The Species Diversity of Aquatic Insects in Karaj River, Central Iran

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Abstract

Aquatic insects spend some portion of their life cycle in the water. They feed in the same ways as other insects. This study was carried out emphasizing on the fauna of aquatic insects in Karaj River, central Iran. The aquatic insects were collected using several methods such as using D-frame nets, dipping and direct search on river floor stones. Specimens were collected and preserved in Ethanol and identified by standard identification keys. Totally, 436 samples were collected belonging to 3 orders (Ephemeroptera, Diptera and Trichoptera). They include 5 families Leptophlebiidae, Ephemerellidae, Helicopsychae, Hydropsychidae and Chironomidae). The most predominant family was Hydropsychidae. Aquatic insects are useful for water quality monitoring as indicators to assess the water contaminations by different pollutants. In addition they could act as biological control of main important arthropod-borne disease vectors which live in water.

Introduction

Aquatic insects are important group of insects in the aquatic ecosystem and they occupy various aquatic environments [1]. They play an important role in the ecological dynamics and in monitoring the health of aquatic environments [2]. Some of these aquatic insects are beneficial to humans while some are dangerous [3]. Many insect orders such as: Diptera, Ephemeroptera, Plecoptera, Trichoptera, Neuroptera, Odonata and Hymenoptera spend most of their immature stages in water while the adults are terrestrial [4]. Ephemeroptera, Plecoptera and Trichoptera (EPT) richness are very useful for the detection of metal pollution in streams. On the other hand, EPT species are often used as biological indicator of water quality [5]. A range of factors (temperature, altitude, season, total suspended solids and vegetation) control the diversity of aquatic insects [6]. Vectors of some infectious diseases like Malaria, Dengue fever, West Nile fever and Filariasis are water-dependent [7]. Dragonfly and damselfly are the host of the trematode *Haematoloechus longiplexus*, they are predators, both in their aquatic larval stage, where they are known as nymphs or naiads and as adults [8].

According to a study in USA by Wallace et al. [9], entomologists used unique case-building behaviors of the *Limnephilidae caddisflies* found on a human corpse to reveal a post-mortem submersion interval range consistent with the disappearance of the victim. Thus aquatic insects can be used in medico-legal entomology for estimation of post-mortem submersion interval to solve crime problems. Some families of the order Odonata, Ephemeroptera, Hemiptera, Trichoptera, Coleoptera and Diptera have been reported from Iran [2,3]. Aquatic entomology is a neglected field of study in Iran and in order to establish a baseline data, studies of this nature are needed which will eventually lead to advancement in the field of aquatic entomology investigations. The aim of this study was to establish a baseline data of aquatic insects faunal in Karaj district of Alborz province, northern Iran.

Material and Methods

Study area

Figure 1: The situation of Karaj River and the study area in Iran map.

Karaj River (*Rud-e Karaj*), is the second major permanent river in the central Iranian plateau after the Zayandarud river. The river runs

245 km, with an average slope of 0.8 percent, average annual discharge of 499 mcm (million cubic meters), and precipitation of 625 mm; the basin area is 2,800 km^2. It flows from the central Alborz sierra through the city of Karaj and the irrigated plain of Shahriar, then with its tributary Jajrood River meeting in Tehran Province to empty into the Namak Lake basin in Qom Province. The Amir Kabir Dam was constructed across the river for water supply, electricity and irrigation in Tehran, Iran (Figure 1).

Sampling technique

The study was conducted in the spring of 2017; samples were collected from five different points using several methods including D-frame nets, dipping, direct search in the river floor stones, aquatic vegetation, over hanging terrestrial vegetation, within burrows, leaf packs and fine sediments. All of the specimens collected were preserved in 70% alcohol container well labeled with the dates of collection, location of study area, temperature and humidity then transferred to the laboratory of medical entomology department, Tehran University of Medical Sciences. Standard keys and stereo-typed microscope were used to identify the samples in the laboratory [10-12]. Table 1 shows the physical characteristics of breeding places.

Temperature (°C)	pH	BOD (mg/l)	Nitrate (mg/l)	Amonia (mg/l)	Total Coliform (n/100 ml)
20 ± 2	8.2	1.5	2.98	0.14	100850

Table 1: Physicochemical properties of Karaj River. Information includes mean temperature, scale of acidity (PH), biological oxygen demand (BOD), scale of Nitrate, Ammonia and Coliform Bacteria in sample sites.

Results

During the sampling in Karaj river, a total of 436 specimens were collected belonging to 3 orders (Ephemeroptera, Trichoptera, Diptera) 5 families (Leptophlebiidae, Ephemerellidae, Helicopsychidae, Hydropsychidae, Chironomidae) Table 2.

