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An Assessment of Epigeal Invertebrate Community in Cement Polluted and Non-polluted Areas

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ABSTRACT

Comparative assessment of the epigeal macroinvertebrate community of cement polluted and non-polluted areas, with almost identical physiographic and geophysical features was carried out during 2002. The study revealed significant differences in species composition, relative density, importance value index and biomass. 17 species composed the community in non-polluted area as against only 7 species in the polluted area. The community of non-polluted area included six species of araneids; five orthopterans; two coleopterans and one species each of Diptera, Hymenoptera and Pulmonata. The polluted site community comprised of four araneid species; two orthopterans and a coleopteran species. Most of the epigeals appeared to be herbivores and higher species number and biomass in non-polluted area was most probably attributable to the availability of fresh vegetation without much particulate matter deposition on the herb layer. In terms of fresh biomass the fauna exhibited a fairly higher accumulation in non-polluted area.

***Key words*:** Macroinvertebrates, epigeal, cement polluted.

INTRODUCTION

India, one of the leading developing countries, has undergone rapid industrialization in the few decades of near past. Besides steel and power the cement production of India is recognized as one of the most important industries. The consumption pattern of cement often denotes economic development of any nation. The rapid and unsafe growth of various industries in the last 50 years has however, resulted in remarkable deterioration of the biosphere. Decline in natural resources and increase in hazardous materials/chemicals in environment is estimated to cause about 7 to 10% loss of GDP in India. Macroinvertebrates constitute an important group of soil fauna playing vital multiple role in food chain. The changes in soil environmental complex have adversely affected the structure and function of soil macroinvertebrate populations. Air emissions can cause reductions in soil organism and shifts in trophic structure as studies have indicated an inverse relationship between ground beetle population numbers and sulfur dioxide emissions (Freitage and Hastings, 1973) and zinc in soil causing decline in earthworm densities (Bengtsson *et al.,* 1983).

In the agroclimatic region of Kashmir of Jammu and Kashmir state Khunmoh – Khrew Karewa belt has lately been identified for exploitation of cement because of the limestone lithological characteristics of the area. The present investigation was taken up as a case study to assess the impact the cement dust has on the epigeal invertebrate community structure in the area.

STUDY AREA

The cement polluted and non-polluted sites were found to have the following salient features.

1. **Non-polluted site**
   This site was located (34° 04´ to 34° 11´N longitude and 74° 54´ to 75° 09´ E) longitude, just outside the official boundary of Dachigam National park.

2. **Polluted site**
   This site (34° 1´ N latitude to 75° 1´ E) longitude was located about 25km. South of Srinagar city at Khrew and was in the very close vicinity of cement factory.

   Both the cement polluted as well as non-polluted sites possessed the identical aspects i. e. were south-facing and were located at the same altitude i. e. 1680m from msl. The floristic community of the two areas was similar. An area of $100m^2$ was demarcated at each site for sampling of the epigeal invertebrates.

MATERIAL AND METHODS

Monthly sampling was performed in both the areas for purpose of recording of the epigeal fauna after using random quadrat method. Collapsible quadrat of $1m^2$ area covered over by mosquito net was used. The parameters evaluated were relative density and importance value index following Dwivedi and Chattoraj (1984) and Misra (1989). Biomass (fresh weight gm/m^2) of epigeal invertebrates was evaluated by weighing organisms within 12 hours of their collection. The relative density was computed by the following formula:

RESULTS AND DISCUSSION

Community Composition and Occurrence of Species

The epigeal invertebrate community of the two study areas was comprised of 18 species. 94.44% i. e. seventeen species were found to comprise the community in the non-polluted area while in the polluted area the species recorded represented 33. 33% (7species). The group wise distribution of the 17 species of non-polluted area included: Six species of araneids; five species of orthopterans; two species of coleopterans, one species each of Diptera, Hymenoptera and Pulmonata. The distribution of 7 species (38.88%) inhabiting the cement polluted area were four species of araneids, two species of Orthoptera and one species of coleopteran.

