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Evaluation of water quality and organic pollution of Shadegan and Hawr Al Azim wetlands by biological indices using insects

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Abstract
In this study the water quality and organic pollution of Shadegan and Hawr Al Azim wetlands by biological indices using insects during October 2011 to September 2012 were evaluated. The results of the biological monitoring working party index indicated that the abundance of family with medium or lower scores was high. The evaluation results of water quality and organic pollution of these wetlands by Ephemeroptera, Plecoptera and Trichoptera, average score per taxon and family biotic indexes indicated that the water quality had a fair to very poor condition assessing probable severe pollution, and likely substantial to severe organic pollution. Also the dominant family index indicated the community was under the influence of environmental stress in these wetlands. Totally assessing outcomes of these biological indices from these wetlands showed that their water quality had a poor condition and they can be used as valuable tools for evaluating the wetland water quality.

Keywords: Biological index, evaluation, insect, organic pollution, water quality, wetland.

1. Introduction

Generally chemico-physical measurements and biological monitoring or biomonitoring are used for determining the level of environmental pollution. The most direct approach to reveal pollution is chemical analysis such as water or sediment. It cannot afford powerful evidence on integrated influence and possible toxicity of pollution on organisms and ecosystem. Indeed they will be searched by biological monitoring. Biomonitoring is now recognized as one of the most valuable tools available in the arsenal of environmentalists. It gives indication of past and current status like a videotape whereas chemico-physical analysis reflects existing conditions when sample taken like snapshots [1, 2].

Biomonitoring has proved invaluable in tracking quality trends over time. The resident organisms living in lake, river, stream and wetland waters are used by environmental advocates as sensitive bioindicators of change in order to achieve and maintain the highest water and environmental quality. Providing tolerance values for some of the many aquatic insects is the focus of this work which they are intended to reflect tolerance to organic and the many other classes of contaminants and pollutants [1].

Wetlands such as Shadegan and Hawr Al Azim (Hawr Al Hawizea) have characteristics that are known as a distinct and the most productive ecosystems [3]. They perform significant economic benefits [4]. They have some naturally products, potential to become a tourism destination and bears many socioeconomic advantages for local residents, and also eco-environmental conditions to prevent the dust phenomena that are extremely important in recent decades [5]. Therefore, protecting the wetlands in turn can protect our safety and welfare. For protecting the wetlands, they need to be monitored over the time [3]. In this regard a wide variety of biotic groups is used for biomonitoring evaluation [1]. Aquatic insects are differentially sensitive to many biotic and abiotic factors in their environment. Consequently, their community structure has commonly been used as a bioindicator of the condition of an aquatic system [6]. Biological indices have been developed which give numerical scores to specific "bioindicator" organisms at a particular taxonomic level [7] and have been used for assessing the rivers water quality and pollution, whereas they have not already been applied for the wetlands. So the present study was designed to evaluate the water quality and organic pollution of Shadegan and Hawr Al Azim wetlands by biological indices using insects during October 2011 to September 2012.

2. Materials and methods

2.1 Geographical information

This study was performed in Shadegan international and Hawr Al Hawizea or Hawr Al Azim wetlands with hot and humid climate in Khuzistan Province, south western Iran. Shadegan international wetland is one of the 18 international wetlands registered on UNESCO's Natural Heritage List. It is the largest wetland in Iran and encompasses an area of 537,700 hectares. It situated 52 km far from Abadan and 40 km far from Ahvaz (the capital city of Khuzistan province). Shadegan wetland surrounded from north to Shadegan city and Khor Doraq, from south to Bahmanshir River, from west to Darkhovien and Abadan road and from east to Khure-Musa. Its surface is covered by great varieties of vegetations and supplied mainly by Karoun River. The Shadegan international wetland area coordinates are: 48º 17'- 48º 50'E 30º 17'- 30º 58'N [5].

Hawr Al Azim and Hawr Al Hawizeh are parts of a single hydrological system and form one of the largest permanent freshwater wetlands in Lower Mesopotamia, being located between 47° 20´- 47° 55´E and 30° 58´- 31° 50´N. This wetland is situated in the North Azadegan Plain, 80 km southwest of Ahvaz city, near the border between Iran and Iraq. The area is about 56654 ha, most (37266 ha) of which lies within the Hawr Al Azim wetland [8].

