



## Diversity and abundance of macro-invertebrate fauna in wheat weed crop complex of Bahawalpur, Pakistan

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### Abstract

Macro invertebrates are the organisms of 0.2 mm in size or more and can be seen with naked eye. They may consist of predators, preys or pests which play a significant role in balancing the natural agro-ecosystem. The organisms were sampled from wheat-weed crop complex of Baghdad-ul-Jadeed university campus and major cropland area of district Bahawalpur. Overall the Order Coleoptera was dominant followed by Hemiptera and Orthoptera while order Opisthoptera, Odonata, Lepidoptera, Hymenoptera and Zygentomawere represented by single species each. Direct hand picking, hand nets and automated sifter techniques were employed for sampling of fauna. Wisemen solution was used for preservation and their systematics was determined with taxonomic literature. The economic status was also determined to separate different categories. Such results are valuable contribution for ecological management of wheat agro-ecosystem.

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## Introduction

Biodiversity is defined as the variety of life on earth. Generally, it is a measure of relative number of types of organisms present. Two concepts are especially important when considering the effect of biodiversity in a system: stability and productivity (Schowalter, 2006). Most agro ecosystem tend to be highly disturbed. Common practices like tillage, planting, application of fertilizers and pesticides, irrigation and harvest can change temporary or long lasting changes in average environmental conditions that change the functioning of the ecosystem.

Agro ecosystems have the ability to recover from stresses because of their rich organism diversity and gain greater resilience. Diversity in agro ecosystem provide a range of pathways for primary production and ecological processes such as nutrient cycle, so that if one pathway is damaged the other alternative pathway can continue the proper functioning. Biodiversity mediated renewal processes and ecological functions are largely biological and their persistence depends upon the maintenance of species integrity and diversity in agro ecosystem (Alteiri, 1999). Studies suggest that more the agro ecosystem is diverse, the longer its diversity remains undisturbed, the more internal links develop to promote greater stability.

Feeding strategies are always important in determining the economic status of organisms. Predators are zoophagous in feeding habit, preys and pests are phytophagous. All the groups are integral part of agro ecosystem and play an imperative role for integrity of an ecosystem. Keeping all in view the present study was conducted to report the macro invertebrate diversity of wheat crop and their seasonal distribution in different localities of district.

## Material and methods

A preliminary survey was made to select the crop fields of wheat. For extensive information on current and past management practices in these habitats, a questionnaire was made for interviewing the land

farmers, with specific reference to the use of chemicals and mechanical operations at farms. Two localities were selected for sampling includes Baghdad-ul-Jadeed university campus (habitat 1) and major cropland area of district Bahawalpur (habitat 2). At each sampling site, two acres were selected randomly for collection of fauna. Sampling was initiated as per schedule from January-May 2011. Sweep net was used to sweep all types of adult and large arthropod present above the canopy of the crop. Heavy duty muslin nets were used to sweep through vegetation forming a figure of eight. Direct hand picking and automated sifters were also employed to collect the wheat foliar fauna. All the arthropod visible to naked eyes were collected from the weeds included immature and adults whether sitting, moving or residing on weeds. Sampled specimens were kept in properly labeled vials containing laboratory grade alcohol with few drops of glycerin. The identification up to species level was done with the help of available related taxonomic information and online electronic keys available on different websites. Three hours were spent in the field for faunal sampling. The trophic levels of each species (phytophagous, zoophagous and saprophagous) were confirmed with the help of recent online literature.

## Results

A total of 33 species of macro invertebrates were identified. Overall eight orders were identified. Four orders were grouped as more abundant (Opisthoptera, Orthoptera, Hemiptera, Coleoptera) while (Odonata, Lepidoptera, Hymenoptera and Zygentoma) were identified as less abundant. Order Coleoptera had highest diversity followed by Hemiptera, Orthoptera, Opisthoptera. Order Zygentoma, Lepidoptera, Hymenoptera and Odonata showed no difference in species diversity in two localities studied. Among different individuals of Order Coleoptera 858 were present in habitat 1 while 843 were present in habitat 2. Species namely, *Tanymericus palliate* (53), *Cocinella larvae* (65), *Hyperapunctata* (66), *Tanymericus sciurs* (193) and *Penthapimelia* (69) were more abundant in habitat 1 while *Aulacophoraspp*

(69), *Harpalus* spp (68), *Coccinella septempunctata* (62), *Cheilomenes sexmaculata* (91), *Pidoniaganathoids* (64), *Hippodamia convergens* (70), *Oxyporus occipitalis* (58), *Calleida punctata* (67) and *Platydemaruficolle* (52) were more abundant in habitat 2.

