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STATUS OF TROPHIC GUILD OF INVERTEBRATES UTILIZING WEEDS OF WHEAT AND SUGARCANE FIELDS OF FAISALABAD

Muhammad Nadeem Abbas[1,*], Shahnaz Akhtar Rana[1], Hammad Ahmad Khan[1] and Khalil-ur-Rehman[2]

[1]Department of Zoology and Fisheries, University of Agriculture, Faisalabad
[2]Department of Chemistry and Biochemistry, University of Agriculture, Faisalabad
[*]Corresponding author's e-mail: nademkhan531uaf@gmail.com

Qualitative synergy level of prey/pest-predator invertebrate populations occurring on weeds of sugarcane and wheat crops was evaluated on the basis of their relative occurrence on the weeds. Seventeen weed species common in and around wheat field harboured 50 species of predators including insects and spiders in addition to 20 known pest species of different crops. These weeds also harboured 14 recycler species. The ratio of pest/prey-predator in the wheat fields was high. Whereas eight weeds common in sugarcane fields harboured 13 species of predator insects and spiders. These weeds were observed to bear 17 known pest species of some major crops in addition to 28 recycler species playing key role (scavenging, fragmenting and decomposing) in some sort of ambient environment of cane fields.
Keywords: Biodiversity, predator, prey, pest, Non crop fauna

INTRODUCTION

Weeds and arthropods interact more frequently in the agroecosystem. It is expected that approximately 26% of the arthropods species are directly associated with approximately 310,000 plants species (Strong *et al*., 1984). It is estimated that interactions between weeds and arthropods are probably much more frequent than are often recognized. More than 70 families of arthropods recognized as potential crop pests are primarily associated with weeds (Altieri, 1994). Many pest species of arthropods are polyphagous and can feed on plants belonging to various genera and families. Polyphagous pest arthropods species that feed on crops and weeds have potential for direct interaction with weed management. Beneficial arthropods are secondary consumers, utilize pest/prey species which are not only feeding on weeds but also on crop plants. The pest/prey living on weeds may be a crop pest or it may be of no influence on crop production. Secondary or tertiary level consumer feed on primary consumers. However, some species are omnivorous too. Many secondary consumer arthropods feed directly on plants at some particular stage, usually adult, in their life cycle. Such organisms thus have the potential to interact with weeds both at the primary and the secondary trophic levels. This leads to a complex of multitrophic interactions and this interaction effect soil biodiversity as well (Van Emden and Wratten, 1991; Rana, *et al*., 2010).

A serious problem may occur when weeds, supporting a pest/prey arthropod within an agroecosystem, are controlled. Following destruction of weeds, the pest/prey arthropods that had been living on the weeds migrate to and attack the crop. One of the earlier reported examples is that of the lesser corn stalk borer in California *Zea mays* (Reynolds *et al*., 1959). The insect can utilize many grass weeds as alternative hosts. These authors stated that eliminating out infested weed hosts just before or after planting a susceptible crop can be disastrous, as it forces virtually the entire resident population to feed upon the seedling (crop) plants. This may result in economic loss instead of benefit from weed eradication. This phenomenon has been reported for several different weed- insect-crop associations (John and Capinera, 2005; Shelton and Badenes-perez, 2006; Ruby, *et al.*, 2010), but is often not recognized as part of an integrated crop management program.

Thus the knowledge of cropland weeds as harbourages of invertebrates especially arthropod fauna is imperative to manipulate the pests and potential pest populations in various crop systems. Present study provides a data about the prey/pest-predator population status of various invertebrates utilizing weeds associated with sugarcane and wheat crops in the suburbs of Faisalabad city.

MATERIALS AND METHODS

The present study was conducted in the months of September 2008 through February 2009 and in the months of December 2009 to May 2010 i.e. round the sugarcane and wheat cropping seasons. As many as 24 samples were taken at random from crop fields at different localities like Gatti, Ayub Agricultural Research Institute, Sidhar By-pass, Samundri Road, Sargdha Road and Sheikhupura Road around Faisalabad city. At each locality two acres of crop fields each of sugarcane and wheat were randomly selected

from an estimated area of 10 acre block to collect invertebrate fauna associated with the weeds.

A total of twenty five frequently occurring weeds were sampled out of which seventeen Viz., *Convolvulus arvensis, Polygonum plebejum, Cenchrus setigerus, Phalaris minor, Coronopus didymus, Euphorbia prostrata, Cynodon dactylon, Rumex dentatus, Euphorbia* spp., *Cyperus rotundus, Dactyloctenium aegyptium, Launaea nudicaulis, Ageratum conyzoides, Avena fatua, Cnicus arvensis, Chenopodium murale,* and *Malva neglecta* were sampled from wheat fields, whereas eight species of weeds namely *Solanum nigrum, Cyperus rotundus, Euphorbia hirta, Malvestrum coromandelianum, Conyza ambigua, Convolvulus arvensis, Poa annua* and *Oxalis corniculata* were sampled for invertebrate fauna from sugarcane fields. All the invertebrates visible with naked eyes were collected from the above weeds. These were mostly arthropods and pulmonates, including all the immature and adults whether sitting, moving or residing (sticking on the foliage or stem) on weeds. All the sampled specimens were put in properly labeled vials with 10 % formalin then preserved in 70% alcohol containing few drops of glycerine after washing with tap water.