2.2 Site selection

The samplings were conducted from six different sites including: 1. Water canal entrance to Shadegan wetland (SW_1) located at the west of the wetland between Darkhovien city and wetland at 15 km of Shadegan-Darkhovien road where waste output of sugarcane expansion plan released into the wetland. 2. The middle of Shadegan wetland area (SW_2) located at 10 km in its middling of this wetland. 3. Ragbeh and Sarakhieh villages surrounding and tourism station of Shadegan wetland areas (SW_3) located at the west of the wetland at 5 km of Shadegan-Darkhovien road. 4. Waste output from sugarcane expansion plan (SW_4) located at the north western of the wetland at 40 km of Ahvaz-Abadan road where waste output of sugarcane expansion plan comes out. 5. The entry of Shadegan city wastewater to Shadegan wetland (SW_5) located at the east of the wetland between Shadegan city and wetland where urban waste released into the wetland. 6. The wide middle area of Hawr Al Hawizeh or Hawr Al Azim wetland (HH) located at 10 km in its middling of this wetland.

2.3 Insect collection

Adult stages of aerial insects were collected by long-handed wide mesh net. A modified student D-form small mesh net [5] was used for collecting of adult and premature insect stages in the lotic, lentic and on the floating aquatic plants. They were collected by a fine forceps after pouring the student D-form net contents into a rectangular container with 15×30×45 cm dimensions and transferred into a container with waters for removing their external muddies. All collected specimens were poured into vials containing Ethanol 96% and transferred to entomology laboratory after labeling. The specimens were identified under a dissecting microscope using different scientific resources and morphology-based identification keys [9, 10, 11, 12, 13, 14, 15, 16, 17] at entomology laboratory and used for calculating of biological indices.

2.4 Biological index calculation and water quality evaluation

In this study the family biotic index (FBI), biological monitoring working party (BMWP), average score per taxon (ASPT), Ephemeroptera, Plecoptera and Trichoptera (EPT) and percent contribution of dominant family (DF) indices were calculated and used for evaluating of the water quality and organic pollution of Shadegan and Hawr Al Azim wetlands.

2.5 Family biotic index (FBI)

The family biotic index (FBI) was originally developed by Hilsenhoff (1982) [18] to provide a single 'tolerance value' which is the average of the tolerance values of all species within the benthic arthropod community. It was subsequently modified to the family-level with tolerance values ranging from 0 (very intolerant) to 10 (highly tolerant) based on their tolerance to organic pollution, creating the family biotic index (FBI) [18, 1]. FBI was calculated as:

$$FBI = \frac{\sum x_i t_i}{n}$$

Where "x_i" is the number of individuals in the "i^{th}" taxon, "t_i" is the tolerance value of the "i^{th}" taxon, and "n" is the total number of organisms in the sample.

2.6 Biological monitoring working party (BMWP)

The biological monitoring working party score (BMWP) provides single values, at the family level, representative of the organisms' tolerance to pollution. The greater their tolerance towards pollution, the lower the BMWP score. BMWP is calculated by adding the individual scores of all families, and order Oligochaeta, represented within the community. In this study the BMWP scores which had determined in the previous studies were used [1, 17].

2.7 Average score per taxon (ASPT)

The average score per taxon (ASPT) represents the average tolerance score of all taxa within the community, and is calculated by dividing the BMWP by the number of families represented in the sample [19, 1].

2.8 EPT index

The Ephemeroptera, Plecoptera and Trichoptera (EPT) index displays the taxa richness within the insect groups which are considered to be sensitive to pollution, and therefore should increase with increasing water quality. The EPT index is equal to the total number of families represented within these three orders in the sample [1].

2.9 Percent contribution of dominant family

The percent contribution of dominant family or percent dominance (%DF) equals the abundance of the numerically dominant family relative to the total number of organisms in the sample. This index indicates the present state of the community balance at the family level. For example, a community dominated by relatively few families would have a high %DF value, thus indicating the community is under the influence of environmental stress [1].