One of the reasons for the higher percent species occurrence of epigeal macroinvertebrates in the non – polluted area as against the cement dust polluted area of Khrew was probably attributable to availability of wider vegetation spectrum to the herbaceous / herbivorous fauna.

Most of the epigeal invertebrates were herbivores and the high species number in non-polluted area, most probably seemed to be to the availability of fresh, lush and without much particulate matter deposited herb layer, the products of which form their food. In terms of fresh biomass also the epigeal fauna showed significantly higher accumulation in non-polluted area. The population of *G. bimaculatus*, *G. africanus* and *H. goansis* was seen to exist in its highest relative density at non-polluted site, presumably because of availability of uncontaminated, sufficient and varied food in such a structurally heterogenous habitat.

A total of 5species of epigeal orthopteran species were recorded from the non-polluted site of Dachigam which were not similar to those of the earlier enumerations of Bhat and Qadri (1999) who have reported 16 species from the same area. The decline in species number might be due to the change in the environmental complex including the continuous drought of about five consecutive years. Only 2 orthopteran species were recorded from the polluted area lying just across the cement factory at Khrew. In the non-polluted area the species might also have locally migrated to suitable patches of habitats.

The orthopteran group was represented by the 5 specie which included *Acrida exaltata, Dicranophyma babaulti, Gastrimargus africanus, Gryllus bimaculatus* and *Leva* sp. The orthopteran group not only depicted remarkable difference in species composition between the two sites, but also the biomass (gm/m^2) of the species showing a difference of significant magnitude with lower biomass values recorded at the cement polluted site as compared to the non-polluted site.

Relative density

The highest relative density of 85. 71 (Table 1) in the non-polluted area was recorded for the orthopteran *Gryllus bimaculatus* and lowest of 66.66% for the araneid *Herphyllus goansis*. On the contrary *Herphyllus goansis* alone appeared to exhibit the highest relative density of 60 while lowest of 20% each was recorded for *Arctosa* sp; *Salticus* sp. (both araneid species); and the orthopteran *Gryllus bimaculatus* in polluted area. Higher relative density of most of these species is most probably related to their diurnally cryptozoic and nocturnal habit of emergence for their feeding etc.

Importance Value Index

In non-polluted area the highest value of 227.37 was exhibited by *Gryllus bimaculatus* followed by *Gastimargus africanus* (222.50), while the lowest importance value index of 25. 48 was recorded for *Scolopendra morsitans* followed by *Asillius* sp. exhibiting the value of 28.42. The highest values for species in polluted area were recorded for the cryptozoic araneid *H. goansis* (300.00), followed by the orthopteran *Leva* sp. (89.93) and lowest of 60.00 each for the non – cryptozoic araneid populations of *Pholcus* sp. and *Salticus* sp. (Table 2).

The importance value index for sixteen species is depicted in Fig. 1.

Biomass

The details of biomass (fresh weight gm / m^2) in respect of epigeal invertebrates are depicted in Table 3. There was a remarkable contrast with regard to the parameter between the polluted and non-polluted area. The dipteran *Asillius* sp. and the hymenopteran *Cimbex sp*. were detected as exclusives to the non-polluted area exhibited a biomass of 0.02 gm/m^2 and 0.24 gm/m^2 respectively. The land snail *Zebrina dextrosinister* with a biomass of 0. 80 g/m^2 was also found to exist only in the non-polluted area probably indicative of the sensitiveness of this land snail to cement pollution.

Table1. Relative density of epigeal populations in areas with cement dust pollution and with no pollution