The collected specimens were identified using the literature given by Brunetti (1923), Christophers (1933), Henery (1935), Borror (1954) and Talbot (1986) and online taxanomic keys available on internet. For the identification of weeds, weeds taxonomists were consulted in the Department of Botany, University of Agriculture, Faisalabad.

RESULTS

Ashiq *et al.* (2003) reported 38 weed species occurring in the wheat and 24 in sugarcane crop fields. Accordingly C*henopodium album, Chenopodium murale, Convolvulus arvensis, Melilotus indica, Anagallis arvensis, Cirsium arvensis, Coronopus didymus, Lathyrus aphaca, Medicago polymorpha, Polygonum plebejum, Rumex dentatus, Gallium aparine, Cnicus arvensis, Ephedra spp., Cynodon dactylon, Cenchrus setigerus, Trianthema partulacastrum, Anagalis arvensis, Trianthema pentandra, Fumaria indica, Centaurea iberica, Carthamus oxyacantha, Asphodelus tenuifolius, Datura fastuosa, Vicia sativa, Spergula arvensis, Cirsium arvensis, Medicago polymorpha, Trigonella monantha, Tribulus terrestris, Phalaris minor, Avena fatua. Malva neglecta, Cyperus rotundus, Dactyloctenium ageyptium, Launaea nudicaulis, Ageratum conyzoides,* and *polypogon monspelliensis* were reported from wheat fields of punjab. The weeds generally found in sugarcane fields were *Phyla nudiflora, Trianthema pentandra, Rumex dentatus, Solanum nigrum, Amaranthus spinosus, Mukia maderaspatana, Conyza striata, Melilotus alba, Medicago polymorpha, Euphorbia granulata, Panicum antidotale, Setaria viridis, Brachiaria reptans, Cyperus rotundus, Chenopodium murale, Euphorbia hirta, Convolvulus arvensis, Oxalis corniculata, Polygonum plebejum, Tribulus terrestris, Trianthema spp., Sonchus spp., Conyza ambigua, and Poa annua,* accordingly.

Presently, seventeen and eight commonly occurring weeds of wheat and sugarcane respectively were as follows. The selected wheat weeds were *Malva neglecta, Chenopodium murale, Cyperus rotundus, Dactyloctenium ageytium, Launaea nudicaulis, Avena fatua, Ageratum conyzoides, Cnicus arvensis, Ephedra spp., Rumex dentatus, Cynodon dactylon, Convolvulus arvensis, Polygonum plebejum, Cenchrus setigerus, Phalaris minor, Euphorbia prostrata* and *Coronopus didymus.* Similarly the weeds selected from sugarcane were *Solanum nigrum, Cyperus rotundus, Euphorbia hirta, Malvestrum coromandelianum, Conyza ambigua, Convolvulus arvensis, Poa annua* and *Oxalis corniculata.*

The weed species found common in both wheat and sugarcane crop fields and along their edges were *Cyperus rotundus* and *Convolvulus arvensis* during the study period.

***Invertebrates on weeds*:** Various species of invertebrates belonging to different trophic levels were found associated to weeds occurring in and around wheat and sugarcane crops in Faisalabad district. Tables 1 and 2 provide the list of invertebrates collected from weeds of wheat and sugarcane crops respectively. The trophic diversity on weeds of respective crops has been shown in Fig. 1 and 2. Accordingly, two relatively different pictures with respect to the status of prey-predator number were depicted in the two types of crop fields.

***Wheat Fields*:** Seventeen weed species common in and around wheat field harbored 42 species of predators including insects and spiders. The known pest species of different crops were 31 whereas five species were the saprophagus/omnivores species playing a key role in the recycling (conversion of plant as well as animal residue present in the crop fields) into organic matter making the soil nutrients again useable to the plants. The ratio of pest/prey-predator in the wheat fields of Faisalabad was high in favor of predators. The presence of greater number of predator species on the weeds as compared to those of herbivorous (prey/pest) species depicted an inverted pyramidical picture which should have been otherwise on an agro-ecosystem when there were large number of producers (crop as well as weed plants). It was noted that these weed plants in the wheat crop fields were the survivors of the weedicidal treatment of the fields. That indicated severe competition among them for their food (pest/prey species) which may lead to starvation and ultimately to extinction of some of the predator species. Consequently, an outbreak of any pest or potential pest could be expected. It was also noteworthy that the predator species occupying the higher trophic levels were relatively safer from agrochemicals