2.10 Evaluation of the water quality and organic pollution degree

The water quality and organic pollution were assessed by family-level biotic index (FBI) according to Hilsenhoff (1988) table [1, 20]. The water quality also was assessed by average score per taxon (ASPT) according to a table mentioned by researchers [1, 21].

3. Results and Discussion

In this study the water quality and organic pollution of Shadegan and Hawr Al Azim wetlands by biological indices using insects during October 2011 to September 2012 were evaluated. Tables 1-7 show the aquatic family insects and their BMWP index in the selected sites of Shadegan and Hawr Al Azim wetlands during October 2011 to September 2012. Also table 8 shows the aquatic family insects and their BMWP index in the Shadegan and Hawr Al Azim wetlands during October 2011 to September 2012. As shown in the tables 1-8 the BMWP index indicates that there are the aquatic family insects with 2-10 BMWP scores. However the abundance of family insects with BMWP scores higher than medium (>5) is low and the abundance of family insects with BMWP scores about medium (= 5) is high. As a result it will be concluded that the environment of Shadegan and Hawr Al Azim wetlands are polluted (Tables 1-8).

Table 9 shows the evaluation results of water quality and organic pollution in the selected sites of Shadegan and Hawr Al Azim wetlands by ASPT and FBI indexes during October 2011 to September 2012 (as the number of individuals in the different month samples for calculating the FBI index takes a several tables, they were not shown). As shown in the table 9 the ASPT index ranged from 0.38 to 2.0 indicating that the water quality assessed probable severe pollution except in the December of the SW_3 (4.25) which assessed probable moderate pollution (Table 9). The FBI index ranged from 5.11 to 8.44 indicating that the water quality degree and organic pollution of Shadegan and Hawr Al Azim wetlands assessed fair to very poor and likely substantial to severe organic pollution, respectively (Table 9).

Table 1: Aquatic insects and their BMWP index at SW_1 during October 2011 to September 2012

Order or Suborder		Family		
		Name (BMWP)	No.	%
Coleoptera		Carabidae (5), Dytiscidae (5), Elmidae (4), Gyrinidae (5), Haliplidae (7), Helophoridae (5), Hydraenidae (5), Hydrophilidae (5)	8	26.67
Diptera		Chironomidae (8), Dolichopodidae (5), Stratiomyidae (8), Tabanidae (7)	4	13.33
Ephemeroptera		Baetidae (4), Caenidae (7), Heptageniidae (10), Isonychiidae (2), Leptophlebiidae (10)	5	16.67
Hemiptera		Corixidae (5), Veliidae (5)	2	6.67
Lepidoptera		Pyralidae (5)	1	3.33
Megaloptera		Corydalidae (4)	1	3.33
Neuroptera		-	0	0
Odonata	Anisoptera	Cordulegastridae (8), Libellulidae (8)	2	6.67
	Zygoptera	Calopterygidae (5), Coenagrionidae (9), Lestidae (9)	3	10
Plecoptera		Perlidae (10), Perlodidae (10)	2	6.67
Decapoda		Cambaridae (6)	1	3.33
Isopoda		-	0	0
Mysida		*Hemimysis* (Genus) (6)	1	3.33
Σ			30	-

Table 2: Aquatic insects and their BMWP index at SW_2 during October 2011 to September 2012

Order or Suborder		Family		
		Name (BMWP)	No.	%
Coleoptera		Chrysomelidae (5), Curculionidae (5), Dytiscidae (5), Elmidae (4), Hydraenidae (5), Hydrophilidae (5)	6	46.2
Diptera		Chironomidae (8)	1	7.69
Ephemeroptera		-	0	0
Hemiptera		Corixidae (5), Pleidae (5)	2	15.38
Lepidoptera		-	0	0
Megaloptera		-	0	0
Neuroptera		-	0	0
Odonata	Anisoptera	Aeshnidae (8), Libellulidae (8)	2	15.38
	Zygoptera	Coenagrionidae (9)	1	7.69
Plecoptera		-	0	0
Decapoda		-	0	0
Isopoda		-	0	0
Mysida		*Hemimysis* (Genus) (6)	1	7.69
Σ			13	-

Table 3: Aquatic insects and their BMWP index at SW_3 during October 2011 to September 2012