Order	Family	No.	Percentage %
Ephemeroptera	Leptophlebiidae	164	37.6
	Ephemerellidae	41	9.4
Trichoptera	Helicopsyche	38	8.7
	Hydropsychidae	185	42.4
Diptera	Chironomidae	8	1.8
Total	5	436	100

Table 2: Aquatic insects collected from the various sampling sites, Karaj River.

Simpson Index	0.3379
Dominance Index	0.6621
Reciprocal Simpson Index	2.959
Shannon Index	1.787

Shannon Index	1.239
Shannon Index	-0.538
Menhinick Index	0.1582
Buzas and Gibson's Index	0.6903
Equitability Index	0.7697

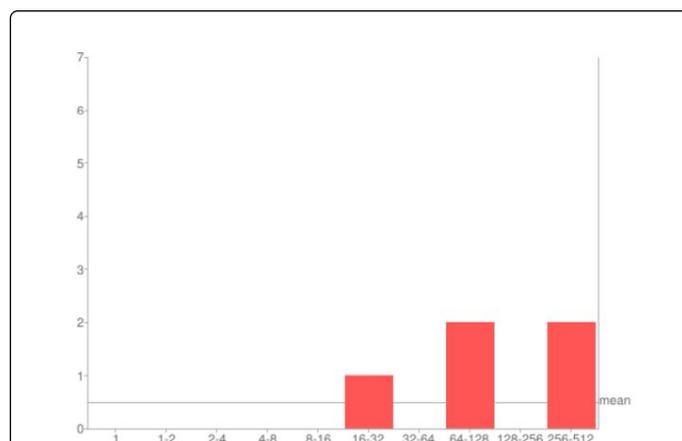**Table 3:** Simpson Index of different families of aquatic insects collected.
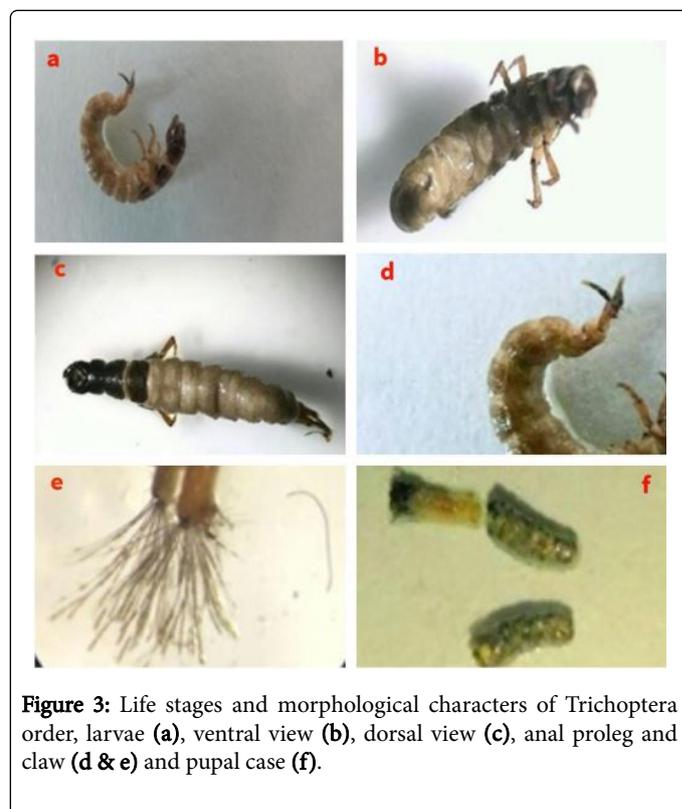

Figure 2: Simpson index of different families.

Figure 3: Life stages and morphological characters of Trichoptera order, larvae **(a)**, ventral view **(b)**, dorsal view **(c)**, anal proleg and claw **(d & e)** and pupal case **(f)**.
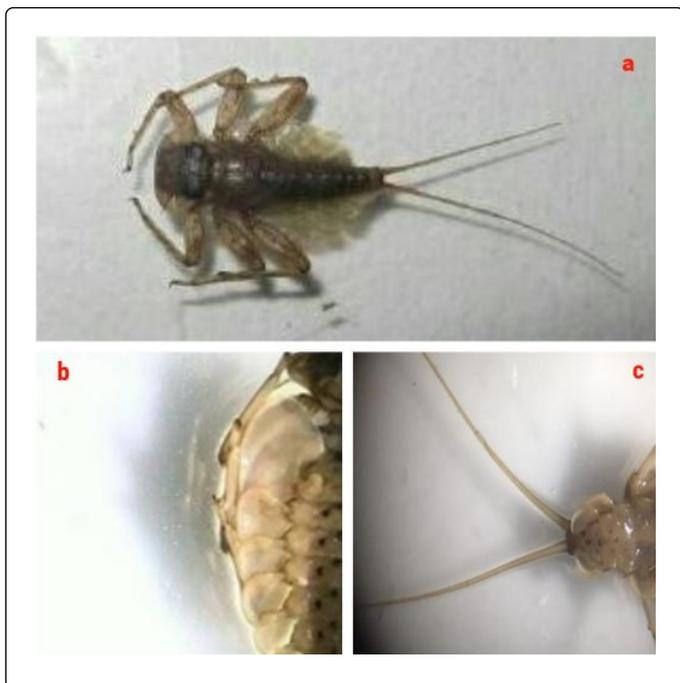
Figure 4: Life stages and morphological characters of Leptophlebiidae Family in Ephemeroptera order, Nypmph stage **(a)**, abdominal gills **(b)** and caudal filaments **(c)**.