Table 1. Trophic guild of invertebrates occurring on some weeds of wheat crop

Species	Weeds																		Feeding Habit
	Malva neglecta	*Chenopo*	*Cyperus*	*Dactyloct*	*Launaea*	*Avena*	*Ageratu*	*Cnius*	*Ephedra* sp.	*Rumax dentatus*	*Cynodon dactylon*	*Convolvu*	*Polygonu m*	*Cnchrus ciliaris*	*Phalaris minor*	*Coronop us*	*Euphorbi*	*Total*	
Goniaea opomaloides	-	01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	01	Feeds on gum leaves
Leptysma marginicollis	-	09	-	-	-	-	-	-	-	-	03	-	-	-	01	-	-	13	Graminivorous
Acrididae nymph	-	-	-	-	-	-	-	03	-	-	03	-	02	-	-	-	-	08	Foliage Grasses
Schistocerca nitens	-	-	-	02	-	-	-	-	-	-	-	-	-	-	-	-	-	02	Pest on ornamental and crop plants
Chorthippus albomarginatus	-	-	-	03	-	-	-	01	-	-	-	-	-	-	-	-	-	04	Graminivorous
Acrida ungarica	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	01	-	01	Monophagous, feeds on cudweed
Hypochlora alba	-	-	-	-	-	-	-	-	-	-	-	02	01	-	-	-	-	03	Plant feeder
Aiolopus thalassinus	-	-	-	-	-	-	-	-	-	-	01	-	-	-	-	-	-	01	Leaves
Conocephalus strictus	-	-	-	-	-	-	-	-	-	-	-	-	-	01	-	-	-	01	Plant feeder
Anisomorpha spp.	-	-	-	-	-	-	-	-	01	-	-	-	-	-	-	-	-	01	Leaves, grasses
Oncopeltus fasciatus	08	-	-	-	-	-	-	-	-	-	-	06	-	-	-	03	04	21	Milkweed seeds
Melanerythrus mactans	-	-	-	01	-	-	-	-	-	-	-	02	-	-	-	-	-	03	beans, cowpeas, soybeans
Spilostethus spp	-	03	01	-	02	03	-	-	-	-	-	01	-	-	-	-	07	17	* Feeds on plant sap
Lygaeus kalmii	-	-	-	-	-	-	-	-	-	-	-	01	-	-	-	-	-	01	Feeds on milkweed and other seeds
Amblypelta lutescens	10	06	-	-	-	01	-	-	-	-	-	-	-	-	-	-	-	17	Plant pest
Euschistus variolarius	-	-	-	-	-		-	01	-	-	-	-	-	-	-	-	-	01	Plant feeder
Acyrthosiphon pisum	-	-	-	-	-	-	-	-	-	-	-	06	-	-	-	-	-	06	Plant feeder
Praon spp.	-	-	-	-	-	-	-	-	-	-	-	-	01	-	-	-	-	01	Feed on Aphids
Aphidus sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	01	-	-	-	01	Parasite of aphids
Dysdercus cingulatus	-	02	-	-	-	-	-	-	-	02	-	-	-	_	03	-	-	07	Feeds on plants
Blattella sp.	-	-	-	-	-	-	-	-	-	-	02	-	-	-	-	-	-	02	*Omnivorous
Galerita janus	-	-	-	-	-	-	-	-	-	04	04	-	-	-	-	-	-	08	* Feeds on insects
Paederus littoralis	-	-	-	01	02	-	-	-	-	-	01	-	-	-	01	-	-	05	*Feeds on other animals
Paederus sp.	-	-	-	-	-	-	-	-	-	-	-	-	01	-	-	-	-	01	*Feeds on other animals
Coccinella septumpunctata	08	22	06	02	03	30	02	09	03	14	13	32	03	02	42	15	-	206	Aphids and moth eggs
Larvae of coccinella septempunctata	-	-	-	-	-	07	-	13	-	-	-	-	-	-	01	-	-	21	Aphids,moth egg,
Pupa of coccinella septempunctata	-	-	-	-	-	-	04	-	-	-	-	-	-	-	-	-	-	04	
Harmonia axyridis	-	-	-	-	-	-	-	-	-	01	-	-	-	-	-	-	-	01	Aphids
Coccinella trifasciata	01	-	-	-	-	-	-	-	-	-	01	-	-	-	03	-	-	05	Aphids
Coccinella transversalis	-	-	04	-	-	-	-	-	-	-	-	-	-	-	-	-	-	04	Egg eaters
Gonocephalium elderi	06	04	06	02	02	-	-	-	-	-	02	-	-	01	01	03	01	28	Litter, wood, leaves
Gonocephalum terminale	-	-	-	-	-	-	-	-	-	-	-	-	01	-	-	-	01	02	*Plants and Grains
Gonocephalum bilineatus	-	-	01	-	-	-	-	-	-	-	-	-	02	01	-	-	-	04	*Plants and Grains
Longitarsus jacobaeae	-	01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	01	Feeds on Plants
Chrysochus cobaltinus	-	-	01	-	01	-	-	-	-	-	-	26	14	-	-	-	-	42	Leaves of plants
Disonycha spp	-	-	-	-	-	-	-	-	-	-	03	-	-	-	-	-	-	03	specially willow.
Disonycha glabrata	-	-	-	-	-	-	-	-	-	02	03	-	-	-	-	-	-	05	*Foliage eater
Cantharis pallida	-	-	-	-	-	-	-	-	-	-	-	02	-	-	-	-	-	02	* Flower nector, insects
Cylas formicarius	-	-	-	-	-	-	-	-	-	-	01	-	-	-	-	-	-	01	Sweet potato
Longitarsus spp.	-	-	-	-	-	-	-	03	-	-	-	-	-	-	-	-	-	03	Feeds on plants
Eilema sororcula	-	-	-	-	-	-	-	-	-	-	02	-	-	-	-	-	-	02	Nectar feeder, Leave and stem