Order or Suborder		Family		
		Name (BMWP)	No.	%
Coleoptera		Dytiscidae (5), Gyrinidae (5), Haliplidae (7), Hydrophilidae (5)	4	36.36
Diptera		Chironomidae (8), Tabanidae (7)	2	18.18
Ephemeroptera		-	0	0
Hemiptera		Corixidae (5)	1	9.09
Lepidoptera		-	0	0
Megaloptera		-	0	0
Neuroptera		-	0	0
Odonata	Anisoptera	Aeshnidae (8), Corduliidae (8), Libellulidae (8)	3	27.27
	Zygoptera	Coenagrionidae (9)	1	9.09
Plecoptera		-	0	0
Decapoda		-	0	0
Isopoda		-	0	0
Mysida		-	0	0
Σ			11	-

Table 4: Aquatic insects and their BMWP index at SW_4 during October 2011 to September 2012

Order or Suborder		Family		
		Name (BMWP)	No.	%
Coleoptera		Chrysomelidae (5), Dytiscidae (5), Hydraenidae (5), Hydrophilidae (5), Staphylinidae (8)	5	21.74
Diptera		Chironomidae (8), Tabanidae (7)	2	8.71
Ephemeroptera		Baetidae (4), Caenidae (7), Heptageniidae (10), Leptophlebiidae (10)	4	17.39
Hemiptera		Corixidae (5), Mesoveliidae (5), Naucoridae (5), Notonectidae (10)	4	17.39
Lepidoptera		Pyralidae (5)	1	4.35
Megaloptera		-	0	0
Neuroptera		-	0	0
Odonata	Anisoptera	Aeshnidae (8), Cordulegastridae (8), Libellulidae (8)	3	13.04
	Zygoptera	Coenagrionidae (9), Lestidae (9)	2	8.71
Plecoptera		-	0	0
Decapoda		Cambaridae (6)	1	4.35
Isopoda		-	0	0
Mysida		*Hemimysis* (Genus) (6)	1	4.35
Σ			23	-

Table 5: Aquatic insects and their BMWP index at SW_5 during October 2011 to September 2012

Order or Suborder		Family		
		Name (BMWP)	No.	%
Coleoptera		Chrysomelidae (5), Dytiscidae (5), Hydraenidae (5), Hydrophilidae (5), Scirtidae (Helodidae) (5)	5	17.24
Diptera		Chironomidae (8), Culicidae (8), Syrphidae (10), Tabanidae (7)	4	13.79
Ephemeroptera		Baetidae (4), Caenidae (7), Leptophlebiidae (10)	3	10.34
Hemiptera		Belostomatidae (5), Corixidae (5), Gerridae (5), Mesoveliidae (5), Notonectidae (10), Veliidae (5)	6	20.69
Lepidoptera		Pyralidae (5)	1	3.45
Megaloptera		-	0	0
Neuroptera		Sisyridae (5)	1	3.45
Odonata	Anisoptera	Aeshnidae (8), Corduliidae (8), Gomphidae (8), Libellulidae (8)	4	13.79
	Zygoptera	Coenagrionidae (9), Lestidae (9)	2	6.91
Plecoptera		-	0	0
Decapoda		Cambaridae (6), Palaemonidae (6)	2	6.91
Isopoda		Asellota (Suborder) (6)	1	3.45
Mysida		-	0	0
Σ			29	-

Table 6: Aquatic insects and their BMWP index at HH during October 2011 to September 2012

Order or Suborder		Family		
		Name (BMWP)	**No.**	**%**
Coleoptera		Chrysomelidae (5), Curculionidae (5), Dryopidae (5), Dytiscidae (5), Elmidae (4), Gyrinidae (5), Haliplidae (7), Heteroceridae (5), Hydraenidae (5), Hydrochidae (5), Hydrophilidae (5), Staphylinidae (8)	12	42.86
Diptera		Chironomidae (8), Tabanidae (7)	2	7.14
Ephemeroptera		-	0	0
Hemiptera		Corixidae (5), Gerridae (5), Hydrometridae (5), Mesoveliidae (5), Naucoridae (5), Notonectidae (10), Pleidae (5), Saldidae (10)	8	28.57
Lepidoptera		Pyralidae (5)	1	3.57
Megaloptera		-	0	0
Neuroptera		-	0	0
Odonata	Anisoptera	Libellulidae (8)	1	3.57
	Zygoptera	Coenagrionidae (9)	1	3.57
Plecoptera		-	0	0
Decapoda		Cambaridae (6), Palaemonidae (6)	2	7.14
Isopoda		-	0	0
Mysida		*Hemimysis* (Genus) (6)	1	3.57
Σ			28	-