The most predominant family was Hydropsychidae (42.4%) while Chironomidae had the lowest population size (1.83%). In this study, the Tricoptera order was the predominant with 223 (51.1%) collection while Diptera was the least order with only 8 (1.83%) collections. The Simpson indexes are presented in Table 3 and Figure 2. All the samples collected (100%) were in their nymphal and larvae stages of development. Two families were collected from Ephemeroptera order, 2 families from Trichptera order and one family was obtained from Diptera order Table 2, Figures 3-5.
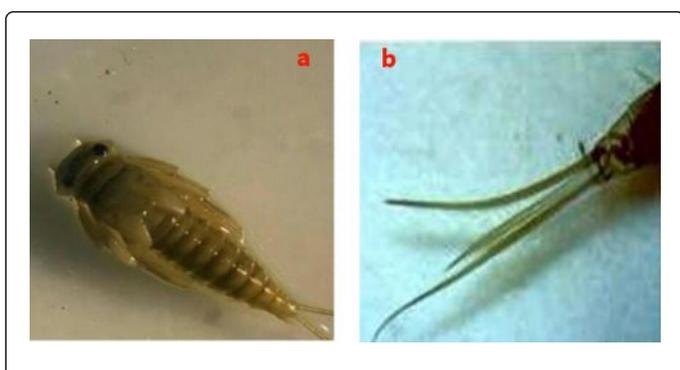

Figure 5: Life stages and morphological characters of Ephemerellidae Family in Ephemeroptera order, Nymph stage **(a)** and caudal filaments **(b)**.

Discussion

In this study, we collected various species of aquatic insects. A total of 436 samples belonging to 3 Orders and 5 families were identified using stereo microscope and standard keys. This study had more species diversity compared to other similar studies on aquatic insects

reported from Iran. The order Trichoptera was the predominant sample collected (51.1%) while Diptera was the lowest order collected (1.83%) Table 2. In a recent study, two families of Ephemeroptera (leptophlebiidae, Ephemerellidae) and two families of trichoptera (Helicopsyche, Hydropsychidae) and one family named Chironomidae belonging to the order Diptera were identified. In another similar research one family of trichoptera (Hydropsychidae) and Heptagenidae family belonging to Ephemeroptera were reported from Karaj River, but Diptera was not found instead they collected two families of Plecoptera order including perlidae and perlodidae [13]. A study carried out by Shayeghi et al. [14] in Zayande Roud River, the samples collected constituted more than 50% of the order Diptera (Culicidae, Syrphidae, Chironomidae) and Trichoptera. The most predominant family was Hydropsychidae (42.4%). Fauna of aquatic insects in sewage maturation ponds of Kashan have been reported. A similar study conducted in the study area by Dehghani et al. [15] is in agreement with the results we obtained, where they reported Chironomidae and Hydrophilidae families as the most prevalent in the study area similar to our findings. Shayeghi et al. [16] in another related study from Sablan River in Ardabil province, reported the two families of the order Diptera (Trichoptera Plecoptera) as the most prevalent (61%) which is similar to our study (Trichoptera 51.1%). They also reported 3 families belonging to Diptera order (Culicidae, Simulidae, Chironomidae). The families of Chironomidae and Hydrophilidae were prevalent. In the other study that conducted by Vafaei et al. [17] for surveying of the aquatic beetles (Coleoptera: polyphaga) of Markazi Province (central Iran) after investigation in freshwater habitats of study area, 24 species (Coleoptera: Hydrophilidae, Helophoridae, Hydraenidae, Elmidae, and Dryopidae) belonging to 13 genera and five families were identified and in this study Hydrophilidae family was one of the collected samples like present study. Some aquatic insects are an important for biological control of larvae and adults of mosquitoes in the breeding places also some of these insects play an important role in transmission of some human and animal diseases. *Anopheles culicifacies s.l.*, *An. stephensi*, *An. dthali*, *An. fluviatilis s.l.*, *An. superpictus*, are known to be the malaria vectors [18-30]. Therefore, the ecological specifications of these insects could provide a clue for further Arthropod-borne disease control.

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