Culex pipiens	-	-	-	-	-	-	-	-	-	-	01	-	-	-	-	-	-	01	Nectar feeder
Eupeodes corollae	-	-	-	-	-	-	-	-	-	02	02	-	-	-	04	-	-	08	Feeds on pollen and nectar and aphids
Riponnensia splendens	-	-	-	-	-	-	-	-	-	-	-	05	-	-	-	-	-	05	*Feeds on flower nectar and aphids
Episyrphus balteatus	-	02	01	-	01	-	-	-	-	02	-	02	01	01	04	02	-	16	Feeds on Nectar, pollen and aphids
Melanostoma scalare	-	-	-	-	-	-	-	-	-	01	01	-	-	-	-	-	-	02	*Feeds on flower nectar and aphids
Meliscaeva auricollis	-	-	-	-	-	-	-	-	03	-	-	-	-	-	-	-	06	09	Feeds on flower nectar and aphids
Melanostoma mellinum	-	-	-	-	-	02	-	-	-	-	-	03	-	-	-	-	-	05	feeds on nectar, aphids
Didea fasciata	-	-	-	-	-	-	-	02	-	-	-	-	-	-	-	-	-	02	Feeds on aphids, flower nectar
Clinocera aucta	-	-	-	-	-	01	-	-	-	-	-	-	-	-	-	-	-	01	*Feeds on other insects
Hilara spp.	-	-	-	-	-	-	-	-	-	-	-	-	02	-	02	-	-	04	Insects.
Empis sp.	-	-	-	-	-	-	-	-	-	-	-	01	-	-	-	-	-	01	Predates on other insects
Lasia purpurata	-	-	-	-	-	-	-	-	04	-	-	-	-	-	-	-	-	04	Adults feeds on nectar aphids
Lasia spp.	-	-	-	-	-	-	-	-	04	-	21	-	-	-	-	-	-	25	Larve of soft body insects and necter
Apsilop spp.	-	-	-	-	02	-	-	-	-	-	-	-	-	-	-	-		02	Insects eaters
Mastrus spp.	-	-	-	01	-	-	-	-	-	-	-	-	-	-	-	-	-	01	Insect eater
Bathythrix spp.	-	-	-	-	-	-	-	-	-	-	-	01	-	-	-	-	-	01	* Feeds on other insects
Allotheca annulipes	-	-	-	-	-	-	-	-	-	-	-	-	-	01	-	-	-	01	Whiteflies, moth
Polytribax sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	01	-	-	-	01	Beetle and fly larvae
Solenopsis invicta	-	-	-	02	-	-	-	-	-	-	-	-	-	-	01	-	-	03	Invertebrates, liquid and plant, dead animals
Solenopsis molesta	-	-	-	-	-	-	-	-	-	-	-	-	05	-	-	-	-	05	Household food, act as pest in fields
Monomorium minimum	-	-	-	-	-	-	-	-	-	-	-	-	04	-	-	-	-	04	Feeds o animals such as aphids
Prenolepis impairs	-	-	-	-	-	-	-	-	-	-	-	-	-	01	-	-	-	01	Feeds on plants and aphids
Dolichoderus spp.	-	-	-	-	-	-	-	-	-	-	03	-	-	-	-	-	-	03	Scavenger on dead arthropods, also feeds on insects
Camponotus sayi	-	01	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	01	Insect eater, aphids and mites
Solenopsis xyloni	-	-	-	-	-	-	-	-	-	05	-	-	-	-	01	-	-	06	Feeds on plants and animals
Formica synguinea	-	-	-	-	-	10	-	-	-	-	-	-	-	-	-	-	-	10	Feed on animals and plants
Camponotus spp.	-	-	04	-	-	-	-	-	-	-	-	-	-	-	-	-		04	Dead and live insects and household waste
Neralsia spine	-	-	-	-	-	-	-	-	-	-	-	-	01	-	-	01	-	02	Invertebrates, vertebrates and plants
Cotesia margininventris	-	-	-	-	-	-	-	-	-	-	01	-	-	-	-	-	-	01	*Feeds on other insects
Clubiona neglecta	-	01	-	-	-	-	-	01	-	-	-	-	-	-	-	-	-	02	Predator of arthropods
Oxyopes salticus	-	-	-	-	01	01	-	-	-	-	-	-	-	-	-	-	-	02	Insect eater
Oxyopes javanus	-	-	02	-	02	-	-	-	-	-	-	-	-	-	02	-	-	06	Feeds on other insects
Cheiracantium fulcatum	-	-	-	-	-	-	-	-	-	-	-	01	-	01	-	-	-	02	* Feeds on other insects
Chrysoperla spp.	-		-	-	-	01	-	01	-	-	-	-	-	-	-	-	-	02	Feeds on aphids
Chrysoperla carnea	-	01	-	-	01	-	-	-	-	01	-	-	-	-	-	-	-	03	Predator of mites , aphids and other insects
Chrysoperla rufilabris	-	-	-	-	-	-	-	-	-	-	-	-	01	-	02	02	-	05	Feeds on aphids
Euschistus servus	-	-	-	-	-	-	-	-	-	-	02	-	-	-	-	-	-	02	Polyphagous, feeds on plants
Potamyia flava	-	-	-	-	-	-	-	-	-	-	02	02	-	02	-	-	-	06	Filter-feeders, algae fungi
Ageopinella nitidula	-	-	05	03	03	16	05	-	-	-	-	-	02	01	-	-	-	35	Predates on other snails
Total number of specimens	**33**	**53**	**31**	**17**	**20**	**72**	**11**	**34**	**15**	**34**	**72**	**93**	**41**	**14**	**68**	**27**	**19**	**654**	
Total number of species	**06**	**12**	**09**	**09**	**11**	**10**	**03**	**09**	**05**	**10**	**20**	**16**	**15**	**11**	**14**	**07**	**05**	**81**	

* Feeding Habit for family

Table 2. Trophic guild of invertebrates occurring on some weeds in sugarcane crop.