Table 7: Aquatic insects and their BMWP index in Shadegan wetland during October 2011 to September 2012

Order or Suborder		Family		
		Name (BMWP)	**No.**	**%**
Coleoptera		Carabidae (5), Chrysomelidae (5), Curculionidae (5), Dytiscidae (5), Elmidae (4), Gyrinidae (5), Haliplidae (7), Helophoridae (5), Hydraenidae (5), Hydrophilidae (5), Scirtidae (Helodidae) (5), Staphylinidae (8)	12	25
Diptera		Chironomidae (8), Culicidae (8), Dolichopodidae(5), Stratiomyidae (8), Syrphidae (10), Tabanidae(7)	6	12.5
Ephemeroptera		Baetidae(4), Caenidae (7), Heptageniidae (10), Isonychiidae (2), Leptophlebiidae (10)	5	10.42
Hemiptera		Belostomatidae (5), Corixidae (5), Gerridae (5), Mesoveliidae (5), Naucoridae (5), Notonectidae (10), Pleidae(5), Veliidae (5)	8	16.67
Lepidoptera		Pyralidae (5)	1	2.08
Megaloptera		Corydalidae (4)	1	2.08
Neuroptera		Sisyridae (5)	1	2.08
Odonata	Anisoptera	Aeshnidae (8), Cordulegastridae (8), Corduliidae (8), Gomphidae (8), Libellulidae (8)	5	10.42
	Zygoptera	Calopterygidae (5), Coenagrionidae (9), Lestidae (9)	3	6.25
Plecoptera		Perlidae (10), Perlodidae (10)	2	4.17
Decapoda		Cambaridae (6), Palaemonidae (6)	2	4.17
Isopoda		Asellota (Suborder) (6)	1	2.08
Mysida		*Hemimysis* (Genus) (6)	1	2.08
Σ			48	-

Table 8: Aquatic insects and their BMWP index in Shadegan and Hawr Al Azim wetlands during October 2011 to September 2012

Order or Suborder		Family		
		Name (BMWP)	**No.**	**%**
Coleoptera		Carabidae (5), Chrysomelidae (5), Curculionidae (5), Dryopidae (5), Dytiscidae (5), Elmidae (4), Gyrinidae (5), Haliplidae (7), Helophoridae (5), Heteroceridae (5), Hydraenidae (5), Hydrochidae (5), Hydrophilidae (5), Scirtidae (Helodidae) (5), Staphylinidae (8)	15	28.3
Diptera		Chironomidae (8), Culicidae (8), Dolichopodidae(5), Stratiomyidae (8), Syrphidae (10), Tabanidae (7)	6	11.32
Ephemeroptera		Baetidae (4), Caenidae (7), Heptageniidae (10), Isonychiidae (2), Leptophlebiidae (10)	5	9.43
Hemiptera		Belostomatidae (5), Corixidae (5), Gerridae (5), Hydrometridae (5), Mesoveliidae (5), Naucoridae (5), Notonectidae (10), Pleidae (5), Saldidae (10), Veliidae (5)	10	18.87
Lepidoptera		Pyralidae (5)	1	1.89
Megaloptera		Corydalidae (4)	1	1.89
Neuroptera		Sisyridae (5)	1	1.89
Odonata	Anisoptera	Aeshnidae (8), Cordulegastridae (8), Corduliidae (8), Gomphidae (8), Libellulidae (8)	5	9.43
	Zygoptera	Calopterygidae (5), Coenagrionidae (9), Lestidae (9)	3	5.66
Plecoptera		Perlidae (10), Perlodidae (10)	2	3.77
Decapoda		Cambaridae (6), Palaemonidae (6)	2	3.77
Isopoda		Asellota (Suborder) (6)	1	1.89
Mysida		*Hemimysis* (Genus) (6)	1	1.89
Σ			53	-

