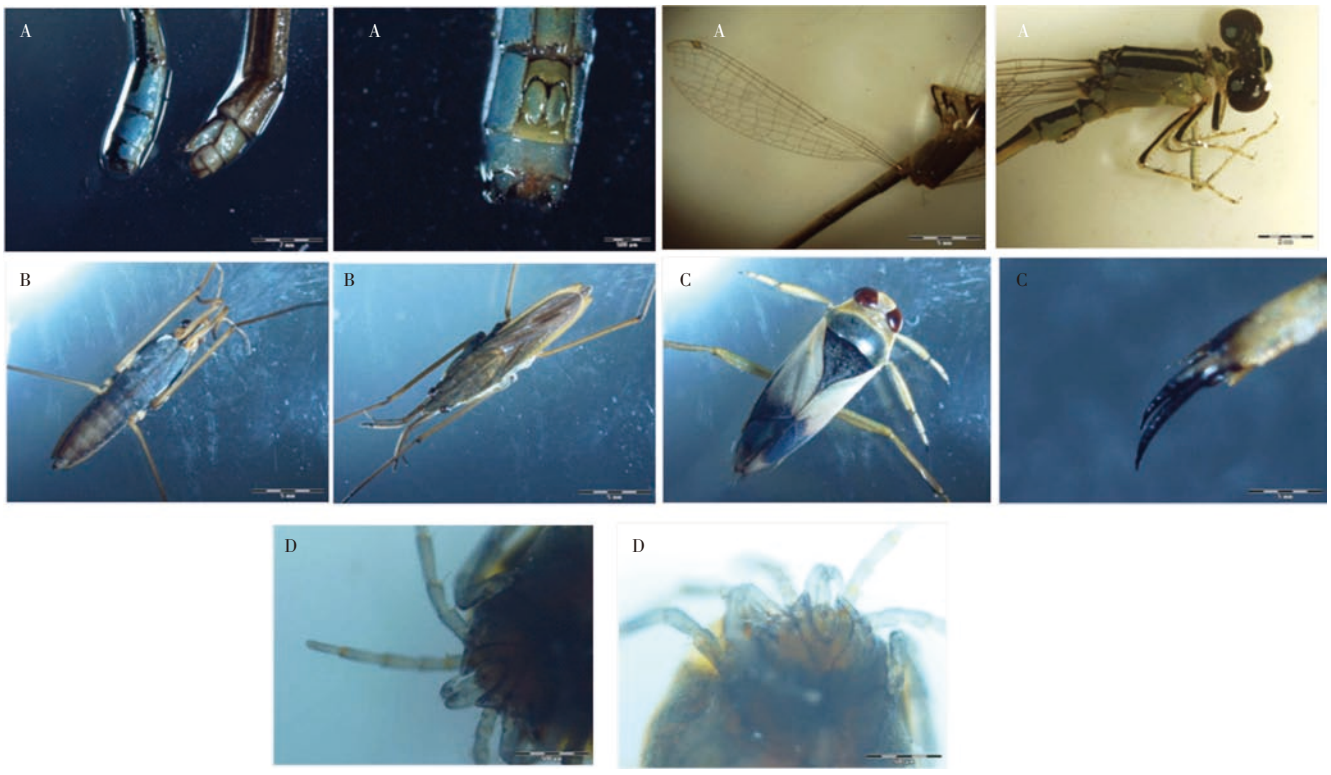

Figure 1. Some of the most important and common order of aquatic insects in the study area.
A- Odonata (Family of Coenagrionidae, female , male and external genitalia and wing structure)
B&C- Hemiptera (Family of Gerridae & Family of Notonectidae)
D- Prostigmata (Family of Hydranchindae)