Species	Weeds									Feeding Habit
	Poa annua	*Oxalis corniculata*	*Convulvulus arvensis*	*Cyperus rotundus*	*Malvestrium coromandelianu*	*Conyza ambigua*	*Solanum nigrum*	*Euphorbia hirta*	Total	
Ischnura aurora	-	-	-	-	-	01	-	-	01	Feeding on small insects and nymphs
Coenagrion spp	-	-	02	-	-	-	-	-	02	feeding on small insects and nymph
Acrida spp.	-	-	-	01	-	-	08	01	10	Plant feeder, Grasses, Roots
Acrida nymph	01	-	03	18	-	06	-	01	29	Feeds on plants
Aeolopus thalassinus	01	-	03	04	-	01	03	01	13	Plant feeder, grasses,
Trilophidia turpis	-	-	02	-	-	-	-	-	02	*Feeds on plants
Acrididae immature	-	-	03	-	-	-	-	-	03	Feeds on plants
Melanoplus sanguinipes	-	-	-	-	01	-	-	-	04	Several plant species
Leptysma marginicollis	-	-	-	-	-	01	-	05	06	Graminivorous
Neoconocephalus triopes	-	-	-	06	-	-	-	-	06	Grass seeds, especially panic grass
Neoconocephalus ensiger	01	02	-	-	-	-	-	-	03	Seed eater
Lepidogryllus spp	06	09	01	-	-	-	-	-	16	*Omnivorous
Gryllus lineaticeps	05	-	02	-	-	-	-	-	07	*Omnivorous, scavengers
Keyacris scurra	01	-	04	-	-	-	-	-	05	Feeds on plants
Juvenile	-	-	-	01	-	-	-	-	01	
Euschistus servus	-	-	-	-	-	-	01	-	01	Seed and plant feeder
Dysdercus koenigi	-	-	01	-	01	-	-	-	02	Seed and plant feeder
Coccinella trifasciata	-	-	-	01	-	-		-	01	Feed on Aphids
Coccinella septumpunctata	03	-	01	-	-	01	03	-	06	Aphids and Mites
Gonocephalum elderi	-	-	-	01	-	-	-	-	01	Litter, wood, leaves
Chrysolenia cerealis	-	-	-	-	-	01	02	01	04	Feeds on plants
Longitarus spp	-	-	-	01	-	-	-	-	01	Feeds on plants
Chrysolina conglomerate	-	01	01	-	-	-	-	-	02	* Feeds on plants
Raphidopala foveicollis	08	06	04	02	04	-	-	-	24	Leaf litter, foliage eater
Amphicyrta spp	-	-	-	01	-	-	-	-	01	Succulent leaves, Damage vegetables
Hylobius pinastri	-	-	-	-	-	01	-	-	01	Feeds on pine seedlings and plants
Synanthedon exitiosa	01	-	-	-	-	-	-	-	01	Plants including trees such as peach
Eilema soroucla	03	-	-	-	-	-	-	-	03	Nectar feeder, Leave and stem
Zizina labradus	-	-	01	-	-	-	-	01	01	* Feeds on stem leaves
Pyrilla perpusilla	-	-	-	07	-	-	-	-	07	Nectar and plant feeder
Culex pipens	-	01	-	-	03	-	02	01	07	Nectar Feeders
Ozodiceromya spp.	-	-	-	01	-	-	-	-	01	Honey Dew, Flower nectar and Pollen
Dolichoderus taschenbergi	-	-	07	02	01	03	06	08	27	Nectar and seed eater, fungus feeder
Dolichoderus fuscus	02	-	-	-	-	-	-	-	02	
Dicamma ceylonense	-	01	-	-	-	-	-	-	01	Nectar and seed eater, fungus feeder
Dolichoderus quadripuntatus	-	01	-	-	-	-	-	-	01	Nectar and seed eater, fungus feeder
Athalia proxima	01	-	01	-	-	-	-	-	02	Nectar feeder, seed eater,
Vespa spp	01	-	01	-	-	-	-	-	02	Insects and spiders
Cotesia marginiventris	-	-	-	-	-	02	-	01	03	Feeds on other insects
Oxyopes javanus	04	07	07	08	04	10	05	05	50	Insect eater
Peucetia spp	-	-	-	-	-	01	-	-	01	Lepidopteran and heteropteran pests
Biomphalaria peregrine	-	01	-	-	-	-	-	-	01	Detritivorous
Planorbis planorbis	-	01	-	01	01	-	-	-	03	Plant feeder like algae and diatoms
Anisus leucostoma	-	01	-	01	10	-	-	-	12	Feeds on surface, tissue and algae
Galba truncatula	-	-	-	01	-	-	-	-	01	Feeds on the algae on the surface
Discus rotumdatus	-	-	-	03	-	-	02	-	05	Feeds on leaf litter, fungus and plants
Punctum pygmaeum	01	-	-	-	-	-	-	-	01	Feeds on leaf litter
Aegopinella nitidula	-	-	-	02	-	-	01	-	03	Predates on other snails
Physopelta gutta	01	-	-	03	-	04	-	02	10	Seed and plant eater
Mantis religiasa	-	01	01	-	-	-	01	01	04	*Feeds on other insects
Tomocerus minor	-	-	-	01	-	-	-	-	01	Feeds on algal diet (mycophagous) also on fungi
Panorpa lugubris	-	-	-	-	02	-	-	-	02	Scavengers, nector
Total number of specimens	**40**	**32**	**45**	**66**	**27**	**32**	**34**	**28**	**304**	
Total number of species	**16**	**12**	**18**	**21**	**09**	**12**	**11**	**12**	**53**	