Table 9: Evaluation of water quality and organic pollution in the selected sites of Shadegan and Hawr Al Azim wetlands by ASPT and FBI indexes during October 2011 to September 2012

Site	Time	ASPT	Water quality	FBI	Water quality degree	Organic pollution
SW_1	October	0.7	PSP*	8.44	Very poor	Severe organic pollution likely
	December	1.5	PSP	8.15	Very poor	Severe organic pollution likely
	March	0.47	PSP	7.64	Very poor	Severe organic pollution likely
	April	0.58	PSP	8.21	Very poor	Severe organic pollution likely
	June	0.69	PSP	7.95	Very poor	Severe organic pollution likely
	July	0.44	PSP	7.02	Poor	Very substantial pollution likely
	September	0.58	PSP	6.54	Poor	Very substantial pollution likely
SW_2	October	0.75	PSP	5.73	Fair	Fairly substantial pollution likely
	December	1.56	PSP	6.95	Poor	Very substantial pollution likely
	March	1.05	PSP	7.38	Very poor	Severe organic pollution likely
	April	1.025	PSP	7.98	Very poor	Severe organic pollution likely
	June	0.85	PSP	7.18	Very poor	Severe organic pollution likely
	July	0.85	PSP	6.12	Fairly poor	Substantial pollution likely
	September	1.28	PSP	5.11	Fair	Substantial pollution likely
SW_3	December	4.25	PMP**	8.4	Very poor	Severe organic pollution likely
	March	0.98	PSP	8.41	Very poor	Severe organic pollution likely
	April	0.94	PSP	7.96	Very poor	Severe organic pollution likely
	June	1.14	PSP	6.09	Fairly poor	Substantial pollution likely
	July	1.22	PSP	5.65	Fair	Fairly substantial pollution likely
	September	1.44	PSP	6.66	Poor	Very substantial pollution likely
SW_4	October	0.92	PSP	8.12	Very poor	Severe organic pollution likely
	December	0.78	PSP	8.1	Very poor	Severe organic pollution likely
	March	2	PSP	8.44	Very poor	Severe organic pollution likely
	April	1.01	PSP	7.06	Poor	Very substantial pollution likely
	June	0.52	PSP	8.26	Very poor	Severe organic pollution likely
	July	0.54	PSP	7.64	Very poor	Severe organic pollution likely
	September	0.46	PSP	7.19	Poor	Very substantial pollution likely
SW_5	October	0.92	PSP	7.69	Very poor	Severe organic pollution likely
	December	0.38	PSP	7.45	Very poor	Severe organic pollution likely
	March	0.84	PSP	7.55	Very poor	Severe organic pollution likely
	April	0.69	PSP	7.25	Poor	Very substantial pollution likely
	June	0.41	PSP	6.22	Fairly poor	Substantial pollution likely
	July	0.49	PSP	6.40	Fairly poor	Substantial pollution likely
	September	1.1	PSP	6.41	Very poor	Severe organic pollution likely
HH	December	1.16	PSP	5.85	Fairly poor	Substantial pollution likely
	March	0.81	PSP	7.04	Poor	Very substantial pollution likely
	April	0.445	PSP	6.58	Poor	Very substantial pollution likely
	June	0.42	PSP	5.39	Fair	Fairly substantial pollution likely
	July	0.46	PSP	5.41	Fair	Fairly substantial pollution likely
	September	0.57	PSP	5.50	Fair	Fairly substantial pollution likely

*PSP=Probable severe pollution, **PMP=Probable moderate pollution

Also table 10 shows the EPT and DF indexes in the selected sites of Shadegan and Hawr Al Azim wetlands during October 2011 to September 2012. The EPT index displays the taxa richness within the insect groups which are considered to be sensitive to pollution, and therefore should increase with increasing water quality [1, 22]. In this study the EPT index ranged from 0 to 4 indicating the poor water quality (Table 10). The DF index indicates the present state of the community balance at the family level. For example, a community dominated by relatively few families would have a high %DF value. Thus indicating the community is under the influence of environmental stress [1, 22]. As shown in the table 10 this situation is confirmed in the Shadegan and Hawr Al Azim wetlands.