4. Discussion

Given that Zayandeh River is in hot climate regions with suitable ecological factors such as shade, moderate temperature and the variety of plant species where there are different species of aquatic insects, this river is one of the appropriate places for the growth of aquatic insects and sample collection. In the current study, the most prevalent collected sample was adult Hemiptera of the family Gerridae (35.52%). One main characteristic that sets gerrids and other true bugs apart from other insects is that the front wing is only half functional. Rather than using it for flight, it acts as a membranous covering and the thickened part is by where claws develop. Consistent with the classification of Gerridae as true bugs, gerrids have a mouthpart evolved for piercing and sucking. Gerrids distinguish themselves by having the unique ability to walk on water. Several endoparasites have been found in gerrids. Trypanosomatid flagellates, nematodes, and parasitic Hymenoptera all act as endoparasites. Water mite larvae act as ectoparasites of water striders. In the present study, the Notonectidae family was recognized. Notonectidae is a cosmopolitan family of aquatic insects in the order Hemiptera, commonly called backswimmers because they swim upside down. They are all predators, up to nearly 2 cm in size. The family Notonectidae can sting human in the case of sting, and it can cause severe pain which sustains for several hours. According to the results obtained, the samples belonging to the order Odanata were recognized. The insect family Coenagrionidae is found in the order Odonata and the suborder Zygoptera. The Zygoptera are the damselflies, which although less known than the dragonflies, are no less common. There are more than 1 100 species in this family, making it the largest damselfly family. Coenagrionidae has six subfamilies and they are Agriocnemidinae, Argiinae, Coenagrioninae, Ischnurinae, Leptobasinae, and Pseudagrioninae. This family is referred to as the narrow-winged damselflies or the pond damselflies. The Coenagrionidae enjoy a worldwide distribution, and are among the most common of damselfly families. This family has the smallest of damselfly species. More than 90 genera of the family Coenagrionidae are currently accepted[3].

Hydrachindae is a large family of water mites in the order of Prostigmata that includes all the common free-living mites of fresh water and a few parasites of the gills of mollusks and that is now usually broken up into numerous separate families. The phenomenon of Hydrachnidae associated with the tick-borne encephalitic viruses complex has been found out during the study of the role of the Hydrachnidae in the arboviruses circulation.

As predators of invertebrates, including many pests, most ground beetles are considered as beneficial organisms. A few species are nuisance pests. Large species, usually Carabinae, can become a nuisance if present in numbers, particularly during outdoor activities such as camping[4,5].

Aquatic beetles have their greatest abundance and diversity in temperate regions. These insects are not selective in their choice of water bodies and occur in a wide variety of habitats, though many species may prefer certain types of water bodies. The aquatic beetle fauna of Iran is partly known. Hosseinie studied the aquatic beetle fauna of Fars, Guilan, Mazandaran and Khuzestan Provinces. Ostovan *et al.* studied the diversity, abundance, and biology of aquatic insects, including aquatic beetles, in Ardabil and Fars Provinces[6]. Atamehr reported 51 species belonging to 40 genera and 14 families from Tabriz Province[7,8].

Given the hot climate of Isfahan and also the enriched ecosystem of Zayandeh River regarding aquatic arthropods, we selected this river as the efficient ecosystem, which is suitable for faunestic study of aquatic insects. According to the findings of this study, it was concluded that there is lots of species biodiversity in the study area. This study was the first investigation in Isfahan and further researches are needed to understand the ecological and behavioral aspects of various species.

5. Conclusion

There are several Anopheline mosquitoes in the country including *Anopheles culicifacies s.l.* , *Anopheles stephensi, Anopheles dthali, Anopheles fluviatilis s.l., Anopheles superpictus*, and *Anopheles pulcherrimus* are known to be the malaria vectors, while *Anopheles sahacrovi* and *Anopheles maculipennis s.l.* are considered as malaria vectors in northern part of the country. There are several works on different aspects of malaria including insecticide resistance monitoring[9-20], sibling species, molecular study, new record[21-28], novel methods for vector control[29,30], faunestic study[31,32], use of plants for larval control[33-36], using bednets and long lasting impregnated nets[37-39], morphological studies[40], malaria epidemiology[41], ecology of malaria vectors[42], biodiversity[43], community participation[44], vector control[45], repellent evaluation[46], anthropophic index of malaria vectors[47], training[48], aquatic insects[49]. *Culex* and *Aedes* species also are existing in different parts of the country. They are nuisance and living in different water bodies. Some aquatic insects play an important role for biological control of larvae and adults of mosquitoes in the breeding places. Understanding the ecology and role of aquatic insects will help the authorities to build new method of vector control.

Conflict of interest statement

We declare that we have no conflict of interest.

Acknowledgements

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Comments

Background

Aquatic insects are a group of arthropods which some parts of their life cycle occur in the water. Some of them live near water or their life to some extent depends on water. This paper describes the aquatic insects of the study area in the country and their distribution.

Research frontiers

Studies are being performed in order to determine the importance of aquatic insect for probable rearing and use as novel method of vector-borne disease control.

Related reports

The paper reported different methods of vector control in the country and their replacement with biological control as integrate vector management.

Innovations & breakthroughs

The first report of the fauna of aquatic insect in the study area and their use for biological control.

Applications

It may be significant to know the distribution of aquatic insects, their identification and classifications and habits. They could be applicable for novel method of vector control.

Peer review

This is a good study in which the authors evaluated the

distribution of aquatic insects. The results are interesting and suggested that due to insecticide resistance in the vector, the replacement of biological control was by predatory insects. It is appropriate for publication.

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