* Feeding Habit for family

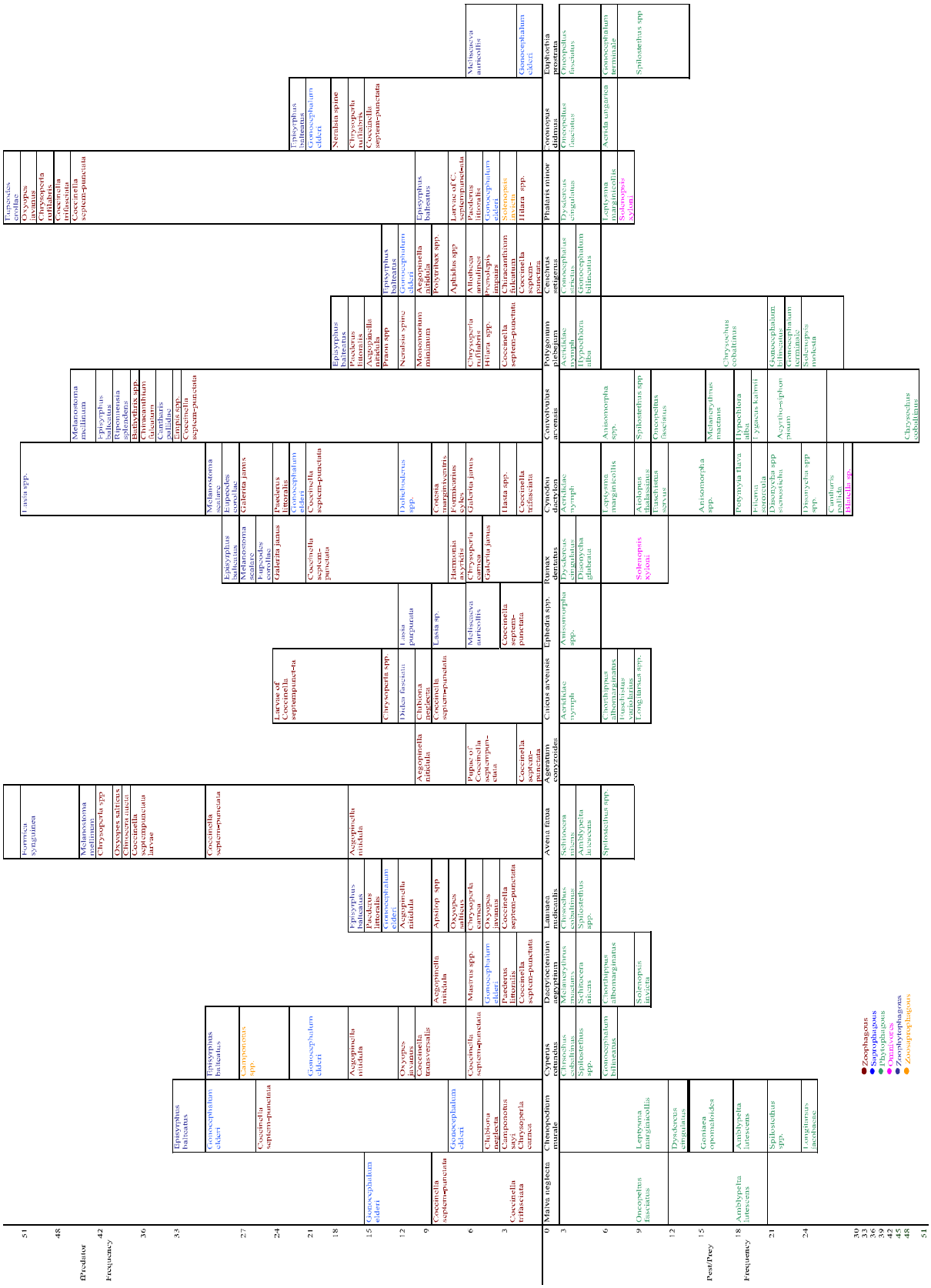

Figure 1. Status of Predator/Scavenger and Pest/Prey Arthropods in Wheat Fields

(especially weedicides which were frequently used in wheat fields) than prey/pest species, because they directly depend on producers (wheat or weed plants) at the first or lowest trophic level of the wheat agro-ecosystem.

***Habitat Breadth*:** The invertebrates occurring exclusively on eight weed species common in sugarcane fields harbored 10 species of predators including insects and spiders, 28 known pest species of some major crops, and four were the saprophagus/omnivorus species scavenging, fragmenting and decomposing in the ambient environment (Fig. 2). This crop seemed to show a relatively balanced prey-predator species structure probably due to no use of weedicides in the crop.