**Table 1.** Distribution of arthropod fauna in the wheat crop complex at two selected habitats.

Order	Family	Texa	H1	H2	Total
Opisthoptera	Megascolecidae	<i>Pheretima hawayana</i>	46	55	101
Odonata	Coenagrionidae	<i>Coenagrion npuella</i>	30	71	101
Orthoptera	Pyrgomorphidae	<i>Chrotogonus robertsi</i> .	60	23	83
	Acrididae	<i>Leptysmamarginicollis</i> .	53	49	102
Hemiptera	Pyrrhocoridae	<i>Dysdercus koenigi</i> .	67	59	136
	Lygaeinae	<i>Lygaeus sp.</i>	84	43	127
	Pentatomoidae	<i>Podisus sp.</i>	54	48	102
	Pyrrhocoridae	<i>Dysdercus cingulatus</i> .	67	35	102
	Chrysomelidae	<i>Aulacophora sp.</i>	33	69	102
	Curculionidae	<i>Tanymecus palliatus</i> .	53	48	101
	Carabidae	<i>Harpalus sp.</i>	37	68	105
Coleoptera	Coccinellidae	<i>Coccinella septempunctata</i> .	39	62	101
	Coccinellidae	<i>Cheilomenes sexmaculata</i> .	87	91	178
	Coccinellidae	<i>Coccinella larvae</i>	65	38	103
	Cerambycidae	<i>Pidoniaganathoids</i>	43	64	107
	Coccinellidae	<i>Hippodamia convergence</i>	39	70	109
	Staphylinidae	<i>Oxyporus occipitalis</i> .	49	58	107
	Curculionidae	<i>Hypera punctata</i> .	66	35	101
	Curculionidae	<i>Tanymecus sciurus</i> .	193	89	282
	Carabidae	<i>Calleida punctata</i>	36	67	103
	Tetratomidae	<i>Pentha pimelia</i>	69	32	101
	Tnebrionidae	<i>Platydema ruficolle</i>	49	52	101
	Lepidoptera	Holometabola	<i>Lepidopteron larvae</i>	69	32
Hymenoptera	Apidae	<i>Apis mellifera</i>	61	48	109
Zygentoma	Lepismatidae	<i>Lepisma saccharina</i> .	39	67	106
Total No. of specimens			1488	1373	3565

**Table 2.** Shannon's diversity index and evenness values for the faunal species.

Order	No	H'	N1	N2	E5
Opisthoptera	1	1.20	2.11	2.90	0.89
Odonata	1	1.10	2.00	2.02	0.81
Orthoptera	2	1.0	2.12	2.92	0.80
Hemiptera	4	1.03	2.10	2.90	0.89
Coleoptera	14	2.12	12.82	13.24	0.84
Zygentoma	1	1.01	2.07	2.90	0.81
Lepidoptera	1	1.09	2.09	2.87	0.83
Hymenoptera	1	1.03	2.10	2.34	0.84

No= Number of species; H'= Diversity; E5=Evenness

Order Hemiptera consisted of 272 individuals from habitat 1 and 185 individuals from habitat 2. Species namely *Dysdercus koenigi* (136), *Lygaeus* sp (127), *Podisus* sp (102), *Dysdercus cingulatus* (102) were abundant in habitat 1. Among Orthoptera 113 individuals were collected from habitat 1 and 72 were collected from habitat 2. Species namely *Chrotogonus robertsi* (102) and *Leptysmamarginicollis*

(83) were abundant in habitat 1. In Opisthoptera 101 individuals of *Pheretima hawayana*, out of which 46 were collected from habitat 1 while 55 were collected from habitat 2. In Zygentoma 39 individuals of *Lepisma saccharina* were collected from habitat 1 while 67 were collected from habitat 2. Odonata consisted of 30 individuals of *Coenagrion npuella* collected from habitat 1 and 71 from habitat 2. Lepidoptera consist of 69 individuals of *Lepidopteron larvae* present in habitat 1 and 32 in habitat 2. In Hymenoptera 61 individuals of *Apes mellifera* were present in habitat 1 while 48 were present in habitat 2.

Shannon's diversity index showed highest diversity for order Coleoptera 2.12 followed by Opisthoptera 1.20 and Odonata 1.10 whereas, evenness values (E5) were high for order Opisthoptera 0.89, Hemiptera 0.89, Coleoptera 0.84 and Hymenoptera 0.84 (Table 2).

### Discussion

Macro-invertebrate fauna redistribute the organic matter, contribute to soil turnover, structure and sustain ecological niches; but their population and diversity play a valuable role in sustainability of bio-geo-chemical cycling (Cousens, 1995). Biotic factors are in continuous threat due to unwise use of pesticides and fertilizers that has increased to many folds over time to meet the massively increasing requirements of world's population (Mason and Madin, 1996).

In the last few decades, changes in consumption pattern increased significance of agricultural intensification with the increasing world population. Unless, crop yield is improved and reduction of fertilizers and pesticides are made in cropland, such intensification would augment contamination of managed and natural agro ecosystem. In more intense agriculture, arthropods have the lowest population. Many contributory factors can be addressed individually. Cropping pattern, frequency of tillage, amount and nature of fertilizers used are considered to be important. However, it is clear that, stability of insect community depends both on the trophic diversity and actual density dependence nature of the trophic levels (Southwood and Way, 1970). Arthropod fauna is integral during evaluation of ongoing cropping practice and help in redesigning of farming system in order to make it economically viable and environment sustainable (Chang and Kareiva, 1999; Gurr and Wratten, 2000; Symondson *et al.*, 2002).

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