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Study of Assemblages of Ground Dwelling Arthropods in Gulbarga District, Karnataka, India

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Abstract: ***The present study provides data of ground dwelling arthropods assemblage in agriculture fields from Hadgil Harutti village Gulbarga, Karnataka. Arthropods play an important role in organic matter decomposition, nutrient cycling, ground aeration and fertility. The study was carried out using pitfall trap during the year January 2013 to December 2013. A total 36,652 individuals were caught. Five class of Arthropoda were found i.e Class Insect, Arachnida, Chilopoda , Diplopoda and Crustacean. In the class the most abundant order was Hymenoptera(ants) 61.489%, followed by Collembola (springtails) 17.191%, Coleoptera (beetles) 8.744% , Acari(mites) 4.768%, Araneae (spiders) 3.288% , Orthoptera (crickets, grasshoppers) 2.581%. The Arthropoda diversity was calculated using Shannon wiener index and Simpson diversity.***

Keywords: Ground Arthropods, Pitfall trap, Evenness, Abundance, Diversity.

1. Introduction

Invertebrates represent an essential part of ecosystem(Seymour and Dean 1999),[15] . They occupy a great variety of habitat and hence adapted themselves to different modes of lifes. In many terrestrial ecosystem Arthropods comprises the greatest faunal species diversity, biomass and number of individuals. Arthropoda is huge in terms of both numbers of species and in terms of numbers of individuals. They have diversified to live in every habitat imaginable, from the tropics to the poles, from the bottom of the oceans to the tops of mountains, both underground and inside other animals and plants, where ever you look Arthropods are ubiquitous. Most of the invertebrates you encounter during your life will be Arthropods, in fact if you only noticed them you would realize that most of the living things you encounter in your life are Arthropods. With an amazing 1 million named species (and estimates of total species numbers rising to 30 million) the Arthropods represent over 80% of the Animal Kingdom and probably at least half of all living organisms. Arthropods are amazingly diverse in form and function. They play vital role in the structure and fertility of soils, as pollinators for flowering plants, act as decomposers, predators and prey in natural ecosystem.

It has been suggested that ground dwelling arthropods are useful in ecosystem monitoring because they are diverse and abundant. Further more ground dwelling arthropods can be used for monitoring environmental and seasonal changes because of their high species abundance, richness and habitat fidelity (Anderson and Majer 2004),[2].

The present study is carried in agriculture fields at Hadgil Harutti village, Gulbarga district, Karnataka. The aim of this work is to understand the community composition of ground dwelling arthropods and study about diversity of species and their abundance.

2. Materials and Method

2.1 Study Area

Gulbarga district lies in the northern part of Karnataka between 16°11' – 17°45' N. latitudes and 76°03' - 77°30' E. longitudes, with a geographical area of 16,174 sq. km. The district is bounded by Bidar district in the north, Bijapur district in west, Raichur district in south and Andhra Pradesh in the east. Gulbarga district lies in the northern plains of Karnataka and has semi – arid type of climate. Dry climate prevails for most part of the year. December is the coldest month with mean daily maximum and minimum temperatures being 29.5°C & 15° to 10°C respectively. During peak summer, temperature shoots up to 45°C. Relative humidity varies from 26% in summer to 62% in winter. The southwest monsoon sets in the middle of June and extends till the end of September. Bulk of the annual rainfall occurs during this season, which constitutes over 75% of the annual rainfall. Significant rainfall occurs during the winter monsoon owing to northeastern monsoon, which constitutes 15% of the annual rainfall. Normal Rainfall of the district is 777 mm (1901 - 70) and actual rainfall is 881.10 mm (2005). Normal rainy days (as per 1901 - 70) are 46. The study area is located at Hadgil Harutti village which is 10 km away from Gulbarga city. The ground dwelling arthropods survey is carried out at agriculture fields of Hadgil Harutti village.