***Habitat Breadth*:** Fig. 4 shows the number of weed species preferred by invertebrate species. Accordingly, 55% invertebrates preferred to live on or utilized single species of weed. 19% used two weed species whereas 9% species were found on three weed species. These invertebrates were Acrida spp., Lepidogryllus spp., Chrysolina cerealis, Planorbis planorbis and Anisus leucostoma. *About 6% species, including* Coccinella septempunctata, Culex pipiens, Mantis religiosa *and* Physopelta gutta *preferred to live on or utilized fours species of weeds. Similarly, 2% arthropods namely, Raphidopala foveicollis and Acrida nymph used five and Dolichoderus fuscus and Aeolopus thalassinus used six weed species as their living resource respectively. Only 2% (Oxyopes javanus) arthropods utilized eight weed species.*

DISCUSSION

The general concept of a weed is that of a plant whose presence is unwanted in the crop fields because of their competition for soil nutrients and space. Such a concept becomes erratic when the ecological importance with respect to supporting biodiversity and sustainability of the cropping system is addressed. This suggests the identification of most important weed species (Marshall and Moonen, 2002; Kostov and Pacanoski, 2007; Hussain, *et al*., 2009). If undesirability with the agro-ecosystem is linked to loss of yield resulting from inevitable crop-weed competition (Benvenuti, 2004), then some weeds are needed to be maintained within crops for insects, birds and small mammals. Insects constitute 41.7% of food items taken by little spotted owl (*Athene brama*) and 33.3% of small Indian mangoose (*Herpetes auropuctatus*) in addition to rodent pests of cropland (Mushtaq-ul-Hassan *et al.,* 2003; Rana *et al*., 2005; Ruby, *et al.*, 2011). Weeds and arthropods interact in agricultural systems. Weeds can directly serve as food sources or provide other ecosystem resources for herbivorous arthropods, and indirectly serve carnivorous (beneficial) arthropods by providing food and shelter to their prey. Weeds can serve as alternative hosts for pest and beneficial arthropods when their preferred crop host is absent. The similar observations were put forward by many researchers (Norris and Kogan 2000; Norris and Kogan, 2005; Strong *et al*., 1984; Aguyoh, *et al.,* 2004). An important point in favour of keeping weed diversity in the crop system was that most of the weeds were observed growing on the field margins showing no competition with crop plants. In other words they help sustaining the phytomorphic diversity in the system and thus favours faunal diversity.

Liu and Chen (2001) found that the common green lacewing, *Chrysoperla carnea* ate 14 to 16 *Aphis gossypii* per day, 11-12 *Myzus persicae*, and 5-6 *Lipaphis erysimi* per day in laboratory conditions. Siddiqui (2006) also calculated a predator-prey ratio of *C. carnea* and two species of aphids *Microsiphum miscanthi* and *Aphis maidis* ranging from 1/10 to 1/16 in various low chemical input wheat fields of Punjab. Taking this ratio as natural (necessary for survival) in the wheat agro-ecosystem, the figure of prey-predator ratio (210/348) or 1/ 1.65 revealed in the present study was highly deviated from prey-predator ratio in situ.

The alarmingly high ratio in favour of predators in wheat system indicates severe competition among predators for their food (prey) species which may lead to starvation and ultimately to the extinction of some of the important predator species. Consequently, an outbreak of any pest or herbivorous potential pest could be expected. It seemed that prey and predator species occupying the different trophic levels received differential effects of weedicides or other chemicals used in the system. Further, most of the weed plants grew along the sides of the crop fields and the sprays were done across the crop. It seemed that the predator species, being more active, took refuge on these weed plants. Contrary to the wheat fields the weed fauna of sugarcane fields depicted a relatively balanced (82/131) or 1/1.59 predator-prey ratio. This was probably due to the lesser or no use of weedicides in sugarcane crop. By and large, the fauna in the sugarcane field was low in abundance probably due to the use of insecticides on this crop.

The question that all or most or some of the naturally occurring weed plants in the crop system should stay in or be eliminated from the system, still needs precise probe for each plant species in the crop and this demands the knowledge of the economic, medicinal and ecological importance of each species and production requirements of the system.