S. No.		April		May		June		July		August		September		October		November		December		January		February		March	
		P	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N
	Aranieda																								
1	*Arctosa* sp.	-	-	-	-	-	-	-	50	-	-	-	-	20	15.4	-	-	20	-	-	-	-	-	-	14.3
2	*Herphyllus goansis*	-	-	-	13	-	-	43	-	-	-	12.5	-	-	-	-	-	60	-	-	66.7	-	-	-	-
3	*Lycosa* sp.	-	-	-	-	-	-	-	-	-	-	-	40	-	-	-	-	-	-	-	-	-	-	-	-
4	*Mantis* sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	-	-	-	-	-	-	-	-
5	*Pholcus* sp.	-	-	-	-	-	-	-	-	-	-	-	-	20	-	-	20	-	-	-	-	-	-	-	-
6	*Salticus* sp.	-	-	-	13	-	-	-	-	-	-	-	-	20	-	-	-	-	-	-	-	-	-	-	-
	Chilopoda																								
7	*Scolopendra morsitans*	-	-	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Coleoptera																								
8	*Carabus* sp.	-	-	-	31	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	*Copris* sp.	-	-	-	-	-	-	29	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	*Bolbocerus* sp.	-	-	-	-	-	-	-	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Diptera																								
11	*Asillius* sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.66	-	-	-	-	-	-	-	-
	Hymenoptera																								
12	*Cimbex* sp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.66	-	-	-	-	-	-	-	-
	Mollusca (Pulmonate)																								
13	*Zebrina dextrosinister*	-	-	-	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Orthroptera																								
14	*Acrida exaltata*	-	-	-	-	-	-	-	-	-	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	*Dicranophyma babaulti*	-	-	-	13	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16	*Gastrimargus africanus*	-	-	-	-	-	-	-	-	-	60	-	13.3	-	84.6	-	26.7	-	-	-	-	-	-	-	-
17	*Gryllus bimaculatus*	-	-	-	13	-	-	-	-	-	13	-	13.3	20	-	-	-	20	-	-	-	-	-	-	85.7
18	*Leva* sp.	-	-	-	-	-	-	29	-	-	13	-	13.3	20	-	-	20	-	-	-	33.3	-	-	-	-

P= cement polluted area N* = Non – polluted area*

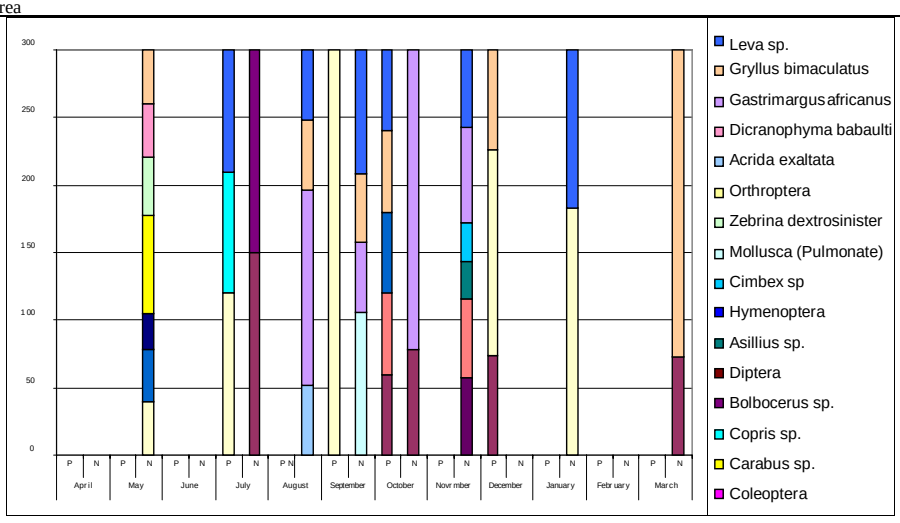
Table 2. Monthly variations in IVI of 16 epigeal macroinvertebrate species in polluted and non-polluted areas