2.2 Methodology

2.2.1 PITFALL TRAP

Pitfall traps are the most frequently used method for sampling ground-dwelling arthropods. This method estimates relative arthropod activity rather than absolute density, reflecting individual abundances of species and movement rates within a given habitat. Current literature shows that pitfall traps can be used in a variety of ways: to evaluate the distribution of ground dwelling arthropods in diverse ecosystems at different scales, to describe activity patterns, habitat associations as well as to establish relative species abundances, or the effects that disturbance can have

on biodiversity. Pitfall trap sampling is one of the easiest and least expensive methods for collecting large numbers of macroinvertebretes.

2.2.2 Sampling for Ground Dwelling Arthropods

Ground dwelling arthropods were sampled using pitfall traps during the year January 2013 to December 2013. A total 720 traps i.e 60 traps per month were placed throughout the year in agriculture fields. Pitfall traps each consisted of a single 1000-ml-capacity plastic cup (top diameter = 12 cm, height = 14 cm) buried so that the top was flush with the ground surface and filled to a depth of 2 cm with a dishwashing soap and water solution to prevent escape by captured invertebrates. Collected specimens were preserved; dry pinned or preserved in 70% ethanol and sorted up to order level taxa.

3. Statistical Analysis

3.1 Measurement of Diversity

The type of diversity used here is alpha - diversity which is the diversity of species within a community or habitat. The diversity index was calculated by using the Shannon – Wiener diversity index (1949).

3.2 Shannon-wiener diversity index:

$$H' = 3.322\left(\log N - \sum \frac{N_i(\log N_i)}{N}\right)$$

N= total # individuals in all species.
Ni= # of individuals in each species.
3.322= Conversion factor from base 10 to base 2
H'= Diversity (0-4)

3.3 Simpson's Index (D)

$$D = \frac{\Sigma\, n(n-1)}{N(N-1)}$$

n = the total number of organisms of a particular species
N = the total number of organisms of all species

3.3 Measurement of evenness

For calculating the evenness of species, the Pielou's Evenness Index (e) was used (Pielou, 1966).

$$e = \frac{H}{In\, S}$$

H = Shannon – Wiener diversity index
S = total number of species in the sample

3.4 Measurement of dominance index

The dominance index is calculated using this formula:

3.5 Relative dominance= $ni\ X \frac{100}{N}$

N: the total number of individuals of all species
ni: the number of individuals of each species

4. Results

A total 36,652 arthropods, classified into five classes Insecta, Crustacea, Arachnida, Chilopoda, Diplopoda and 19 orders were collected. Among five classes, Class Insect represents highest abundance of 91.179% followed by Class Arachnida 8.053%, Class Chilopoda 0.376% , Class Diplopoda 0.322% and Class Crustacea 0.057%.

The investigation shows the distribution of different species of class insects belongs to 15 orders. Based on over all occurance the following species has been collected Order Coleoptera (beetles) 3,205, Order Dermaptera (earwigs) 187, Order Orthoptera (crickets, grasshoppers) 946, Order Hymenoptera (ants) 22,537, Order Hemiptera (riptortus,treehoppers,aphids) 40, Order Diptera (flies) 49, Order Thysunura (silverfish) 33, Order Thysanoptera (thrips) 55, Order Neuroptera (antlions) 6, Order Isoptera (termites) 48, Order Mantodea (mantid) 7, Order Blattodea (cockroaches) 3, Order Lepidoptera (butterfly) 1, Order Plasmida (stick insects) 1, Order Collembola (springtails) 6,301. The Class Crustacea belongs to only one order i.e Order Isopoda (sowbugs) 21 number of individuals were collected. The Class Arachnida belongs to 3 order i.e Order Acari (mites)1,747, Order Araneae (spiders) 1,203 , Order Scorpionida (scorpion) 2 were collected. The Class Chilopoda (centipedes) 138 and the Class Diplopoda (millipedes) 122 individuals were collected.