Totally assessing outcomes of these biological indices from the selected sites of Shadegan and Hawr Al Azim wetlands showed that their water quality had an undesirable situation. Also data from the analysis of the investigated water quality parameters confirmed current study. Results showed that the water quality of these wetlands had a poor water quality condition which threatens their wetland lives [5].

Table 10: EPT and DF indexes in the selected sites of Shadegan and Hawr Al Azim wetlands during October 2011 to September 2012

Site	Time	EPT	DF		
			Order: Family	**Total**	**%**
SW_1	October	3	Zygoptera: Coenagrionidae	47	71.2
	December	1	Zygoptera: Coenagrionidae	153	72.9
	March	4	Zygoptera: Coenagrionidae	216	43.1
	April	1	Zygoptera: Coenagrionidae	386	62.56
	June	2	Zygoptera: Coenagrionidae	149	53.21
	July	1	Zygoptera: Coenagrionidae	66	28.08
	September	2	Zygoptera: Coenagrionidae	51	38.6
SW_2	October	0	Coleoptera: Hydraenidae	11	36.67
	December	0	Zygoptera: Coenagrionidae	34	39.54
	March	0	Zygoptera: Coenagrionidae	308	53.01
	April	0	Zygoptera: Coenagrionidae	449	50.85
	June	0	Zygoptera: Coenagrionidae	189	54.16
	July	0	Coleoptera: Hydrophilidae	160	48.48
	September	0	Coleoptera: Hydrophilidae	130	67.7
SW_3	December	0	Diptera: Chironomidae	154	59.46
	March	0	Zygoptera: Coenagrionidae	475	71.86
	April	0	Zygoptera: Coenagrionidae	339	68.07
	June	0	Hemiptera: Corixidae	211	52.11
	July	0	Coleoptera: Hydrophilidae	179	60.68
	September	0	Coleoptera: Hydrophilidae	62	42.5
SW_4	October	2	Zygoptera: Coenagrionidae	62	76.54
	December	3	Zygoptera: Coenagrionidae	125	61.58
	March	0	Diptera: Chironomidae	393	53.76
	April	0	Hemiptera: Corixidae	181	38.19
	June	0	Zygoptera: Coenagrionidae	583	77.63
	July	1	Zygoptera: Coenagrionidae	131	56.71
	September	2	Zygoptera: Coenagrionidae	62	40
SW_5	October	2	Zygoptera: Coenagrionidae	19	34.54
	December	2	Diptera: Culicidae	1074	75.37
	March	0	Diptera: Chironomidae	509	57.91
	April	0	Diptera: Chironomidae	778	64.62
	June	0	Hemiptera: Corixidae	138	34.33
	July	2	Anisoptera: Libellulidae	134	24.72
	September	0	Coleoptera: Dytiscidae	72	41.4
HH	December	0	Coleoptera: Hydrophilidae	26	50
	March	0	Diptera: Chironomidae	250	43.7
	April	0	Coleoptera: Dytiscidae	184	25.45
	June	0	Coleoptera: Dytiscidae	630	60.34
	July	0	Coleoptera: Dytiscidae	726	53.03
	September	0	Coleoptera: Dytiscidae	308	43.31

4. Conclusion
In this study the water quality and organic pollution of Shadegan and Hawr Al Azim wetlands by biological indices using insects during October 2011 to September 2012 were evaluated. Totally assessing outcomes of biological indices including BMWP, ASPT, FBI, EPT and DF indexes from the selected sites of Shadegan and Hawr Al Azim wetlands showed that their water quality had an undesirable situation.