S. No.		April		May		June		July		August		September		October		November		December		January		February		March	
		P	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N
	Aranieda																								
1	***Arctosa* sp.**	-	-	-	-	-	-		150	-	-	-	-	60	78	-	-	74	-73						
2	***Herphyllus goansis***	-	-	-	39	-	-	120	-	-	-	300	-	-	-	-	-	153	-	-	183	-	-	-	-
3	***Lycosa* sp.**	-	-	-	-	-	-	-	-	-	-	-	106.4	-	-	-	-	-	-	-	-	-	-	-	-
4	***Mantis* sp.**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	57.6	-	-	-	-	-	-	-	-
5	***Pholcus* sp.**	-	-	-	-	-	-	-	-	-	-	-	-	60	-	-	57.6	-	-	-	-	-	-	-	-
6	***Salticus* sp.**	-	-	-	39	-	-	-	-	-	-	-	-	60	-	-	-	-	-	-	-	-	-	-	-
	Chilopoda																								
7	***Scolopendra morsitans***	-	-	-	25	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Coleoptera																								
8	***Carabus* sp.**	-	-	-	73	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	***Copris* sp.**	-	-	-	-	-	-	90	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	***Bolbocerus* sp.**	-	-	-	-	-	-	-	150	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Diptera																								
11	***Asillius* sp.**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	28.4	-	-	-	-	-	-	-	-
	Hymenoptera																								
12	***Cimbex* sp**	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	28.4	-	-	-	-	-	-	-	-
	Mollusca (Pulmonate)																								
13	***Zebrina dextrosinister***	-	-	-	43	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Orthroptera																								
14	***Acrida exaltata***	-	-	-	-	-	-	-	-	-	52	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	***Dicranophyma babaulti***	-	-	-	39	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16	***Gastrimargus africanus***	-	-	-	-	-	-	-	-	-	144	-	51.13		223	-	70.2	-	-	-	-	-	-	-	-
17	***Gryllus bimaculatus***	-	-	-	39	-	-	-	-	-	52	-	51.13	60	-	-	-	74	----------						227
18	***Leva* sp.**	-	-	-	-	-	-	90	-	-	52	-	91.31	60	-	-	57.6	-	-	-	117	-	-	-	-

Table 3. Fresh average biomass (gm/m^2) of epigeal invertebrate species from polluted and non-polluted areas.

S.No	Order/Species	April		May		June		July		August		September		October		November		December		January		February		March	
		P	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N	P	N
	Aranieda																								
1	*Arctosa* sp.	-	-	-	-	-	-		0.1	-	-	-	-	0.1	0.1	-	-	0.1	-	-	-	-	-	-	0.1
2	*Herphyllus goansis*	-	-	-	0	-	-	0	-	-	-	0	-	-	-	-	-	0.1	-	-	0.08	-	-	-	-
3	*Lycosa* sp.	-	-	-	-	-	-	-	-	-	-	-	0.4	-	-	-	-	-	-	-	-	-	-	-	-
4	*Mantis* sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.09	-	-	-	-	-	-	-	-
5	*Pholcus* sp.	-	-	-	-	-	-	-	-	-	-	-	-	0	-	-	0.05	-	-	-	-	-	-	-	-
6	*Salticus* sp.	-	-	-	0	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-
	Chilopoda																								
7	*Scolopendra morsitans*	-	-	-	0.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Coleoptera																								
8	*Carabus* sp.	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	*Copris* sp.	-	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	*Bolbocerus* sp.	-	-	-	-	-	-	-	0.3	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Diptera																								
11	*Asillius* sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.02	-	-	-	-	-	-	-	-
	Hymenoptera																								
12	*Cimbex* sp	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.24	-	-	-	-	-		-	-
	Mollusca (Pulmonate)																								
13	*Zebrina dextrosinister*	-	-	-	0.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Orthroptera																								
14	*Acrida exaltata*	-	-	-	-	-	-	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	*Dicranophy ma babaulti*	-	-	-	0.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16	*Gastrimargu s africanus*	-	-	-	-	-	-	-	-	-	5.5	-	0.24		5.5	-	2.22	-	-	-	-	-	-	-	-
17	*Gryllus bimaculatus*	-	-	-	0.3	-	-	-	-	-	0.2	-	0.2	0.1	-	-	-	0.1	-	-	-	-	-	-	0.7
18	*Leva* sp.	-	-	-	-	-	-	0	-	-	0	-	0.29	0.1	-	-	0.14	-	-	-	0.12	-	-	-	-

P*= cement polluted area N* = Non – polluted area



P*= cement polluted area N* = Non – polluted area

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