The Simpson index, Shannon wiener diversity and Evenness are calculated from January 2013 to December 2013 :

Table 1: Month wise diversity of Ground dwelling Arthropods

Month	Total No. of samples in month	Simpson's Index	Shannon Wiener Index	Evenness
January	2298	0.443	1.484	0.185
February	2615	0.546	1.754	0.222
March	2206	0.616	1.754	0.227
April	2975	0.453	1.468	0.183
May	2007	0.554	1.790	0.120
June	2929	0.268	0.916	0.114
July	2898	0.635	2.036	0.255
August	3455	0.47	1.571	0.192
September	6520	0.641	1.8104	0.206
October	3097	0.646	1.936	0.240
November	2573	0.633	1.969	0.250
December	2369	0.642	1.930	0.248

The dominace index is calculated by order wise and it is as follows:

Table 2: Dominance index of ground dwelling arthropods:

Class	*Order*	*Common Name*	*Total Individuals Species*	*Percentage*
INSECTA	COLEOPTERA	beetles	3205	8.744%
	DERMAPTERA	earwigs	187	0.510%
	ORTHOPTERA	Crickets, grasshoppers	946	2.581%
	HYMENOPTERA	ants	22,537	61.489%
	HEMIPTERA	Bugs,treehoppers, aphids	40	0.109%
	DIPTERA	flies	49	0.133%
	THSANURA	silerfish	33	0.090%
	THYSANOPTERA	thrips	55	0.150%
	NEUROPTERA	Antlions	6	0.016%
	ISOPTERA	termites	48	0.130%
	MANTODEA	mantid	7	0.019%
	BLATTODEA	cockroaches	3	0.008%
	LEPIDOPTERA	butterfly	1	0.002%
	PLASMIDA	Stick insect	1	0.002%
	COLLEMBOLA	springtails	6301	17.191%
Crustacea	ISOPODA	sowbugs	21	0.057%
Arachnida	ACARI	mites	1747	4.768%
	ARANEAE	spiders	1203	3.288%
	SCORPIONIDA	scorpion	2	0.005%
Chilopoda		centipede	138	0.376%
Diplopoda		millipede	122	0.332%
Total			36,652	

5. Discussion

This is the first diversity study based on a planned and intensive sampling effort that describes the composition and structure of the ground dwelling arthropoda diversity of agriculture fields in Hadgil Harutti village, Gulbarga, Karnataka. The most important order based on abundance were Hymenoptera(ants) 61.489%, Collembola (springtails) 17.191% , Coleoptera (beetles) 8.744% , Acari(mites) 4.768%, Araneae (spiders)3.288%, Orthoptera (crickets, grasshoppers) 2.581% and the least abundance order were Blattodea (cockroches) 0.008% , Lepidoptera (butterfly) 0.002% and Plasmida (stick insects) 0.002%.
The most abundant were ants and its role is of well known in agricultural ecosystems. They participate actively in natural control, pollination, soil improvement, and nutrient cycling some species also can be considered as ecosystem engineers, since that are responsible for the structure of the soil.

Collembola were the second most abundant and are considered a biological regulator and have important functions in ecosystems. They are known to feed on bacteria and fungi, mineral soil particles, organic matter, protozoa, nematodes and increase soil respiration and accelerate nitrogen mineralization. Collembola are also an alternative prey to generalist predators.

The predatory arthropod community was dominated by ants and third abundant species were beetles.

Mites, were the fourth most abundant species and have similar ecological functions as Collembola; they are agents of organic matter decomposition and consequently are important in nutrient recycling .They feed on dead and dying tissues and/or yeasts, bacteria, and algae. (Krantz 1978), and are part of the diet of some ant species (Wilson 2005).

6. Conclusion

This work gives the knowledge of the composition, taxonomy, and structure of ground-dwelling arthropod communities in agriculture fields of Gulbarga. Additionally, it is necessary to place the results of this study within a conservation context because the richness and composition of a community of ground-dwelling arthropods can be taken as a reflection of the biotic and structural diversity of whole terrestrial ecosystems. Because of its abundance, diverse behaviors, and ecological interactions, the development of new lines of research to elucidate the variables controlling the main ecological aspects of ground dwelling arthropods will contribute significantly to the knowledge and functioning of terrestrial ecosystems. It also helps to create and assess management and conservation tools for the semi-arid terrestrial ecosystem.

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