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6. References
1. Mandaville SM. Benthic macroinvertebrates in freshwaters-taxa tolerance values, metrics, and protocols. Soil and Water Conservation Society of Metro Halifax. Project H-1. 2002, 48.
2. Muralidharan M, Selvakumar C, Sundar S, Raja M. Macroinvertebrates as potential indicators of environmental quality. Indian Journal of Biotechnology 2010; 1(Special Issue):23-28.
3. EPA, Wetlands. 2012. http://water.epa.gov/type/wetlands/index.cfm, 16 Oct, 2014.
4. Constanza RR, d'Arge R, de Groot R, Farber S, Grasso M, Hannon B *et al.* The value of the world's ecosystem services and natural capital. Nature 1997; 387:253-260.
5. Nasirian H. Using insects for heavy metal contamination survey in Shadegan wetland. Thesis for fulfillment of the PhD degree in Medical Entomology and Vector Control, School of Public Health. Tehran University of Medical Sciences, 2013.
6. Rosenberg DM, Resh VH. Freshwater biomonitoring and benthic macroinvertebrates, Chapman & Hall, London, 1993.
7. Armitage PD, Moss D, Wright JF, Furse MT. The Performance of A New Biological Water Quality System Based on Macroinvertebrates Over a Wide Range of Unpolluted Running Water Sites. Water Research 1983; 17(3):333-347.
8. Mirzaei R, Conroy J, Yoxon P. Otters in the Hawr Al Azim wetland, Iran. Hystrix Italian Journal of Mammalogy 2010; 21:83-88.
9. Shahgudian ER. A key to the anophelines of Iran. Acta Medica Iranica 1960; 3:38-48.

10. Woodrow WM, Roberts SL. Adult and Immature Tabanidae (Diptera) of California. Bulletin of the California Insect Survey; v. 22. University of California Press, Ltd, Londen, England, 1980.
11. Zaim M, Cranston PS. Checklist and keys to the Culicinae of Iran (Diptera: Culicidae). Mosquito Systematics 1986; 18:233-245.
12. Morse CJ, Yang L, Tian L. (ed.). Aquatic Insects of China Useful For Monitoring Water Quality. Hohai University Press, Nanjiing People's Republic of China, 1994, 569.
13. Reuben R, Tewari SC, Hiriyan J, Akiyama J. Illustrated keys to species of *Culex* (*Culex*) associated with Japanese encephalitis in southeast Asia (Diptera: Culicidae). Mosquito Systematics 1994; 26:75–96.
14. Paulson D. Field Key to Adult Alaska Dragonflies. Slater Museum of Natural History, University of Puget Sound, Tacoma, WA 98416, 2004.
15. Borror, DJ, DeLong DM. Introduction to the study of insects. Edn 7, Norman F. Johnson and Charles A. Triplehorn. Publisher: Peter Marshal, Thomson, Brooks/Cole, 2005.
16. Heckman CW. Encyclopedia of South American aquatic insects: Odonata-Zygoptera: Illustrated keys to known families, genera, and species in South America. Springer; Softcover reprint of hardcover Edn 1, 2008, 692.
17. DeLorme A. Digital key to aquatic insect of North Dakota. North Dakota Department of Health. This key has been based on 7 years of collections carried out by the North Dakota Department of Health and 5 years of collecting carried out by Dr. Andre DeLorme's macroinvertebrate lab at Valley City State University. Valley City State University-101 College Street SW-Valley City, ND 58072-1-800-532-8641, 2012.
18. Hilsenhoff WL. Using a Biotic Index to Evaluate Water Quality in Streams. Tech Bull Wisc Dept Nat Res 1982; 132.
19. Sivaramakrishnan KG. Composition and zonation of aquatic insect fauna of Kaveri and its Tributaries and the identification of insect fauna as indicator of pollution. D.O.E. Project Number 22/18/89-Re, 1992.
20. Hilsenhoff WL. Rapid field assessment of organic pollution with a family-level biotic index. J N Am Benthol Soc 1988; 7(1):65-68.
21. Hynes KE. Benthic Macroinvertebrate Diversity and Biotic Indices for Monitoring of 5 Urban and Urbanizing Lakes within the Halifax Regional Municipality (HRM), Nova Scotia, Canada. Soil & Water Conservation Society of Metro Halifax. 1998; 14:114.
22. Plafkin JL, Barbour MT, Porter KD, Gross SK, Hughes RM. Rapid Bioassessment Protocols for use in Streams and Rivers: Benthic Macroinvertebrates and Fish. U.S. Environmental Protection Agency. 1989, EPA 440/4-89/001. 8 chapters, Appendices A-D.