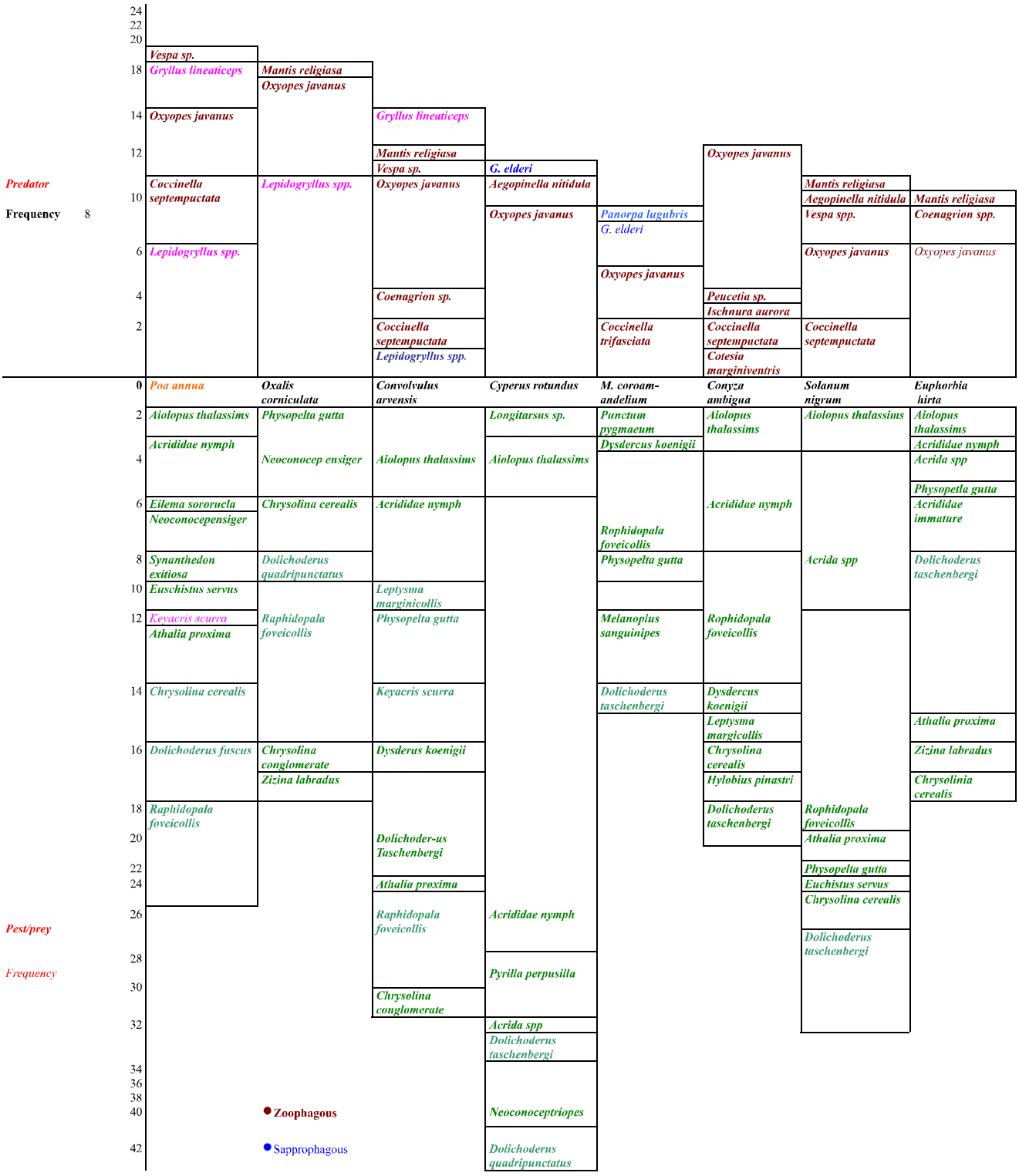

Figure 2. Status of Predator/Scavenger and Pest/Prey Arthropods in Sugarcane Fields

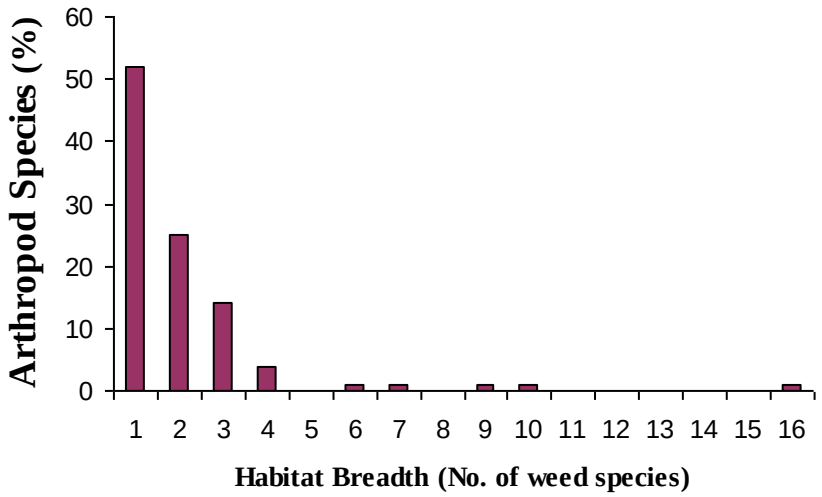

Figure 3: Arthropods populations occurring on weeds of wheat fields

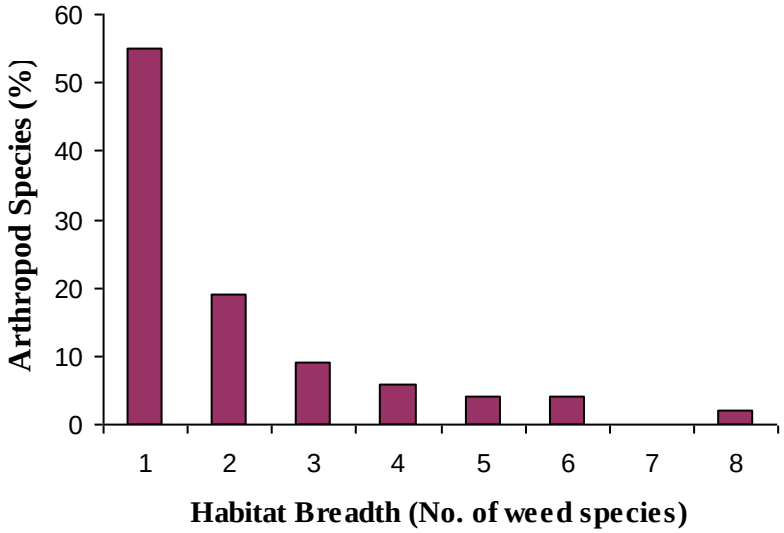

Figure 4: Arthropods populations occurring on weeds of sugarcane fields

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